ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

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FROM THE TROPICAL RESEARCH STATION IN BRITISH GUIANA

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VOLUME III. NUMBERS 1 AND 2
(Tropical Research Station Contribution Numbers 94 and 95)

1. OBJECTS OF THE TROPICAL RESEARCH STATION

By HENRY FAIRFIELD OSBORN,
President of the New York Zoological Society

2. CONTRIBUTIONS OF THE TROPICAL RESEARCH STATION, 1916 TO 1921

By WILLIAM BEEBE,
Director of the Tropical Research Station and Honorary Curator of Birds

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK, NEW YORK
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New York Zoological Society

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Corrected to September, 1921

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

FROM THE TROPICAL RESEARCH STATION IN BRITISH GUIANA

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VOLUME III. NUMBER 1

(Tropical Research Station Contribution Number 94)

1. OBJECTS OF THE TROPICAL RESEARCH STATION

By HENRY FAIRFIELD OSBORN,
President of the New York Zoological Society

PUBLISHED BY THE SOCIETY
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SEPTEMBER, 1921

FIG. 1. THE RESEARCH STATION AT KARTABO

OBJECTS OF THE TROPICAL RESEARCH STATION

By Henry Fairfield Osborn.

The main object of the Tropical Research Station from the beginning has been the *observation of living organisms in their natural environment.* To make this intensive and inclusive of the entire fauna, a single region has been selected and the fauna studied as a whole and in detail so far as possible through the expert knowledge of members of the staff and of the several experts who have been invited to work at the laboratory from time to time.

The work of the Station, therefore, is unique in two respects: First, its very intensive character; second, its restriction to a single locality on the border of a great zoological region, namely, the eastern tropical forests of the Amazonian basin. In many biological aspects it is new, in others it is the sequel to the long, distinguished period of exploration of this general region, beginning as early as 1812. The six best known explorers of eastern South America have been the following:

Charles Waterton, four voyages from 1812 to 1824, chiefly in Guiana.

Charles Darwin, 1832-1835, from Bahia around the entire South American coast to the Galapagos.

Alfred Russel Wallace, 1848-1852, the Amazon and Rio Negro.

Henry Walter Bates, 1848-1859, the Amazon basin from Para to Peru.

Thomas Belt, 1868, Nicaragua.

W. H. Hudson, born in Argentina seventy-odd years ago, and left for England about 1890.

To Waterton we owe the pioneer review of the life of this wonderful forest region; to Darwin, Wallace, Bates, and Belt the intimate relations of animals and plants with each other and with their environment, color and form adaptation, and struggle for existence; to Darwin and Hudson especially the complex chain of relations which connect the whole series of organisms together.

In the work of the Station it has been found absolutely necessary to lay a secure foundation in systematic zoology. For this purpose efforts are being made to complete and round out the faunal lists of various systematic workers in this region.

These lists will give a common language to the distinctive research feature of this Station, which, as remarked above, is intensive biologic observation in one region, in fact, in one locality, as distinguished from the observations of those who have covered and are covering the whole biologic field of South America.

The area chosen by our Honorary Curator of Birds, William Beebe, when he founded the Station in 1916, is the eastern edge of the tropical rain-forest of South America, which extends unbroken across the greater part of the continent. The fauna and flora are in general uniform with those of the entire Amazonian region. The locality at Kartabo, Bartica District, British Guiana, the point of junction of the Mazaruni and Cuyuni rivers, demonstrated in the first season its exceptional advantages as the site for a permanent station. Within ten minutes walk are sandy and rocky beaches, mangroves, grassland, swamp, and high jungle, each with a growth of life peculiar to itself. Free exposure to the trade winds, the absence of flies and mosquitos, invariably cool nights, excellent buildings assigned by the government—all these features contribute to the wide range of life and the unbroken health of the scientific staff. The work of the year 1916 was so full of promise that Mr. Beebe, then Curator of Birds of the New York Zoological Park, was promoted to the rank of Director of the Tropical Research Station and given entire charge both of the choice of the personnel and of the supervision of the scientific work.

The Station is now entering its sixth year. Owing to the difficulty of transportation at the time of the war, there was a lapse during 1917, but work was resumed in 1918, continued in 1919, and the present VOLUME III of ZOOLOGICA opens the contributions of the year 1920-1921, which has proved to be the most productive of all.

The staff of specialists, artists and investigators has included in the course of the past six years the following persons:

WILLIAM BEEBE, *Director*, Columbia University and New York Zoological Society

General Evolutionary Problems in Ornithology and Ecology

IRVING W. BAILEY — Harvard University
Relations of Ants to Certain Plants

T. DONALD CARTER, *Collector*, New York Zoological Society

ISABEL COOPER, *Artist* — Bryn Mawr College

ALFRED EMERSON — Cornell University
Life Histories of Kartabo Termites

GERTRUDE EMERSON — University of Chicago
Anthropology

WINIFRED J. EMERSON, *Artist* — Cornell University

J. F. M. FLOYD — University of Glasgow
Parasites of Vertebrates

W. T. M. FORBES — Cornell University
Organs of Hearing in Lepidoptera

H. GIFFORD — University of Nebraska
Comparative Opthalmology

G. I. HARTLEY — Cornell University
Relationships of Certain Non-oscine Birds

RACHEL HARTLEY, *Artist* — New York

PAUL G. HOWES — Bruce Museum
Studies in Hymenoptera

GEORGE W. HUNTER — Carlton College
General Biology

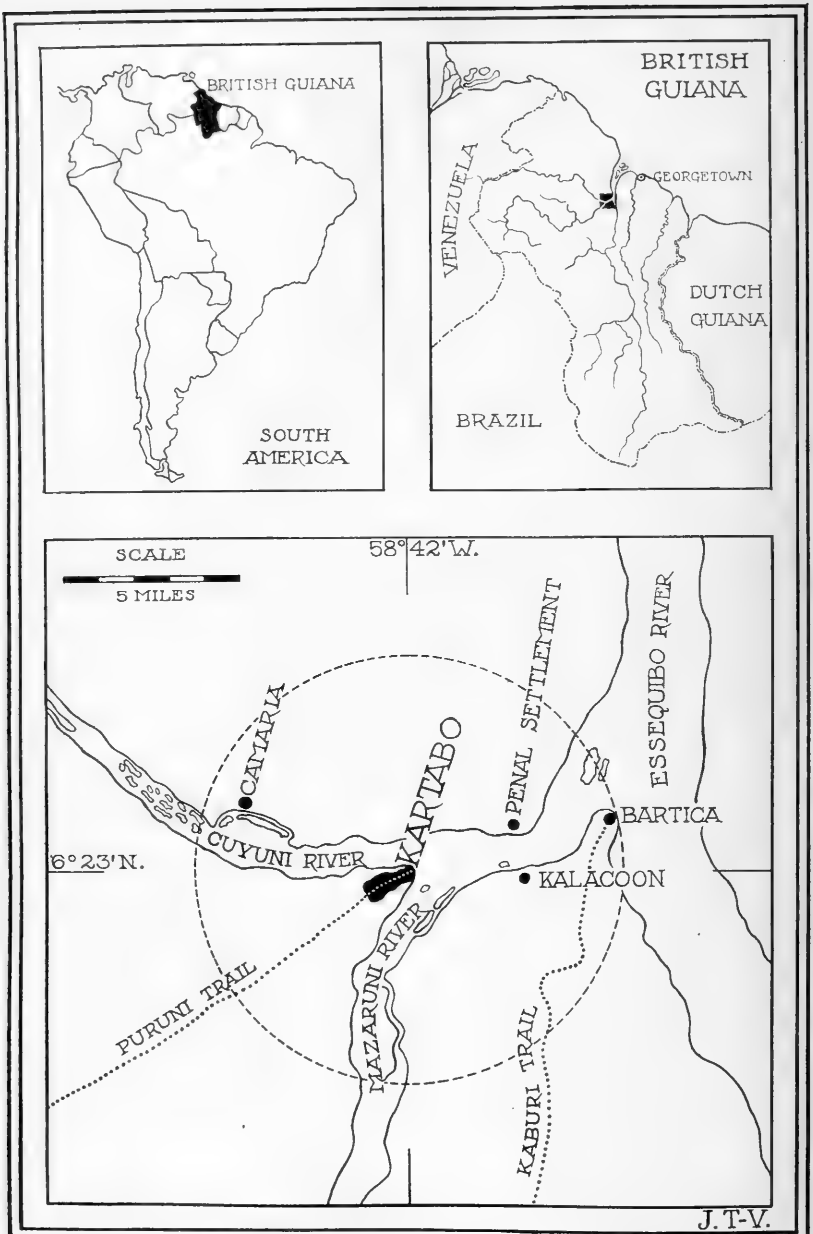

FIG. 2. LOCATION OF THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY

The circle represents a radius of six miles.

CLIFFORD POPE — University of Virginia
Life Histories of Kartabo Fish

ALBERT M. REESE — University of West Virginia
Embryology of Crocodiles and Investigation of Microscopical Beach Life

MABEL SATTERLEE — Columbia University
Coloration of *Ameiva* and Painting Optical Fundi

T. V. SMOLUCHA — New Jersey
Photography and Pen-and-Ink Drawing

ANNA TAYLOR — South Carolina
Botanical Paintings

JOHN TEE-VAN — New York Zoological Society
Ecology of Certain Lepidoptera

WM. MORTON WHEELER — Harvard University
Ants of Kartabo

C. A. WOOD — Leland Stanford University
Optical Fundi of Birds and Other Vertebrates

Ninety-three contributions have already been published from the Tropical Research Station, of which a complete annotated list is given in ZOOLOGICA III, No. 2. Of these eighty-nine are scientific papers and magazine articles, while four are included in the following bound volumes:

TROPICAL WILD LIFE IN BRITISH GUIANA, by Beebe, Hartley and Howes.

INSECT BEHAVIOR, by Paul G. Howes.

JUNGLE PEACE, by William Beebe.

EDGE OF THE JUNGLE, by William Beebe.

These published observations of the Station are so broad in scope that only a few salient features can be noted in this Introduction. They extend from color changes and adaptations to anatomical and physiological characters of the archaic forms of life, like the hoatzin, as well as of the most highly modernized and specialized forms. The colors of living amphibians and reptiles are almost an untouched field, since all modern systematic zoology and description of these phyla have been founded on alcoholic specimens, in which the colors are either modified or lost altogether. It is only in the feathers of birds and in the coats of mammals that the natural color hues can be preserved. The paintings made directly from life by the artists of the Station, Miss Cooper and Miss Satterlee, will be published in a series of plate volumes accompanying the text volumes of ZOOLOGICA. The opportunity of studying the faunal and floral complex and the independent and interrelated adaptations in all grades of life, both in the vertical and in the horizontal life zones, opens up vistas for future research extending over many years. The vertical division of the fauna and flora into distinctive life zones, extending from the tree summits to the sub-soil, is a biologic contribution of first importance.

The Station was honored during the year 1920-1921 by the presence of Dr. Wm. Morton Wheeler, who makes an extremely important contribution to entomology in the present volume of ZOOLOGICA through his article on *A Study of Some Social Beetles in British Guiana and of Their Relations to the Ant-plant Tachigalia.*

Of the work of the Staff of the Research Station the following may be mentioned as having been accomplished to date:

Life History Notes on 445 species of birds, by Beebe and Hartley.

Life History Notes on 106 species of reptiles and amphibians, by Beebe.

One thousand five hundred and thirty-two photographic negatives, by Beebe, Howes, Tee-Van and Smolucha.

Ten thousand feet of moving picture film, by Tee-Van.

Collection of 340 water color drawings by Isabel Cooper.

Collection of types of 50 new species of termites.

Four hundred transparent preparations of embryos and tongues, etc.

Four hundred skeletons of mammals and birds.

Nests and eggs of 132 species of birds, many new to science.

Materials for a monograph on the syrinx and the voice of tropical birds.

Collection of 75,000 insects.

Collection of 776 bird skins.

Collection of 110 embryos of birds.

Materials for the study of the optical fundi of birds.

Monographic work on Trogons.

Cooperation with the Zoological Park, the Aquarium, the American Museum of Natural History, and Other Institutions

Besides the research work carried on at the Station there are three general lines of cooperation with other institutions. First, living organisms collected for the New York Zoological Park and the New York Aquarium, among which the most interesting forms are the following:

Birds

3 Cocks-of-the-Rock	*Rupicola rupicola* (Linné)
Hawk-headed Parrot	*Deroptyus accipitrinus accipitrinus* (Linné)
Imperial Amazon Parrot	*Amazona imperialis* (Richm.)
White-necked Rails	*Porzana albicollis* Vieill.
Bat Falcons	*Falco rufigularis rufigularis* Daud.
imThurn's Blackbird	*Agelaius imthurni* Sclater
Etc.	

Mammals

Silky Anteater	*Cyclopes didactylus didactylus* (Linné)
Tayra	*Tayra barbara barbara* (Linné)
2-toed Sloth	*Choloepus didactylus* (Linné)
3-toed Sloth	*Bradypus tridactylus* Linné
Spotted Cavy	*Agouti paca paca* (Linné)
Red Howling Monkey	*Alouatta seniculus macconnelli* Elliot
Jaguarondi	*Herpailurus jaguarondi unicolor* (Traill)
Wild Dog	*Cerdocyon thous thous* (Linné)
Etc.	

Reptiles	
8-foot Bushmaster	*Lachesis mutus* (Linné)
Iguanas	*Iguana iguana* (Linné)
White Amphisbena	*Amphisbena alba* Linné
Black and White Amphisbena	*Amphisbena fuliginosa* Linné
5 Crocodiles	*Caiman sclerops* (Schneid.)
Etc.	
Amphibians	
Marine Toads	*Bufo marinus* (Linné)
Five-fingered Jungle Frog	*Leptodactylus pentadactylus* (Laur.)
Sharp-nosed Toad	*Bufo typhonius* (Linné)
Harlequin Frogs	*Dendrobates* sp.
Etc.	
Fish	
Electric Eels	*Electrophorus electricus* (Linné)
Marbled Eel	*Symbranchus marmoratus* Bloch.
Perai	*Pygocentrus niger* (Schomb.)
Etc.	

Second, for the American Museum of Natural History, there has been brought together a collection of 485 mammals belonging to numerous species, preserved with their skins, skulls and skeletons. Many of these mammals are of especial interest because of the fact that most of the South American types of the great Swedish naturalist Linnaeus were brought originally from this region of the continent. Alcoholic collections of several hundred reptiles, amphibians and fish have been made, preserved, labeled, and shipped to the American museum.

Third, of especial significance is the collection of photographic and botanical material which, together with the actual specimens themselves, has been gathered and furnished to the Museum for large groups of Red Howling Monkeys, *Alouatta seniculus macconnelli* Elliot, and Hoatzin, *Opisthocomus hoazin* (P. L. S. Mull.).

Other institutions have been aided as follows: (1) Specimens have been supplied to the Embryological Laboratories of the Carnegie Institution at Johns Hopkins University, for study of the embryology of the Red Howling Monkey; (2) numerous electric eels have been captured and sent to Dr. Ulric Dahlgren at Princeton University, for investigation of the electric organs of these animals; (3) a large collection of birds in alcohol has been made for Dr. C. A. Wood, for future study, at Leland Stanford University, of the various structures of the eye.

ZOOLOGICAL SOCIETY, New York, July 12, 1921.

FIG. 3. THE MAZARUNI RIVER
Looking east from the Research Station at Kartabo.

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE
NEW YORK ZOOLOGICAL SOCIETY

FROM THE TROPICAL RESEARCH
STATION IN BRITISH GUIANA

VOLUME III. NUMBER 2

(Tropical Research Station Contribution Number 95)

2. CONTRIBUTIONS OF THE TROPICAL RESEARCH STATION, 1916 TO 1921

By WILLIAM BEEBE,

Director of the Tropical Research Station and Honorary Curator of Birds

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK, NEW YORK

SEPTEMBER, 1921

CONTRIBUTIONS
OF THE
TROPICAL RESEARCH STATION
OF THE
NEW YORK ZOOLOGICAL SOCIETY

By William Beebe.

From the date of the establishment of the Tropical Research Station in January, 1916, to September, 1921, there have been published ninety-three contributions. Of these, eighty-nine are scientific papers or magazine articles and four bound volumes. To correlate, in convenient form, these contributions with the more important facts set forth in them, I have prepared the following list:

1916

Contribution Number

1. ESTABLISHMENT OF THE TROPICAL RESEARCH STATION
   William Beebe
   Bull. Zool. Soc. XIX, No. 4, July, p. 1369
   Hints for the formation of a tropical station, and photographs of jungle and laboratory.

2. NOOSING A BUSHMASTER
   William Beebe
   Ibid, p. 1372
   Method of capturing an eight-foot venomous snake alive and unharmed. *Lachesis mutus* (Linné)

3. THE COCK-OF-THE-ROCK
   Lee S. Crandall
   Ibid, p. 1375
   Habits of the bird, wild and in captivity. *Rupicola rupicola* (Linné).

4. NESTLING HOATZINS AT HOME
   William Beebe
   Bull. Zool. Soc. XIX, No. 5, Sept., p. 1393
   Thorough account of the activities and psychology of hoatzin chicks, photographs of the chicks climbing and in the nest, adult on nest, nest and eggs, and general environment. *Opisthocomus hoazin* (P.L.S. Mull.)

5. PICTURES FROM THE TROPICAL RESEARCH STATION
   William Beebe and Paul G. Howes
   Ibid, p. 1400
   Photographs of
   House Bats, *Vampyrus* sp.,
   Beesa Monkey, *Pithecia pithecia* (Linné)
   Aracari Toucan, *Pteroglossus aracari atricollis* (P.L.S. Mull.) and Akawai Indian Benab.

6. WASPS AT THE TROPICAL RESEARCH STATION
   Paul G. Howes
   Ibid, p. 1412
   Brief account of wasp life at the Station. Photographs of the insects and their nests.

7. NOTES ON THE PERAI
   G. Inness Hartley
   Bull. Zool. Soc. XIX, No. 6, p. 1428
   Description, habits and methods of capture, photographs of teeth and entire fish, *Serrasalmo niger* (Schomb.).

8. A JUNGLE-BOUND RESEARCH STATION
   William Beebe and Paul G. Howes
   New York Tribune, Photogravure Section, December 24th, p. 3
   Photographs of
   Trumpeter Chicks, *Psophia crepitans* Linné
   Rhinoceros Beetle Grub, *Megasoma actacon* Linné
   House Bats, *Hemiderma p. perspicillatum* (Linné)
   Beesa Monkey, *Pithecia pithecia* (Linné)
   Young Aracari Toucan, *Pteroglossus aracari atricollis* (P.L.S. Mull.)
   Young Hoatzins, *Opisthocomus hoazin* (P.L.S. Mull.)
   Perai, *Serrosalmo niger* (Schomb.)
   Giant Tree Frog, *Hyla maxima* (Laur.).

9. ANNUAL REPORT TO THE ZOOLOGICAL SOCIETY
   Annual Report, New York Zool. Soc., 1916, p. 113
   Résumé of first season's work at the Station, with personal contributions; photographs of laboratory.

1917

10. THE ALLIGATORS OF GEORGETOWN
    William Beebe
    Bull. Zool. Soc. XX, No. 1, p. 1437
    Life history, breeding habits, method of capture, variation of young, photographs, drawings of young, *Caiman sclerops* (Schneid.).

11. INTERESTING BIRD'S NESTS FROM SOUTH AMERICA

WILLIAM BEEBE and PAUL G. HOWES

Ibid., p. 1458

Folio of photographs of Bird's Nests from the Station. Cayenne Hermit Hummingbird, *Phoethornis superciliosus superciliosus* Linné

Guiana Pygmy Flycatcher, *Tyranniscus acer* (Salv. and God.)

Oily Flycatcher, *Pipramorpha oleaginea oleaginea* (Licht.).

12. THE POMEROON TRAIL

WILLIAM BEEBE

Atlantic Monthly, January

Note on distribution of opossums, reptiles, insects and seeds by floating logs and currents; account of a road newly built from the sea through a tropical jungle; bird life of rice-fields.

13. A NATURALIST'S TROPICAL LABORATORY

THEODORE ROOSEVELT

Scribner's, January, p. 46.

Detailed account of the founding, the operation and the environment of the Research Station, and of jungle life as observed on walks. Photographs of jungle, Indian huts, bats, *Phyllostomus h. hastatus* (Pallas), Nestling Parrots, *Pionus fuscus* (P.L.S. Mull.), and Mouse Opossum, *Marmosa murina murina* (Linné).

14. TROPICAL WILD LIFE IN BRITISH GUIANA

WILLIAM BEEBE, G. INNESS HARTLEY and PAUL G. HOWES, with introduction by THEODORE ROOSEVELT

Published by New York Zool. Soc.

General and detailed account of the first year's work of the Station. 143 photographs by William Beebe and Paul G. Howes. This volume contains contributions 15 to 50, which are reviewed under their respective numbers.

15. INTRODUCTION TO TROPICAL WILD LIFE IN BRITISH GUIANA

THEODORE ROOSEVELT

Introduction, p. ix.

Character of the work accomplished at a static research station in the tropics.

16. ESTABLISHMENT OF THE TROPICAL RESEARCH STATION

WILLIAM BEEBE

Chap. I, p. 23

Detailed account of the conception and establishment of the Research Station at Kalacoon, on the Mazaruni River, British Guiana. Map and photographs of the Station.

17. HISTORICAL BARTICA
    WILLIAM BEEBE
    Chap. II, p. 31
    History of three hundred years of occupation by the Spanish and Dutch.

18. THE NATURALISTS OF BARTICA DISTRICT
    WILLIAM BEEBE
    Chap. III, p. 38
    Brief account of the work of Schomburgk, Hilhouse, Appun, Lloyd, imThurn, Whitely and McConnell.

19. THE GENERAL FIELD OF WORK
    WILLIAM BEEBE
    Chap. IV, p. 43
    General surroundings and geology; map and photographs of the country.

20. THE OPEN CLEARING AND SECOND-GROWTH
    WILLIAM BEEBE
    Chap. V, p. 51
    Succession of plant communities consequent upon clearing primitive jungle and a subsequent four years' second growth. Birds inhabiting the various areas.

21. THE JUNGLE AND ITS LIFE
    WILLIAM BEEBE
    Chap. VI, p. 69
    Temperature and lack of dangers in jungle; seasons; vertical life zones of the jungle, with detailed distribution of birds and mammals.

22. THE BIRD LIFE OF BARTICA DISTRICT
    WILLIAM BEEBE
    Chap. VII, p. 91
    Comparison of temperate with tropical avifauna; daily and seasonal migrations; roosting habits; northern migrants; classification of birds as to sociability, voice, coloration, food, friends, enemies; relations to the Indians; legal protection of wild birds in British Guiana; collecting for the Zoological Park.

23. LIST OF THE BIRDS OF BARTICA DISTRICT
    WILLIAM BEEBE
    Chap. VIII, p. 127
    Classified list of 350 species of birds. By a proof-reading error on the part of one of the authors, the 22 starred species were made to read as new to the Colony of British Guiana, instead

of new to Brabourne and Chubb's List of the Birds of South America, the error being more absurd because some are among the most abundant species. This slip was deservedly corrected in a detailed article by Thomas E. Penard, (Auk, Vol. 36, No. 2, p. 217.)

24. AKAWAI INDIAN AND COLONIAL NAMES OF BIRDS AND MAMMALS

William Beebe

Chap. IX, p. 138

Akawai names of 143 species of birds and 41 species of mammals, taken orally, and after reconfirmation, transcribed.

25. METHODS OF RESEARCH

William Beebe

Chap. X, p. 147

Methods of shooting, trapping, or otherwise collecting and observing tropical organisms.

26. FURTHER NOTES ON THE LIFE HISTORY OF HOATZINS

William Beebe

Chap. XI, p. 155

Life History Notes of the Hoatzin, *Opisthocomus hoazin* (P.L.S. Mull.), in addition to those presented in "Ecology of the Hoatzin," Zoologica, Vol. I, No. 2, 1909, pp. 45-66. Photographs of environment, birds, nests and eggs.

27. THE HOMES OF TOUCANS

William Beebe

Chap. XII, p. 183

Detailed account of discovery of breeding habits of five species of Toucans, Red-billed Toucan, *Ramphastos monilis* Muller, Sulphur-and-white-breasted Toucan, *Ramphastos vitellinus* Licht., Black-necked Aracari, *Pteroglossus aracari atricollis* (P.L.S. Mull.), Green Aracari, *Pteroglossus viridis* (Linné), and the Guiana Toucanet, *Selenidera culik* (Wagler). Record and description of eggs of *Ramphastos monilis*, and of young *Pteroglossus aracari atricollis.* Photographs of nesting sites, eggs, young; diagrams of heel-pads of Black-necked Aracari.

28. ORNITHOLOGICAL DISCOVERIES

William Beebe

Chap. XIII, p. 213

Detailed description of nests and eggs of seventeen species of tropical birds which "have not heretofore been described, or are almost unknown." (For critical discussion of this paper, see Thomas E. Penard, Auk, Vol. 36, No. 2, p. 221).

Talpacoti Ground Dove *Chaemepelia talpacoti* (Temm. and Knip.), Red Mountain Dove *Oreopelia montana* (Linné), White-necked Crake, *Porzana albicollis* (Vieill.), Cayenne Crake, *Creciscus viridis viridis* (P.L.S. Mull.), Dusky Nighthawk, *Caprimulgus nigrescens* Cab., Guiana Tyrantlet, *Tyranniscus acer* (Salv. and God.), Oily Flycatcher, *Pipramorpha oleaginea oleaginea* (Licht.), Varied Flycatcher, *Empidonomus varius varius* (Vieill.), Cinereous Bushbird, *Thamnomanes glaucus* Cab., Rufus-fronted Antcatcher, *Anoplops rufigula rufigula* (Bodd.), Quadrille Bird, *Leucolepia musica musica* (Bodd.), Orange-headed Manakin, *Pipra aureola aureola* (Linné), Brown-breasted Pygmy Grosbeak, *Oryzoborus angolensis brevirostris* (Berlepsch), Chestnut-bellied Seedeater, *Sporophila castaneiventris* Cab., Black-headed Seedeater, *Sporophila bouvronides* (Less.), Blue Honey Creeper, *Cyanerpes cyaneus cyaneus* (Linné), and the Moriche Oriole, *Icterus chrysocephalus* (Linné). Photographs of nests.

29. YOUNG GREY-BACKED TRUMPETERS

William Beebe

Chapter XIV, p. 247

Detailed description of appearance, molt and habits of young Trumpeter, *Psophia crepitans* Linné, with photographs and colored plate.

30. THE WAYS OF TINAMOU

William Beebe

Chap. XV, p. 253

Life histories, nests, eggs and general account of Guiana Great Tinamou, *Tinamus major major* (Gmel.), Pileated Tinamou, *Crypturus soui soui* (Hermann), and the Variegated Tinamou, *Crypturus variegatus variegatus* (Gmel.), with photographs.

31. WILD LIFE NEAR KALACOON

William Beebe

Chap. XVI, p. 271

Detailed account of awakening of tropical wild life from 5.30 to 6.45 A.M., on mornings of March 26, May 16 and July 2nd, 1916. Log of occurrences, broods, migrations and nesting seasons of tropical organisms, from June 15th to August 16th.

32. THE ALLIGATORS OF GEORGETOWN

William Beebe

Chap. XVII, p. 283

Detailed account of life history, breeding habits, eggs, young, variation in young, photographs and diagrams of young. *Caiman sclerops* (Schneid.).

33. NOTES ON THE DEVELOPMENT OF THE JACANA

G. INNESS HARTLEY

Chap. XVIII, p. 293

General development, pterylosis, head of embryo, toes and claws, spurs, relationships of growing leg and wing to body. With diagrams of wing growth, of legs and wings compared to body and of ontogenetic variations. Photograph of spurs. *Jacana jacana jacana* (Linné).

34. NOTES ON THE DEVELOPMENT OF THE SMOOTH-BILLED ANI

G. INNESS HARTLEY

Chap. XIX, p. 307

Detailed description of pterylosis of embryo and adult, wing pads, development of wing, bones of leg, and development of bill. With diagrams, charts, and photograph of embryo. *Crotophaga ani* (Gmel.).

35. NOTES ON A FEW EMBRYOS

G. INNESS HARTLEY

Chap. XX, p. 321

Pterylosis and external characters of embryos of *Caprimulgus nigrescens* Cab., *Pitangus sulphuratus sulphuratus* (Linné), and *Empidonomus varius varius* (Vieill.).

36. NESTING HABITS OF THE GREY-BREASTED MARTIN

G. INNESS HARTLEY

Chap. XXI, p. 328

Breeding season, courtship, nest-building, eggs, young, food, development of flight, and instincts of young birds. Photograph of young. *Progne chalybea chalybea* (Gmel.).

37. PRELIMINARY NOTES ON THE DEVELOPMENT OF THE WING

G. INNESS HARTLEY

Chap. XXII, p. 342

Development of the wing and pinion in relation to habits of *Opisthocomus hoazin* (P. L. S. Mull.), *Psittacula passerina* (Linné), *Psophia crepitans* Linné, *Butorides striata* (Linné), *Pteroglossus aracari atricollis* (P.L.S. Mull.), *Galeoscoptes carolinensis* (Linné), *Cacicus cela cela* (Linné), *Pitangus sulphuratus sulphuratus* (Linné), and *Progne chalybea chalybea* (Gmel.). Development of the pinion of the following species: *Opisthocomus hoazin* (P. L. S. Mull.), *Psophia crepitans* Linné, *Pitangus sulphuratus sulphuratus* (Linné), *Pteroglossus aracari atricollis* (P. L. S. Mull.), *Galeoscoptes carolinensis* (Linné), *Progne chalybea chalybea* (Gmel.).

38. NOTES ON THE PERAI FISH

G. Inness Hartley

Chap. XXIII, p. 342

A general account of this dangerous fish elaborated from contribution number 7.

39. THE BEES AND WASPS OF BARTICA

Paul G. Howes

Chap. XXIV, p. 371

General account, relation of rainfall to nesting, difficulties in rearing larvae.

40. TWO POTTER WASPS

Paul G. Howes

Chap. XXV, p. 376

General account, nests, food of young, egg, larva, cocoon, pupation. Red Potter Wasp *Eumenes canaliculata*, and Buff Eumenes, *Eumenes*, sp. Colored plates of egg, larva, pupa and imago. Photographs of wasp on nest, nests, and of larva within the nests.

41. LARVAL SACRIFICE

Paul G. Howes

Chap. XXVI, p. 386

Life history, nest, eggs, discussion of transformation from larva to pupa and imago. Colored plate of egg, larva, pupa and imago, Figure 125—9, 10, 11 and 12. Photographs of pupa, and of transformation from larva to pupa. *Podium rufipes* (Fabr.).

42. THE BLACK REED WASP

Paul G. Howes

Chap. XXVII, p. 394

Nests, nesting, nest provisions, egg, larva, pupa, method of depositing eggs in chambers of nest. Colored plate of egg, larva, pupa and imago, Figure 125—13, 14, 15 and 16. Photographs of nests. *Trypoxylon cinereohirtum* Cam.

43. THE WHITE-FOOTED WASP

Paul G. Howes

Chap. XXVIII, p. 401

General account, method of laying eggs, larval food, nests, eggs, larva, cocoon, pupa, emergence. Colored plate of egg, larva, pupa and imago, Figure 133—1, 2, 3 and 4. Photograph of cocoon. *Trypoxylon leucotrichium* Rohmer.

44. THE FOREST SHELL WASP

Paul G. Howes

Chap. XXIX, p. 407

General account, nests, egg, larval food, larva, artificial feeding of larva, pupation, emergence. Colored plate of egg, larva, pupa and imago, Figure 133—5, 6, 7 and 8. Photographs of nests and larvae. *Zethusculus hamatus* Zav.

45. THE ONE-BANDED DAUBER

Paul G. Howes

Chap. XXX, p. 413

General account, methods of constructing nests, discussion of sense of direction, larval food, egg, larva, pupa, cocoon. Colored plate, Figure 133—9, 10, 11 and 12. Photographs of nest, wasp at nest and newly emerged specimen. *Sceliphron fistulare* Dahlb.

46. THE BLUE HUNTRESS

Paul G. Howes

Chap. XXXI, p. 413

General account, nest, larval food, egg, larvae, pupa, emergence from cocoon. Colored plate, egg, larva, pupa and imago, Figure 133—13, 14, 15 and 16. Photographs of wasp at nest, cocoon. *Chlorion neotropicus* Kohl.

47. PARALYZED PROVENDER

Paul G. Howes

Chap. XXXII, p. 436

General account of the actions of wasps in paralyzing spiders and insects. Forms of paralysis produced by wasps.

48. CONTROLLED PUPATION

Paul G. Howes

Chap. XXXIII, p. 443

General account of larva of Trypetid flies of genus *Spilographa*. Transformation of larva to pupa. Photographs of larva.

49. NOTES FROM THE HINTERLAND OF GUIANA

Walter G. White

Chap. XXXIV, p. 453

General account of the country and the animals found along the upper Rupununni River.

50. INDIAN CHARMS

James Rodway

Chap. XXXV, p. 488

Charms and superstitions of the Guiana Indians, with colored plate of plant leaves used as charms.

51. A HUNT FOR HOATZINS

William Beebe

Atlantic Monthly, February.

Detailed account of the general environment of hoatzins. *Opisthocomus hoazin* (P. L. S. Mull.).

52. WITH ARMY ANTS SOMEWHERE IN THE JUNGLE

William Beebe

Atlantic Monthly, April

Method of attack, securing and carrying food, and general account of the offensive activities of *Eciton burchelli* Westwood.

53. A WILDERNESS LABORATORY

William Beebe

Atlantic Monthly, May

Method of founding and operating a jungle laboratory with description of the environment, opportunities for research, servants, etc.

54. COLONEL ROOSEVELT AND THE TROPICAL RESEARCH STATION

William Beebe

Timehri (3), IV, June, p. 27

Brief narrative of the part which Colonel Roosevelt played in the conception and development of the Station.

55. JUNGLE NIGHT

William Beebe

Atlantic Monthly, July

Activities of organisms on moonlit nights in the Guiana jungle.

56. ANNUAL REPORT OF THE TROPICAL RESEARCH STATION

William Beebe

Annual Report of the New York Zool. Soc. 1917, p. 99

Activities of the Station staff during the year 1917.

1918

57. A SILKY EATER OF ANTS

William Beebe

Bull. Zool. Soc. XXI, No. 1, January, p. 1561

General account of the Silky Anteater, *Cyclopes didactylus didactylus* (Linné), with photographs and drawings.

58. LABEL-MAKING IN THE FIELD

William Beebe

Ibid., p. 1574

Short account of simple photographic method of making field labels of small size.

59. A SECOND IMPERIAL PARROT

William Beebe

Ibid., p. 1578

General account of the second specimen of this rare parrot brought to the Zoological Park, *Amazona imperialis* (Rich.).

60. INSECT TYRANTS

William Beebe

Bull. Zool. Soc. XXI, No. 5, p. 1670

General account of the methods of attack, and methods of transportation used by the army ant, *Eciton burchelli* Westwood. With two drawings.

61. ANTS COLLECTED IN BRITISH GUIANA BY MR. WILLIAM BEEBE

William Morton Wheeler

Jour. N. Y. Ento. Soc., Vol. XXVI, No. 1, March, p. 23

Account of a small collection of ants taken from twenty square feet of bushes at Penal Settlement, Bartica District. The collection comprises 42 forms and the following new species:

Camponotus (*Myrmobrachys*) *beebei* Wheeler.
Crematogaster ornatipilis Wheeler.

62. ISLANDS

William Beebe

Jour. Am. Mus. Nat. Hist., Vol. XVIII, No. 6, p. 453

Notes on the West Indies, from St. Thomas to Barbados.

63. CONVICT TRAIL

William Beebe

Atlantic Monthly, September

The cutting of a trail through second growth jungle and the subsequent effect on flora and fauna; social sleeping habits of Ithomiid and Heliconid butterflies.

64. SEA WRACK

William Beebe

Atlantic Monthly, October.

Study of the pelagic life and sargossa weed organisms between New York and British Guiana.

65. JUNGLE PEACE

WILLIAM BEEBE

8vo., New York, Henry Holt & Co. Illustrated by the author.

Collection in book form of contributions 12, 51, 52, 53, 55, 62, 63 and 64.

66. BEES FROM BRITISH GUIANA

T. D. A. COCKERELL

Bull. Amer. Mus. Nat. Hist., Vol. XXXVIII, Art. XX, p. 685

Account of a small collection of bees from Bartica District, with key to all the forms in the collection, and descriptions of the following new species and varieties:

Euglossa decorata Smith, var. *ruficauda* Cockerell
Euglossa ignita Smith, var. *chlorosoma* Cockerell
Epicharis maculata var. *barticana* Cockerell
Rhathymus beebei Cockerell
Augochlora callichlorura Cockerell
Florilegus barticanus Cockerell

Included in this paper is a description of a new species from French Guiana in the author's collection:

Augochlora maroniana Cockerell.

67. ANNUAL REPORT OF THE TROPICAL RESEARCH STATION

WILLIAM BEEBE

Annual Report N. Y. Zool. Soc., 1918, p. 84

Activities of the Station during 1918.

1919

68. REVIEW OF "TROPICAL WILD LIFE IN BRITISH GUIANA"

GEORGE W. HUNTER

Bull. Zool. Soc., XXII, No. 1, p. 21

Critical and detailed review of the work of the Tropical Research Station as narrated in "Tropical Wild Life in British Guiana."

69. HAMMOCK NIGHTS

WILLIAM BEEBE

Atlantic Monthly, February

Night life of the jungle as observed from a hammock.

70. HIGHER VERTEBRATES OF BRITISH GUIANA, LIST OF AMPHIBIA, REPTILIA AND MAMMALIA

WILLIAM BEEBE

Zoologica, Vol. II, No. 7, p. 205

Check list of 52 amphibians, 112 reptiles and 119 mammals of British Guiana of which almost half occur at the Station.

(See in connection with this paper, "Comments on a Recent Check-list," by Thomas Barbour, American Naturalist, Vol. LIV, page 285.)

71. BIRDS OF BARTICA DISTRICT

William Beebe

Zoologica, Vol. II, No. 8, p. 229

Check list of 75 birds new to the Bartica District. This list is a supplement to the list found in Contribution 23.

72. LIZARDS OF THE GENUS *AMEIVA*

William Beebe

Zoologica, Vol. II, No. 9, p. 235

A brief, critical study of the pattern and color of *Ameiva* lizards, with a discussion of Barbour and Noble's paper, "A Revision of the Lizards of the Genus *Ameiva*," Bull. Mus. Comp. Zool., Harvard, LIX, No. 6, 1915, pp. 417-479.

73. THE TROPICAL RESEARCH STATION

William Beebe

Bull. Zool. Soc., XXII, No. 4, p. 274

Brief account of the re-establishment of the Tropical Research Station at its new home, Kartabo, with short account of some of the forms of life at the Station.

74. THE TERMITES OF KARTABO

Alfred Emerson

Ibid., p. 75

Notes on termite nests and general termite ecology.

75. A HOME TOWN OF THE ARMY ANTS

William Beebe

Atlantic Monthly, October

Detailed account of the temporary nest and the intricate nest activities of a colony of *Eciton burchelli* Westwood.

76. INSECT BEHAVIOR

Paul G. Howes

Richard G. Badger, Boston, Mass.

Chapters II to IX, inclusive, are reprints of contributions 41 to 48 from "Tropical Wild Life."

77. ANNUAL REPORT OF THE TROPICAL RESEARCH STATION

William Beebe

Annual Report, N. Y. Zool. Soc. 1919, p. 115.

Activities of the Station for the year 1919.

1920

78. A JUNGLE CLEARING

    WILLIAM BEEBE

    Atlantic Monthly, January

    Comparison of superficial aspects of tropical with temperate fauna and flora; biocoenose of a weed, parrakeets, cotingas and toucans.

79. THE LURE OF KARTABO

    WILLIAM BEEBE

    Atlantic Monthly, February

    The founding of the Station at its permanent site, and description of the wild life in the immediate vicinity.

80. TROPICAL TADPOLES

    JOHN TEE-VAN

    Bull. Zool. Soc., Vol. XXIII, No. 1, Jan., p. 9

    Brief account of tadpoles and tadpole habits at Kartabo.

81. FOURTH YEAR OF THE NEOTROPICAL RESEARCH STATION

    HENRY FAIRFIELD OSBORN

    Science, June 11, 1920, pages 585-587

    Résumé of the foundation, objects and achievements of the Station.

82. ANNUAL REPORT OF THE TROPICAL RESEARCH STATION

    WILLIAM BEEBE

    Annual Report, N. Y. Zool. Soc. 1920, p. 111.

    Activities of the Station during 1920.

1921

83. A TROPIC GARDEN

    WILLIAM BEEBE

    Atlantic Monthly, February

    Habits of manatees, *Trichechus manatus* Linné, jacanas, *Jacana jacana jacana* (Linné), mongoose, *Mungos mungo* (Gmelin), and herons.

84. GUINEVERE THE MYSTERIOUS

    WILLIAM BEEBE

    Atlantic Monthly, March

    Phyllomedusa bicolor (Bodd.), its environment, metamorphosis and habits.

85. A NEW CASE OF PARABIOSIS AND THE "ANT GARDENS" OF BRITISH GUIANA

William Morton Wheeler

Ecology, Vol. II, No. 2, April, 1921, p. 89

Résumé of the known cases of myrmicine parabiosis. Records of the parabiosis of *Camponotus* and *Crematogaster* in 80 per cent of the ant gardens found near the Station; detailed account of these gardens.

86. THE BAY OF BUTTERFLIES

William Beebe

Harpers Magazine, April

Habits of the Giant Singing Catfish, *Doras granulosus* Valenciennes; the Long-armed Beetle, *Acrocinus longimanus* (Linné), and general life of the tidal area of the Mazaruni shore; migration and social habits of five species of *Catopsilia.*

87. A JUNGLE BEACH

William Beebe

Atlantic Monthly, May

The ecological results, floral and faunal, of the falling of a single tree into the water; organisms living in the tide-washed roots of trees.

88. OBSERVATIONS ON ARMY ANTS IN BRITISH GUIANA

William Morton Wheeler

Proc. Am. Acad. Arts and Sci., Vol. 56, No. 8, June 1921, p. 291

Notes on the life histories of twelve species of army-ants, three of which are new to science; description of the female of *Eciton burchelli* Westwood, and the males of that species and of *Eciton pilosum* F. Smith. Descriptions of the following new species and varieties: *Eciton (Acamatus) angustinode* Emery subsp. *emersoni* Wheeler, *Eciton (Labidus) praedator* F. Smith var. *guianense* Wheeler, *Eciton (Acamatus) pilosum* F. Smith var. *beebei* Wheeler, and *Cheliomyrmex megalonyx* Wheeler. With many photographs and drawings.

89. THE GARDENS OF THE JUNGLE

William Beebe

House and Garden Magazine, July

An account of the plants raised by the Akawai Indians of Guiana.

90. THE ATTAS—A JUNGLE LABOR UNION

William Beebe

Atlantic Monthly, July

Atta cephalotes Fab. Foundation of the nest by the queen, leaf cutting activities, the trails, functions of the minims in the field, and abnormal actions of the maxims.

91. THE ATTAS AT HOME

WILLIAM BEEBE

Atta cephalotes Fab. The nest, its appearance, environment, visitors, parasitic and otherwise, reactions in defense, fungus gardens, habits of the parasitic cockroach *Attaphila*, marriage flight of the males and females, founding of a new colony.

92. SEQUELS

WILLIAM BEEBE

Atlantic Monthly, October

Instrumental sounds made by Tapping Wasp, *Synoeca irina* Spinola; voice of *Trogonurus curucui curucui* (Linné); remarkable exhibition of instinct by *Eciton burchelli* Westwood, an entire colony being confined to a one-hundred yard circle for several days.

93. EDGE OF THE JUNGLE

WILLIAM BEEBE

8vo. Henry Holt & Co., New York, October

Collection in book form of contributions Nos. 69, 75, 78, 79, 83, 84, 86, 87, 89, 90, 91, 92.

APPENDIX

Before the establishment of the Tropical Research Station there were published in the first and second volumes of ZOOLOGICA a number of articles by William Beebe, then Curator of Birds, dealing with Neotropical zoology. In order to correlate all the past work of the Society in this direction a list of titles is presented:

A CONTRIBUTION TO THE ECOLOGY OF THE ADULT HOATZIN

WILLIAM BEEBE

Zoologica, I, No. 2, 1909, p. 45

History, names, distribution, general appearance, parasites, food, nests, eggs, enemies and odors. Field notes on this species made in British Guiana and Venezuela. Methods of photographing. Bibliography, map of distribution and photographs of the adults in their natural surroundings. *Opisthocomus hoazin* (P. L. S. Mull.).

AN ORNITHOLOGICAL RECONNAISSANCE OF NORTHEASTERN VENEZUELA

WILLIAM BEEBE

Zoologica, I, No. 3, 1909, p. 67

General character of the pure mangrove forest, the mainland forest and the pitch lakes. Annotated list of the birds observed, and ecological conclusions concerning the birds of the Orinoco region. Notes on the voice of many species of birds. Descriptions of the nests and eggs of the following species: Great Blue Tinamou, *Tinamus tao* Temm., Venezuelan Rufous-tailed Jacamar, *Galbula ruficauda* Cuv., Yellow-backed Cassique, *Caccicus persicus* Linné, and the eggs and young of the Yellow-fronted Amazon Parrot, *Amazona ochrocephala* (Gmel.).

NEW SPECIES OF INSECTS COLLECTED BY C. WILLIAM BEEBE IN SOUTH AMERICA

Zoologica, I, No. 4, 1910, p. 118

Descriptions of the following new genera and species of insects collected by William Beebe in British Guiana and Venezuela:

MALLOPHAGA

Colpocephalum armiferum Kellogg—host *Opisthocomus hoazin* (P. L. S. Mull.); *Lipeurus absitus* Kellogg—same host. Described by Vernon L. Kellogg, Stanford University, California.

ORTHOPTERA

Stagmomantis hoorie Caudell. Described from male and female specimens from near the Hoorie gold mine on Hoorie Creek, a tributary of the Barama River, British Guiana, by A. N. Caudell, U. S. National Museum, Washington, D. C.

LEPIDOPTERA

The following new species and genera were described by Harrison G. Dyar, U. S. National Museum, Washington, D. C.: *Hylesia indurata, Zatrephes cardytera,* genus *Zaevius, Zaevius calocore,* genus *Thyonaea, Thyonaea dremma, Illice biota, Neophaenis aedemon, Emarginea empyra, Hadena niphetodes, Capnodes albicosta, Thermesia dorsilinea, Claphe laudissima, Rifargia phanerostigma, Eois costalis,* the female of *Racheolopha nivetacta, Acropteryx opulenta, Saccopleura lycealis,* genus *Dichocrocopsis, Dichocrocopsis maculiferalis, Ischnurges bicoloralis,* genus *Hositea, Hositea gynaecia,* genus *Incarcha, Incarcha aporalis, Macalla pallidomedia, Paracraga amianta, Minacragides arnacis, Trosia nigripes,* and *Hemipecten cleptes.* All of the above insects are described from specimens captured at Hoorie, British Guiana.

RACKET FORMATION IN TAIL FEATHERS OF THE MOTMOTS

William Beebe

Zoologica I, No. 5, 1910, p. 141

Methods and means of denudation of the barbs of the central rectrices of the Motmots, *Momotus, Eumomotus sp.,* to form the characteristic racket.

NOTES ON THE ONTOGENY OF THE WHITE IBIS, GUIRA ALBA

William Beebe

Zoologica I, No. 12, 1914, p. 241

Breeding habits, eggs, young, food of young, development and annual changes in coloration and form of the White Ibis, *Guira alba* (Linné). With a colored plate.

SPECIALIZATION OF TAIL DOWN IN CERTAIN DUCKS

William Beebe and Lee S. Crandall

Zoologica I, 13, 1914, p. 247

Account of retention of the caudal down by attachment to the growing juvenile rectrices in *Aix sponsa* Linné, *Erismatura jamaicensis* (Gmel.), and *Merganetta columbiana* Des Murs.

NOTES ON THE BIRDS OF PARÁ, BRAZIL

William Beebe

Zoologica II, No. 3, 1916, p. 55

Account of a visit to Pará, Brazil, with discussion of the region, the general ecology, and of the visit of seventy-six species of birds to a single tree. Notes on some of the invertebrates of the region. Notes on the molt of some Pará birds. Annotated list of the birds observed.

FAUNA OF FOUR SQUARE FEET OF JUNGLE

William Beebe

Zoologica, II, No. 4, 1916, p. 107

An investigation of four square feet of debris taken from the jungle floor near Pará, Brazil, and carefully searched for minute forms of life. Accounts of the many interesting invertebrates found within the debris. Illustrations of the following new ants, *Glamyromyrmex beebei* Wheeler, and *Blepharidatta brasiliensis* Wheeler.

Also belonging to this series is the following volume, dealing with the account of a trip into the British Guiana jungle in the year 1909.

OUR SEARCH FOR A WILDERNESS

M. B. & C. W. Beebe

8vo., 408 pages, illustrated. Henry Holt & Co., New York, 1910
Pages 111 to 398 deal entirely with British Guiana and the animal life found there.

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ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

FROM THE TROPICAL RESEARCH STATION IN BRITISH GUIANA

Smithsonian Institution
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VOLUME III. NUMBERS 3-11

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SCIENTIFIC CONTRIBUTIONS OF THE
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FROM THE TROPICAL RESEARCH
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VOLUME III. NUMBER 3

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By William Morton Wheeler

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If organic evolution had stopped with insects it would still have been a succession of achievements that angels might desire to look into. The entomologist watches by the most copious fountain of wonder in the world—a well of surprises for eye and intellect.—J. ARTHUR THOMSON, "*The System of Animate Nature,*" p. 545.

A STUDY OF SOME SOCIAL BEETLES IN BRITISH GUIANA AND OF THEIR RELATIONS TO THE ANT-PLANT TACHIGALIA*

By WILLIAM MORTON WHEELER

INTRODUCTION.

The materials for the following paper were obtained during July, August and September, 1920, while I was working with Prof. I. W. Bailey on the myrmecophytes of British Guiana. We had gone to the Tropical Laboratory of the New York Zoological Society at Kartabo for the purpose of making an intensive study of the relations of the ants to such plants as *Cecropia, Triplaris, Cordia* and *Tococa;* Prof. Bailey's investigations being primarily concerned with the anatomical peculiarities of the plants, my own with the identification and habits of their various ants. During these investigations I encountered two species of beetles of such unusual social habits that I was led to devote considerable attention to their behavior. They live in the fusiform enlargements of the petioles of a singular tree, *Tachigalia,* which is also inhabited by numerous species of ants. Both the beetles and the ants cultivate coccids in the hollow petioles, and with the beetles and coccids there are, moreover, several associated, parasitic or synœketic insects. And since there are also other insects, besides those already mentioned, associated with the plant, we may regard the latter as the focus of a very interesting and complicated biocoenose.

The elements of this biocoenose are so numerous and heterogeneous that I have had to appeal to several specialists for assistance in making identifications and writing descriptions. Dr. E. A. Schwarz and Mr. H. S. Barber kindly studied and described the social beetles and a little Coccinellid which feeds on their coccids. Dr. Adam Böving made a fine study of the beetle larvæ;

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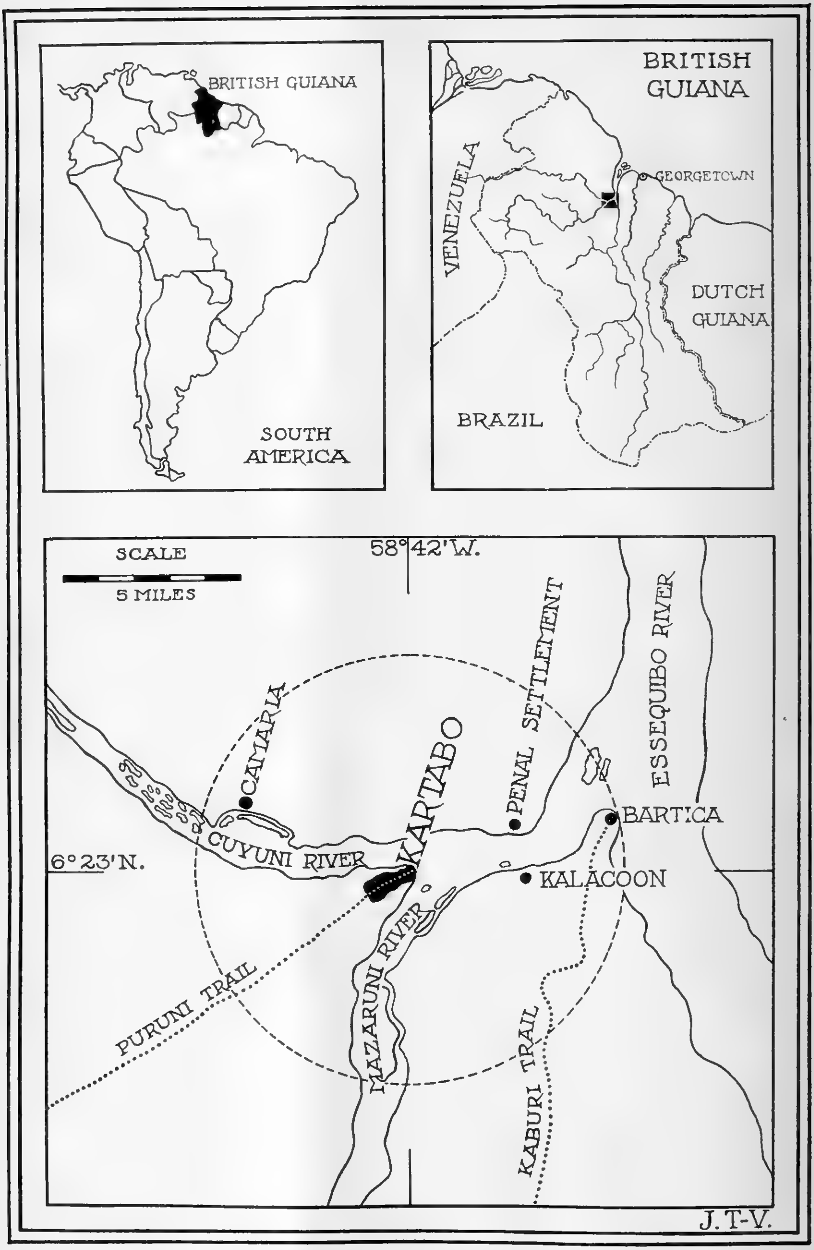
Mr. Harold Morrison identified the coccids; the Hymenopterous and Dipterous parasites of the latter were studied by Prof. C. T. Brues and Dr. E. P. Felt. Dr. J. Bequaert, Prof. Herbert Osborn, Prof. J. W. Folsom and Dr. R. V. Chamberlin identified a wasp, two Membracids, a Collembolan and a Myriopod found living in *Tachigalia* petioles; and Prof. Roland Thaxter found and identified a fungus growing on the surfaces of one of the species of social beetles. I have added the reports of several of these investigators as appendices to the present paper, and wish to express my great indebtedness to all of them for their generous assistance and to Mr. Wm. Beebe for his many kindnesses to Prof. Bailey and myself while we were at Kartabo and the pains he has taken, since our return to Boston, to ascertain further facts concerning the *Tachigalia* and other myrmecophytes and to collect additional species of Formicidæ. So many of the ants inhabiting the *Tachigalia* prove to be new to science that I have had to provide a special paper for their taxonomic descriptions (Zoologica III, No. 4).

Although I have endeavored to acquire a comprehensive knowledge of the various insects associated with the *Tachigalia,* I am aware that my account must be very fragmentary. The territory covered was limited and in other parts of British Guiana the same tree undoubtedly harbors other insects. This is indicated by the few published observations on the trees of the genus *Tachigalia* and their insects in Brazil and other parts of South America. Moreover, only the leaves and petioles and their inhabitants were studied and there are probably many peculiar insects that live only in the wood and seeds or merely visit the flowers, which in some species, at least, are conspicuous and sweet-scented. The seeds were found only after they had germinated, and the trees showed no indications of flowering during our stay in British Guiana. Our inference that they might bloom during the winter months has not been confirmed, since up to the time of this writing (March, 1921), Mr. Beebe has seen no flowers on any of the trees which Prof. Bailey marked for observation. I trust, nevertheless, that my account of the *Tachigalia* biocoenose will give such a picture of the astonishing complexity and exuberance of the insect fauna of the Neotropical Region, and of the fierce competition among these organisms on the one hand and of their intimate co-operation on the other, as to stimulate some future investigator to complete my observations. At any rate, the following pages may serve to direct the attention of our younger entomologists to one of the many wonderful, almost untouched fields for investigation in tropical America.



LOCATION OF THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY

The circle represents a radius of six miles.

The Tachigalia.

The Leguminous myrmecophytes of the genus *Tachigalia* comprise more than a dozen known species of trees and shrubs belonging to the forest formation (hylæa) of the Guianas and the Amazon basin. The first species, *paniculata,* was described by Aublet as long ago as 1775, and re-described by Tulasne in 1844. The former derived the generic name from the Carib "tachigali," "tachi" being the term employed by the natives of the Guianas and Brazil for the stinging ants of the genus *Pseudomyrma,* which regularly inhabit the swollen petioles of the species of *Tachigalia* and the hollow branches and trunk of the various species of *Triplaris.* Spruce (1869) was also familiar with several species of *Tachigalia* and their ant-inhabited petioles. Owing to our not finding the trees at Kartabo in bloom, Prof. Bailey and I have been unable as yet to ascertain their specific name. They closely resemble, however, at least in their younger stages, the species described by Harms (1906) as *T. formicarum* and figured by Ule (1907), who discovered it in Brazil (Plate I).

I first found the *Tachigalia* on the Puruni Trail near the Kartabo laboratory on July 22. The specimens were small and slender, from a foot and a half to six or seven feet tall, with only two or three to about a dozen leaves, and were growing in the shade. The petioles were inhabited either by beetles or by ants of the genera *Azteca* and *Pseudomyrma.* On the following day Prof. Bailey found what we at first took to be a different *Tachigalia* on the left bank of the Cuyuni River. It was a small tree, 30 to 40 feet high, with denser foliage and very different leaves. Its petioles were all inhabited by parts of a single huge colony of a yellow *Pseudomyrma.* Later, on finding more material, we became convinced that both trees were merely the juvenile and adult forms of the same plant, the former growing in the shade, the latter in the sun. Prof. Bailey found the seedlings in various stages and was able to ascertain that the seed is a peculiar samara, not a pod as in most Leguminosæ, and that the plants grow in loose colonies, the seedlings springing up in the shade about the base of the parent tree, which rises to a height of 40 to 60 feet, with a crown of foliage at the summit of a very slender trunk.

Further search revealed the fact that the *Tachigalia* is not uncommon in many localities within a mile of the laboratory, especially along the Puruni and Cuyuni Trails. It was also found scattered through the beautiful primeval forest at Kalacoon and Baracara on the right bank of the Mazaruni and in the jungle behind the Penal Settlement on the opposite banks of the same stream. Though the tree was often found in all the localities mentioned, it is, nevertheless, rather sporadic compared with many other components of the hylæa. It may also be very local in British Guiana and the adjacent countries. This is indicated by the fact that there seemed to be no specimens of it in the herbarium of the Botanical Garden at Georgetown nor in that of the Botanical Garden at Port of Spain, Trinidad, and neither the botanists of those institutions nor the chief of the forestry department at Georgetown had ever seen the plant. Moreover, the halfbreed Indian caretaker of the Kartabo laboratory, though familiar with it and its ant-inhabitants, did not know its native name, notwithstanding his remarkably accurate memory for the aboriginal names of most other trees of the jungle. Thus we were unable to ascertain even the generic name of the *Tachigalia* till we had gone over the works on the South American flora in the library of the Arnold Arboretum.

As Prof. Bailey will publish a detailed account of the anatomical peculiarities of the tree, I may here confine myself to a brief sketch of its appearance. For the purposes of this study it will be advantageous to distinguish rather sharply between the young, shade and large, sun forms, since their insect inhabitants are, as a rule, very different. In the shade form (Plate I) the *Tachigalia* has an extremely slender, straight trunk, from about a foot to eight or twelve feet in height, with long alternate, pinnate leaves coming off of it at right angles and at such long intervals that even the smallest of the young plants have only two or three, the largest hardly more than a dozen leaves. These are dark green, smooth and somewhat shining, a except at the base, where it forms a fusiform swelling two to four inches in length and a third to half an inch in diameter. The longer, more distal portion of the petiole bears six to eight pairs of broadly lanceolate leaflets, which are not drooping or pendant. The stipules at the base of the petiole are small and inconspicuous. The sun form (Fig. 4) is much more vigorous and has numerous branches at or near the summit of the long, slender, foot or less in length. The petiole (Fig. 5*a*) is very slender smooth, gray-barked trunk. The leaflets are pendant, more crowded, much coarser, brighter green, with more rugose surfaces and the petiole is thicker, with a large, three-cornered basal swelling more gradually continued into the leaflet-bearing portion (Fig. 5*b*). The cavity of the petiole also extends nearly throughout its length instead of being confined to the basal, swollen portion, and there are also cavities in the branches near each leaf. The stipules are large and conspicuous and palmately multifid. Forms of the plant intermediate between the shade and sun forms were rarely seen. The specific identity of the two forms was proved by finding young shoots of the typical shade form growing from the trunk of a large sun tree in an abandoned cassava patch at points where the wood had been cut back by the natives.

The Tachigalia Biocoenose.

The interrelationships of the various organisms constituting that portion of the *Tachigalia* biocoenose with which this paper deals, *i. e.*, the numerous insects with their parasites and satellites, that infest the young shoots and leaves, are represented in the accompanying diagram (Plate II). It will be seen that the portion of the plant which forms what may be called the center of the biocoenose is the leaf-petiole, and it is, of course, the peculiar structure of this organ that determines the specific relations of the various insects to the host-plant and is, therefore, the key to an analysis and understanding of the whole living complex. As Prof. Bailey will publish a detailed account of the histological composition of the petiole, I here confine myself to a general description, dwelling only on the more salient features.

The petioles of the shade-plants are very long and slender and their enlargement is fusiform and restricted to the base, proximal to the leaflets. In cross-section (Pl. IV) the enlargement is nearly circular, with one surface, corresponding to the dorsal surface of the petiole, flattened. In the sun-plants the basal thickening passes gradually into the leaflet-bearing portion of the petiole and the cross-section (Pl. III, figs. 3 and 4) is distinctly triangular, one of the sides being dorsal, the two others forming together the inverted roof-shaped ventral portion, so that the petiole might be described as flattened dorsally and carinate ventrally. The dorsal surface is distinctly winged, or alate on each side. In the very young leaves the petiolar enlargement is solid, its interior being filled with juicy pith (Pl. III, fig. 3). This soon dries up, however, and is converted into a flocculent or fibrillar, cinnamon brown substance, lying loosely in a large cavity, the walls of which are lined by a thin layer of the same reddish tissue. The same kind of tissue, the cells of which are filled with a homogeneous amber-colored substance, is also continually forming in four longitudinal strands or rays in the dorsal wall of the petiole (Pl. IV, fig. 1). Later a few similar strands make their appearance also in the ventrolateral walls. Since the amber-colored substance which characterizes this tissue evidently has a high nutritive value, I shall call it the nutritive parenchyma. In a few petioles in this stage I found from four to six small Curculionid larvæ feeding on the loose material and reducing it to a red, powdery frass. Unfortunately these larvæ could not be reared, so that their specific identity is unknown. They are not, however, necessary agents in the preparation of the petioles for their future occupants.

As soon as the petiole has reached the stage just described it is evident that any small insect, sufficiently enterprisng to bore a hole in its wall, would find comfortable lodgings, which could easily be rendered even more comfortable by tossing the dried remnants of the pith out of the entrance or by compacting them in the narrow ends of the spindle-shaped cavity. And if the insect were a vegetable feeder it might find also an abundant food-supply in the remains of the pith still forming the lining

FIG. 4. BRANCH OF AN ADULT (SUN) *TACHIGALIA*

The leaflets have been removed from two of the petioles. Photograph by John Tee-Van.

FIG. 5. BASES OF LEAF-PETIOLE OF *TACHIGALIA* SP.

a, of young, shade tree; *b*, of large, sun tree, both nearly ½ natural size. Pieces of the older petiole and adjacent trunk have been cut out to show the cavity inhabited by *Pseudomyrma*.

of the cavity and especially in the rays of nutritive parenchyma. That the very exuberant neotropical fauna comprises a considerable number of such enterprising insects, the following observations will show.

It will conduce to clearness if we divide the insects which take possession of the petiolar enlargements into two series (Plate II). The first series comprises a small number of ants, social beetles and coccids which utilize all the advantages afforded by the petioles, *i. e.*, use them not only as dwellings for themselves and their young but also as sources of food. Among these three groups of insects the coccids occupy a peculiar and important position. They are present in considerable numbers and of all sizes in all petioles inhabited by established colonies of the beetles and ants. Specimens of the coccids from petioles of both young and adult trees were submitted to Mr. Harold Morrison, who pronounces them all, without exception, to belong to a single species of mealy-bug, *Pseudococcus bromeliæ* Bouché (Fig. 9), a well-known form which has been taken in widely scattered tropical and subtropical localities (India, Zanzibar, Brazil, Florida and even in the hot-houses of Massachusetts) and on a variety of plants (mulberry, Canna, Hibiscus, pineapple). As these insects are, of course, quite unable to make openings in the walls of the petioles, they either wander into the cavities from the surface of the plant, after the ants and beetles have entered, or they are carried in by the former insects. Once inside the petioles the coccids attach themselves to the longitudinal strips of nutritive parenchyma in the walls, insert their beaks and find an abundant supply of sap. The ants can then absorb the saccharine excrement ("honey dew") of the coccids and thus vicariously feed on the plant. The beetles, as we shall see, not only utilize this same source of liquid nutriment but also feed on the solid nutritive parenchyma of the petiolar walls.

The other series, which comprises many more forms, merely use the petioles as nesting, dwelling or hiding places. They enter petioles that have been previously occupied and abandoned, and behave in all respects like the insects which live in old oak-galls in our northern woods. They are in fact merely tenants, or inquilines, or what German zoologists call "Raumparasiten." No coccids are found in the petioles inhabited by these insects, which may be divided into two groups, miscellaneous arthropods and ants. The former are probably very numerous but I have notes only on the following five:

1. In one abandoned petiole I found that a female katydid had enlarged the opening with her jaws, had thrust her ovipositor through it and had deposited her flattened eggs in the cavity.

2. On another occasion I found a petiole of a young plant inhabited by termites (*Nasutitermes* sp.) They had built an earthen gallery along the stem from the ground to an opening in the petiole and were living in the cavity.

3. At the Penal Settlement, near Bartica, I found in one old petiole the mature and pigmented pupa of a solitary wasp, which Dr. J. Bequaert has identified as *Podium ruficrus* Fabr. The mother wasp had stored the petiole with spiders, laid an egg on them and sealed up the entrance.

4. Another petiole, found near the laboratory, contained a small, red female centipede, identified by Dr. R. V. Chamberlin as *Otostigmus limbatus* Meinert, previously known from Brazil and Paraguay. She was coiled about her small, white, recently hatched young.

5. Some of the old and abandoned petioles on young trees were occasionally seen to be inhabited by spiders, especially by Attids.

Inasmuch as the ants comprise the more numerous and more important insects associated with the *Tachigalia* they may be considered in somewhat greater detail, and since their relations to the plant are of five different kinds (Plate II) they may be most conveniently grouped under as many captions.

1. *Defoliators.* Only one species, *Atta cephalotes* L., the common leaf-cutting ant of Central America and northern South America, was actually proved to defoliate young Tachigalias at a time when many of their petioles were not inhabited by other ants or inhabited only by recently fecundated queens of *Pseudomyrma* that had not yet produced their colonies of belligerent, stinging workers. In the jungle behind the Penal Settlement I observed a few such trees which had been either completely

defoliated or had had large semicircular pieces bitten out of their leaflets by *Atta* workers. I have no doubt that these ants would carefully refrain from thus injuring larger Tachigalias in the possession of well-developed *Pseudomyrma* colonies. In all probability the smaller leaf-cutters of the genus *Acromyrmex*, not uncommon in the same locality, may also occasionally visit and defoliate the young trees, but this was not actually observed.

2. *Attendants of Homoptera.* The terminal shoots of young plants are often infested with a small brown Membracid in all stages *(Endoastus* (?) *productus* Osborn) and peculiar flat Membracid nymphs (probably belonging to the genus *Microcentrus*, according to Osborn) the piercing mouthparts of which leave on the surfaces of the petioles permanent scars that may perhaps serve later as convenient points for the beetles and queen ants to bore into the enlargements. At least four species of ants were taken in attendance on these Membracids: *Camponotus femoratus* Fabr., *Crematogaster limata parabiotica* Forel, *Ectatomma tuberculatum* Oliv. and *Dolichoderus attelaboides* Fabr. The first two were the most frequently encountered and belong to another interesting biocoenose, that of the "ant-gardens," which I have described in a recent paper (1921), the last two were of more sporadic occurrence. A few notes on their habits are recorded in Zoologica, Vol. III, No. 4.

3. *Inquilines.* These comprise no less than sixteen different forms, representing thirteen species, belonging to the genera *Neoponera, Leptothorax, Crematogaster, Allomerus, Solenopsis, Pheidole, Camponotus* and *Brachymyrmex*. Most of them are small and all are timid and nonaggressive species which never keep coccids, and are more frequently found in other situations, especially in the dead twigs and branches of various shrubs and trees. And most or all of them merely take possession of petioles that have been previously perforated, inhabited and abandoned by other ants or by the social beetles. The inquiline ants, moreover, are confined to the young Tachigalias growing in the shade. Although the number of them I have collected is considerable and although they represent very diverse genera and even subfamilies, it is certain that further search, especially in other localities, will greatly increase the number, for the petiolar cavities of *Tachigalia* are sufficiently commodious to accomodate

at least the young colonies of nearly all of the twig-inhabiting ants of British Guiana and the list of these is a long one, comprising many small species of *Cryptocerus, Procryptocerus, Pseudomyrma, Leptothorax, Crematogaster, Azteca, Tapinoma, Myrmelachista, Camponotus,* etc.

4. *Thief-ants.* The only species belonging to this category is the tiny *Solenopsis altinodis* Forel, (Fig. 15). which is closely related to a series of "lestobiotic" *Solenopsis* species that nest in the walls of ant-or termite-nests and prey on their brood. It does not live in the *Tachigalia* petioles but enters those inhabited by the social beetles, when their entrances happen to be unguarded, and destroys their larvæ. In all probability it also attacks small, defenceless colonies of the inquiline ants and devours their brood. I infer that it nests in the ground from the fact that it often appeared suddenly in considerable numbers during the night and exterminated the colonies of the Pseudomyrmas in vigorous *Tachigalia* and *Triplaris* branches that had been left on a table in the yard of the laboratory. I have also seen it wandering about on the laboratory tables indoors, over the foliage of the undergrowth in the dark jungle or feeding on the pulp of injured fruits of the water cocoa (*Pachira aquatica* Aubl.) growing along the river banks.

5. *Obligatory Ants.* I would thus designate the ants that are definitively attached to the *Tachigalia* as their host-tree. There are only four species: *Pseudomyrma damnosa* sp. nov., (Fig. 13), *Ps. maligna* sp. nov. (Fig. 14), with its two varieties, *cholerica* and *crucians, Azteca foveiceps* sp. nov. (Fig. 16), and *A. traili* Emery. The last is doubtfully included for reasons to be given below. The recently fertilized queens of these ants perforate and enter the petioles of young Tachigalias growing in the shade, close the openings behind them with particles gnawed from the walls and eventually produce their broods in the cavities. Occasionally queens of the two species of *Pseudomyrma* or of these and *A. foveiceps* may be found, each in a petiole of the same plant and even of one with only a few leaves. That the founding of the colonies may be frought with many dangers is shown by the fact that dead queens are often found shut up in the petioles precisely as in the case of the *Azteca* queens in the internodes of young Cecropias. Some of the unfortunate in-

sects undoubtedly succumb to hunger or the attacks of fungi, but in many cases they seem to be killed by alien ants or by the beetles boring into the same petioles. If the queens survive, however, and produce their broods of workers, the latter open from the inside the entrances made by the queens and eventually take possession of the whole plant. Since all the petioles of larger trees are invariably inhabited by a single flourishing colony of a single species or variety, we must suppose that the offspring of different queens on opening their respective petioles either fight for the possession of the plant or, if they belong to the same species or variety, unite to form a single polycladic colony. The fact that the petioles of large trees contain several deälated fertile females of *Ps. damnosa* or *maligna* would seem to indicate that the eventual climax colony, as it may be called, is established by alliance of several broods rather than by the survival of the offspring of a single queen. Furthermore, the climax colony seems to be far too populous to represent the offspring of a single mother.

No sooner are the petioles opened by the young broods of workers than the coccids enter or are carried in by the ants and attach themselves to the areas of nutritive parenchyma which furnish optimum conditions for feeding and growth. Here they can multiply and be cared for by the ants which undoubtedly find in them a most welcome source of food. As the tree grows and puts forth new leaves, each young petiole as soon as it has reached the proper size is perforated by a detachment of ants and coccids. The later leaves, as I have stated, have cavities extending nearly the entire length of the petioles and adjacent to their insertions there are also cavities in the branches, which are likewise entered and occupied by the insects. The largest leaves have petioles with such broad cavities at their bases that the ants find it necessary to make chambers in them by building carton partitions. The materials for the carton are gnawed from the walls. *Azteca foveiceps* builds a much more elaborate system of partitions than the Pseudomyrmas. This is not surprising, because the Aztecas are nearly all wonderful experts in carton construction.

When the climax stage of the *Tachigalia* biocoenose has been reached, it has been reduced to only three organisms, the plant, the coccids and *Azteca foveiceps* or more frequently one of the two species of *Pseudomyrma* or one of the varieties of *Ps. maligna*. Merely rapping on the tree then reveals the situation, for the angry workers rush out of the petioles, cover the leaflets, trunk and branches and can be readily identified by their size and color, *Ps. damnosa* being yellow, *A. foveiceps* and *Ps. maligna* var. *crucians* black; *maligna* s. str. and its var. *cholerica* both black with yellow markings, but differing in size. Of *A. traili* only a single very young colony was seen, and this was inhabiting a petiole of a small *Tachigalia*. There were coccids in the cavity of the petiole, however, and both for this reason and because the ant is known to be associated with other myrmecophytes, I have included it among the obligates in the diagram. It is, in fact, conceivable that in some localities in British Guiana *traili* may be the dominant species and replace *foveiceps* in the climax stage of the biocoenose.

I have noticed unmistakable indications of two other insects on young Tachigalias, both attacking the foliage. One was a caterpillar of some kind, which had gnawed the leaflets of a few plants and had disappeared, so that I was unable to secure a specimen for identification. The other was an Itonidid gall which occurred in great numbers on a single plant on both the upper and lower surfaces of the leaflets. This gall was 2-4 mm. long, erect and cylindrical, with a conical tip, and somewhat resembled the galls produced by *Cecidomyia caryæcola* Osten Sacken on the leaves of our northern hickories. The smaller galls were undeveloped and contained no larvæ but each of the larger ones had a round hole at the tip and contained in the base of its tubular cavity a cylindrical cocoon enclosing the pupa of a small parasitic Hymenopteron, evidently a Eulophid. Some of the specimens were fully pigmented and nearly ready to hatch, others had been killed by an *Entomophthora*-like fungus. Probably the mother of the parasite had made the round hole in the tip of the gall in order to enter and oviposit on its maker.

It will thus be seen that the *Tachigalia* biocoenose comprises at least 51 different organisms, the host plant and 50 organisms associated primarily with its leaves and terminal shoots or secondarily with the organisms thus associated.

The Social Beetles.

A. Coccidotrophus socialis Schwarz and Barber.

After a careful taxonomic study of the beetles which I found in the *Tachigalia* petioles, Messrs. Schwarz and Barber conclude that they belong not only to perfectly distinct species but to different genera of the family Silvanidæ. While still at Kartabo I convinced myself of their specific difference, but unfortunately not till it was too late to make a detailed study of the differences in their behavior. While the species described in Zoologica III, No. 5 as *Coccidotrophus socialis* was so abundant that I obtained nearly four hundred of its colonies, *Eunausibius wheeleri* was so scarce that I encountered it in less than a dozen petioles. For some time I took it to be merely a depauperate variety or aberration of the *Coccidotrophus* and therefore gave it little attention. Finally, when I had come to appreciate its distinct specific status, my stay at the laboratory was drawing to a close and I could secure only a few of its colonies. My account, therefore, relates almost entirely to *Coccidotrophus* and my notes on *Eunausibius* yield only a few rather summary remarks which may be most conveniently relegated to a brief separate caption (p. 88).

The *Coccidotrophus* (Plate III, fig. 2; Plate VI, figs. 1-5) was taken only near Kartabo and only in the petioles of young Tachigalias growing in the shade along the Puruni, Hacka and Cuyuni trails, within a mile of the Tropical Laboratory. Although the tree was not uncommon in the jungle behind H. M. Penal Settlement and along the trails in the primeval forest near Kalacoon and Baracara, I found no traces of the beetle in these localities. It would seem, therefore, to be rather local. Its body is flattened-cylindrical, long, slender and parallel-sided, with short, stout legs, the femora, especially the fore pair, being conspicuously thickened. It varies in size from 3.5 to 4.5 mm. and when fully mature is deep castaneous brown to almost black, with more reddish appendages. Specimens recently emerged from the pupa, however, are pale reddish testaceous, with more yellowish elytra. The surface of the body is shining and glabrous, the head and thorax punctate, the elytra punctate-striate. The head bears a singular and significant resemblance to that of certain small ants of the genus *Cryptocerus*. The antennæ are short, compactly jointed and distinctly clubbed at the tip. The female is, perhaps, somewhat smaller than the male, but I have been unable to detect any other external differences between the sexes, and Schwarz and Barber in their more careful study of the structural peculiarities of the species, have been no more successful. For further details the reader is referred to their taxonomic description in Zoologica III, No. 6.

The eggs (Fig. 11) are pure white, regularly elliptical, 0.55 long and 0.25 mm. broad, with rather thick, leathery, smooth and shining chorion. The larva is described and figured in great detail in Dr. Böving's article (Zoologica III, No. 7, Plates VII and VIII). In life it is whitish and beautifully translucent so that the straight alimentary tract and its contents can be distinctly seen, but as maturity approaches the body becomes more opaque and milk-white, owing to a considerable increase in the fat-body. The pupa is even more opaque, but just before eclosion becomes yellowish or testaceous, with pigmented eyes. Both beetle and larva are very active and alert, the latter at all times, the former when hungry or disturbed. At other times the beetle is rather sluggish or quiescent, but shows no tendency to "feign death" when handled. Though its wings are well-developed (Plate VI, fig. 5) I have never seen it attempt to fly. The pupa (Plate IX, figs. 19-21) is also very active when stimulated, wriggling its abdomen from side to side, but is unable to move about.

The beetles enter petioles which have either not been previously perforated by other insects or those which have been occupied for some time and have then been abandoned by ants or other beetles or have been occupied by queens of *Pseudomyrma* or *Azteca* that have died before they could produce their broods of workers. The beetles either enter as a single pair or one beetle enters and is very soon joined by an individual of the opposite sex. I have been unable to decide which of these methods is followed or whether the opening in the petiole is made by the male or the female or by either indifferently. Certainly the great majority of colonies in their first, or incipient stage consist only of a male and a female beetle. On the rare occasions when only a single beetle was found in a petiole, the other may have escaped or eluded my attention while I was cutting into the cavity. Twice I have actually seen both beetles

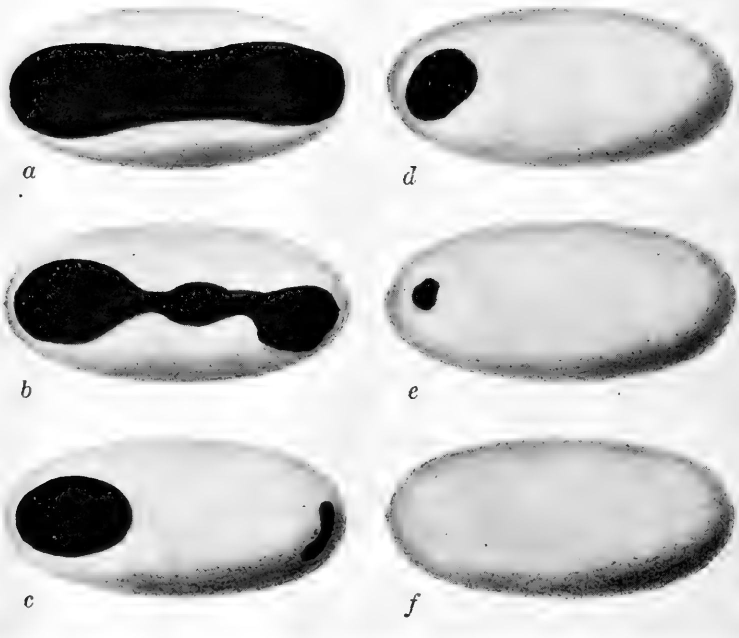


FIG. 6. SIX SUCCESSIVE STAGES IN THE CONSTRUCTION OF THE COCOON BY THE FULL-GROWN LARVA OF *COCCIDOTROPHUS SOCIALIS.*

See text for explanation.

in a cavity diligently cleaning it up for occupancy. Such house-cleaning is necessary both in previously unoccupied and in previously occupied petioles since in the former the particles of fibrillar or powdery pith, which partially fill the cavity, and in the latter the dead bodies of ants, beetles, etc. must be removed. The entrance opening gnawed in the wall is transversely elliptical and just large enough to admit the slender bodies of the beetles. It is most frequently made in the lateral wall some distance from the narrow ends of the petiolar swelling. The petiole occasionally has several openings, sometimes as many as five to seven. I believe that each of these must be the work of the founders of one of the colonies which have successively occupied the same cavity. In other words, the pair of beetles seems not to utilize the openings of previous occupants for the purpose of entering the petiole but insists on making an opening of its own, so that the considerable number of orifices occasionally noticed in an old petiole represent the number of colonies of beetles or potential colonies of ants that have from time to time taken up their abode in its cavity.

The beetles accomplish the removal of the loose pith or the remains of previous tenants by pushing this refuse into the pointed ends of the cavity with their flattened heads, much as a slovenly servant might tidy a room by sweeping things under the furniture or into closets. Smaller particles of pith are sometimes thrown out of the entrance but the decomposed and more or less disarticulated bodies of queen ants and beetles are too voluminous to be disposed of in this manner so that they can only be packed away compactly into the ends of the cavity. This behavior brings the insects into contact with the outermost layer of pith still adhering to the ligneous walls of the cavity and the strips of nutritive parenchyma laden with amber-colored substance. (Plate IV, fig. 1, Plate III, fig. 5). That this tissue actually constitutes the food of the beetles is proved not only by finding it in their intestines but also by actually observing their feeding activities. Very soon, however, young coccids begin to enter the petiole through the opening made by the beetles and take up their positions on the walls of the cavity and preferably along these very strips of nutritive tissue which, as the beetles feed, become gradually deepened into grooves. The coccids station themselves in a row in each groove, with the long axes of their bodies parallel with the long axis of the petiole. Since both beetles and coccids center their feeding activities on the tissue forming the floor of these grooves it is important that they shall be kept clean so that the parenchyma, which is continually proliferating, can be easily reached by both species of insects. (Plate III, fig. 5). Hence the beetles carefully deposit their feces, or frass, which has a chocolate brown color, on the areas between the grooves. As time goes on the accumulations of frass acquire the form of more or less longitudinal ridges projecting into the petiolar cavity (Plate IV, figs. 2-3 and Plate V). In many petioles these ridges are strikingly regular, in others more vermiculate, interrupted or anastomosing. In old petioles inhabited by old colonies of *Coccidotrophus* the interior of the petiolar cavity presents the appearance of the figures on Plate V. In addition to these frass ridges the beetles also build a more or less circular wall of the same substance around the entrance, so that the latter is converted into a short tube, in which one of the beetles often stations itself on guard for hours at a time, with the long axis of its body at right angles to the long axis of the petiole and its flattened head exactly filling the elliptical orifice. (Fig. 11). From time to time the beetle may project its antennæ out into the air and wave them about, so that the petiole from the outside suggests the nest of one of the smaller species of *Cryptocerus*, with a soldier or worker ant on guard at the orifice.

The female beetle begins to lay her eggs either before or after the entrance of the coccids. They are deposited singly along the edges of the frass ridges and evidently at intervals of several hours or even days, for dissection of the beetles shows that only a few eggs mature at a time in the ovaries. They are glued to the wall of the petiole rather firmly and always with their long axis parallel with its long axis and that of the food-grooves and frass ridges (Fig. 11). As I have not witnessed oviposition I have been unable to determine the length of the embryonic period. The eggs hatch, of course, at intervals, so that the larvæ vary greatly in size, some being very small and evidently just hatched, others a third or half-grown or actually full-grown and ready to pupate. Like the beetles, the

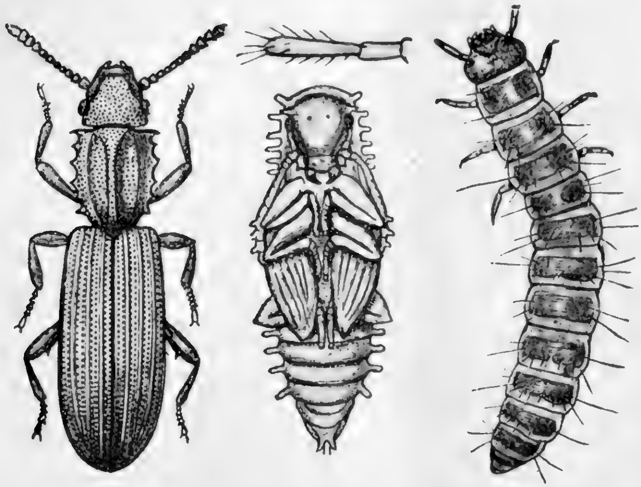


FIG. 7. *ORYZAEPHILUS SURINAMENSIS* L.
Beetle, pupa and larva, showing the teeth on the sides of the pronotum of the beetle and tubercles of the pupa in which they are formed. Courtesy of the Federal Bureau of Entomology.

larvæ feed on the nutritive parenchyma. Its amber colored cells in the intestines may be distinctly seen through the clear integument and body cavity of the larvæ. The colony, which is now in its second stage consists of the pair of parent beetles, about one or two dozen larvæ, mostly immature and in most cases of about the same number of young or half-grown coccids.

When mature the larvæ make brown cocoons and pupate in them, as will be described in detail below. These are formed singly and the beetles emerging from them remain in the petiole with their parents and larval brothers and sisters, mate and produce eggs and larvæ in turn, thus leading to the third or climax stage of the colony, which may eventually consist of several dozen beetles of both sexes and numerous larvæ and pupæ in all stages of development. The coccids also increase in number, so that the cavity of the petiole sometimes becomes so crowded that its inmates must find their movements greatly impeded. In the meantime the old and exhausted beetles gradually die off and their bodies are consigned to the refuse accumu-

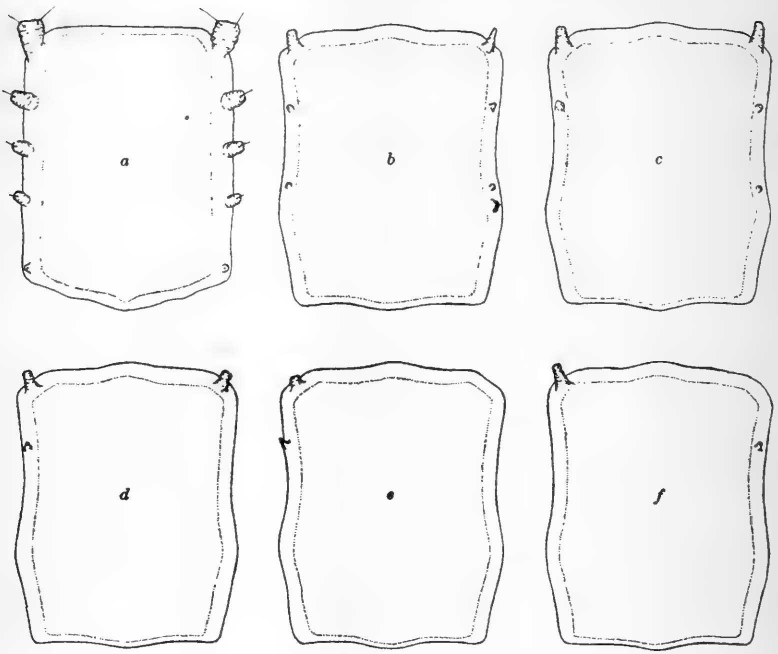


FIG. 8.

a, pronotum of pupa of *Eunausibius wheeleri* showing lateral tubercles; *b*, to *f*, pronota of five pupæ of *Coccidotrophus socialis*, showing vestigial lateral tubercles and their variation.

lations, or kitchen-middens in the pointed ends of the cavity. When this crowded condition is reached, beetles begin to leave the colony either singly or in pairs, seek and enter other petioles of the same or other Tachigalias and thus establish new colonies.

In order to study the stages of colony development just described as well as those that supervene, I found it necessary to split each petiole longitudinally and to place its two halves, with their cavities turned outward in a slender vial or test-tube plugged with cotton. The cotton could be pushed in till it held the two halves firmly against the inner surface of the glass. Through the latter the behavior of the beetles could then be studied with the pocket-lens (magnifying 10-20 diameters) or the binocular dissecting microscope. Splitting the petiole, of course, so greatly disturbs the insects that many of them at once escape into the tube. Moreover, a certain number are killed or injured by the knife-blade. But all the uninjured soon return to the two half-cavities and remain in them. At first I carefully kept the tubes in the dark, but I soon found that they could be left in the diffuse day-light on my table without disturbing the activities of the insects. It was necessary, however, to keep them in a horizontal position, like that of the petiole on the living plant, for when they were placed upright, gravity seriously interfered with the activities of the beetles and especially of the larvæ, causing them to drop and accumulate at the lower ends of the cavities or of the tubes. Of course, this position did not interfere with the coccids which remained attached by their sucking mouthparts to the nutritive parenchyma. Colonies of *Coccidotrophus* can be kept in tubes and under close observation for a week to ten days but by the fifth or sixth day the petioles are apt to become so dry even during the rainy season that the beetles, larvæ and coccids become demoralized. The modifications of behavior thus induced will be considered in the sequel.

There is, perhaps, nothing very remarkable in the fact that both the beetles and their larvæ feed on the nutritive parenchyma of the *Tachigalia,* since other Silvanidæ, e.g., certain species of *Oryzæphilus, Silvanus, Cathartus* and *Nausibius* are known to be vegetarian, but the fact that both the imaginal and larval *Coccidotrophus* actually solicit and imbibe the saccharine excrement ("honey dew") of the coccids, is so unusual and startling that it will be advisable to give a more detailed account of these insects and of their treatment by the beetles.

The adult female *Pseudococcus bromeliæ* (Fig. 9) measures nearly 3 mm. in length and is broadly and regularly elliptical, evenly convex dorsally, flattened ventrally and of a pinkish flesh-color or pale dull red, but the body is so completely covered with snow-white wax as to be scarcely visible in healthy specimens. The wax is secreted in a thin, even, mealy layer over the dorsal surface but around the periphery of the body as a regular fringe of stiff, blunt pencils which are longest on the posterior segments, somewhat shorter on the anterior border of the head and still shorter along the sides. Large specimens of the insect are less numerous in the petioles than the smaller or recently hatched individuals, many of which scarcely exceed .5 mm. in length. These are reddish because they have not yet

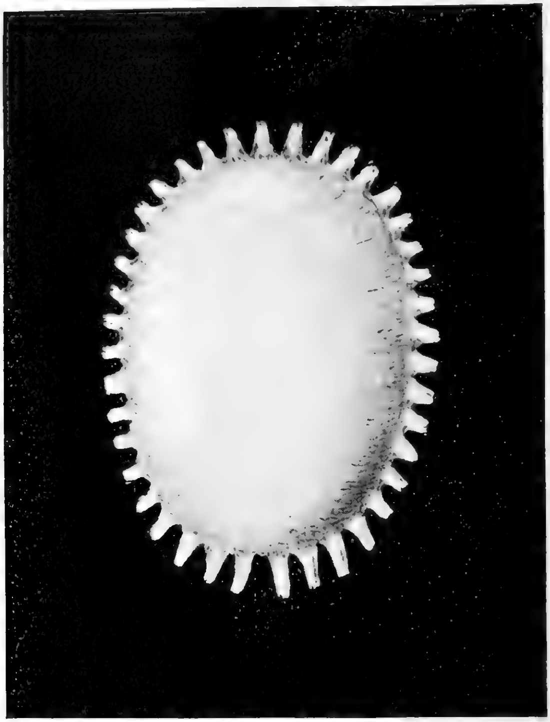


FIG. 9. *PSEUDOCOCCUS BROMELIAE* BOUCHE.
Sketch of an adult living female with intact covering and peripheral pencils of wax.

secreted an appreciable quantity of wax from their dorsal integument, and lack the peripheral fringe of snow-white pencils. I have not seen the males. Young individuals are rather active, not infrequently moving about in the petiole, but the older ones remain stationary in the food grooves till the petiole begins to dry up, when they take to wandering about aimlessly in search of more succulent pastures.

In specimens of the *Pseudococcus* treated with caustic potash and stained according to the method recommended by MacGillivray (1921, Chapter II), the details of the integument are clearly visible (Fig. 10). Only a few of the structures are of interest in connection with the following behavioristic account, such as the anus, which is on the ventral surface of the flattened posterior border of the body, and, on the dorsal surface, two pairs of peculiar organs which have the form of transverse, mouth-like slits with thick lips. One pair of these organs is situated near the posterior corners of the head, the other between the sixth and seventh abdominal segments. Coccidologists have long been familiar with these organs in certain genera of mealy-bugs of the subfamily Eriococcinæ, and have called them "eye-like glands" "cicatrices," "osteoliform or labiate foveæ," or "dorsal ostioles." Šulc called them "adipopugnatorische Organe" and MacGillivray has recently dubbed the two pairs "cephalabiæ" and "caudalabiæ" respectively, terms so barbarous that they make one's flesh creep. I shall call them anterior and posterior ostioles. Berlese regarded them as apodemes, or invaginations of the integument for the insertion of muscles. Comstock, Newstead, Šulc and MacGillivray regard them as glands. In 1882 Comstock stated that he had "observed in *Dactylopius* a pair of openings on the dorsal side of the sixth abdominal segment, which are evidently homologous with the honey tubes of Aphidæ. A female mealy-bug was gently rubbed near the caudal end of the body, when suddenly there appeared two drops of a clear fluid, resembling in appearance the honey-dew of plant-lice. This experiment was repeated many times and with many specimens. Mr. Pergande assures me that he has observed a similar excretion from a pair of openings on the cephalic margin of the first thoracic segment." Comstock was, of course, under the erroneous impression that the honey-dew of aphids is a secretion of the cornicles instead of being the excrement of the insects and therefore extruded from the anus. According to MacGillivray: "There can frequently be observed on living specimens a small globule of a clear fluid over the mouth of each labia, more frequently the caudalabiæ than the cephalabiæ, so that they are probably also glandular in structure as suggested by Comstock. For, as he suggested, when the specimens are stroked with a pencil or dissecting needle, the insect will hump up its back and extrude a globule of liquid. The insect is unable to repeat this operation until the pocket is again filled with the clear fluid. Specimens have been observed to extrude globules from all four labiæ at the same time. The labiæ undoubtedly have a glandular function which is probably of later origin than their earlier function, a parademe for the attachment of muscles."

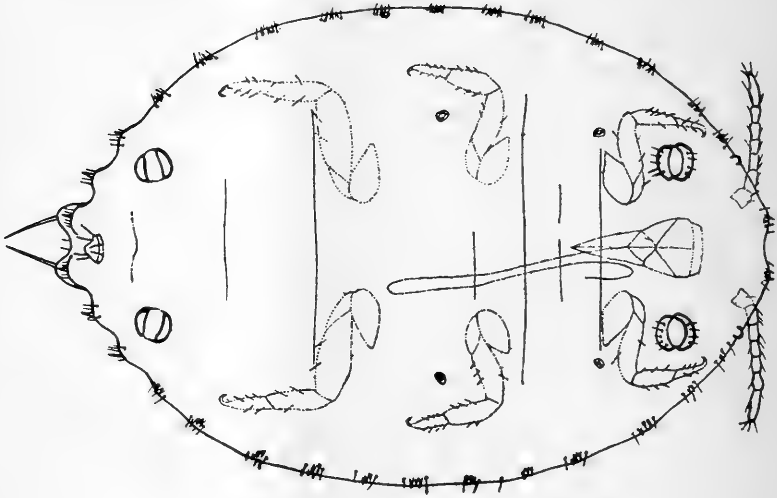


FIG. 10. *PSEUDOCOCCUS BROMELIAE* BOUCHE.
Adult female treated with caustic potash to show the openings of the anterior and posterior ostioles, anal orifice, etc. The specimen is mounted dorsal surface uppermost.

Šulc (1909) made a histological and physiological study of the anterior and posterior ostioles in *Pseudococcus farinosus* De Geer. When the female of this insect was stroked with a brush, each of the ostioles suddenly emitted a droplet of orange-yellow liquid, which partly adhered to the brush and partly rolled off from the wax-powdered dorsal surface. The liquid was found to consist of cells and a few blood-corpuscles. Šulc concludes that the organs are repugnatorial, and that their secretion is employed like that of the cornicles of aphids for gluing up the appendages of insect enemies. His account of the function of the secretion is by no means convincing, since it might also be regarded as an exudate, derived directly from the fat-body, like the exudates produced by various termitophiles and myrmecophiles (*Cf.* Wheeler 1918), and hence employed for allurement instead of repulsion.

Returning to a consideration of the *Coccidotrophus* in the *Tachigalia* petioles, we find that the beetle often remains motionless for hours at a time, in a food-groove, which just fits its long slender body. If at other times, when it is moving about, it chances upon a coccid, it stops suddenly and seems at once to become more alert or excited, for as soon as its clubbed antennæ touch the dorsal surface of the insect, their beat, hitherto leisurely and exploratory, becomes greatly accelerated. With each beat, each antenna rapidly describes a minute transverse ellipse on the surface of the coccid, and the beats of the two appendages seem not to be quite synchronous. At the same time the beetle, with a much slower rhythm, rocks its body forward and backward by bending its legs, while the mobile articulations between the head and prothorax and between the prothorax and mesothorax enable it to cover more of the coccid's dorsum and to keep the antennal clubs in contact with its rounded surface. While engaged in this perfomance the beetle resembles an expert pianist moving his hands from side to side over the key-board, or a masseur with his hands in soft gloves, massaging a patient. The beetle undoubtedly distinguishes a large coccid's posterior from its anterior end, since it lavishes most attention on the former. It seems, however, to be quite as interested in the medium-sized or smallest coccids and will spend just as much time in stroking them. The time devoted to the performance in any particular case seems to vary directly with the beetle's appetite or thirst. A beetle may thus spend ten, twenty or even forty or more minutes massaging a single coccid, with occasional short pauses. After a coccid in the proper condition has been stroked in this manner for a few moments it may slowly turn up its wax-penciled posterior segments and discharge from the anal orifice a perfectly limpid droplet of sweet excrement, which the beetle at once greedily swallows. The coccid then flattens down its posterior segments and the beetle resumes its massage. The coccid may thus contribute a droplet every few minutes or it may remain inert and unresponsive. An ant confronted with such a situation would take the hint and at once look up another coccid, but the beetle stubbornly keeps on and may work for an hour or more without receiving another drink. Usually, however, some of the larvæ or one of the other beetles of the colony intervene and the scene may change, as described in a later paragraph.

That the antennæ of the beetle are beautifully adapted for stroking the coccids is apparent at a glance (Plate III, fig. 2,

Plate VI, fig. 1). Their compact structure and clubbed extremities recall the antennæ of many myrmecophilous beetles or of certain ants, for many of these insects, of course, use their antennæ in soliciting liquid food from one another. The basal joint of the *Coccidotrophus* antenna is even elongated to form a crude scape, although the remaining joints do not form an angle with it as in ants. The relations of the beetle to the coccids, moreover, are physiologically similar to those of symphilic beetles to the host ants that feed them with regurgitated liquids, and the *Coccidotrophus* like the symphiles has a short, broad tongue and short labial palpi. Wasmann (1896) and Escherich (1902) have dealt with these antennal and labial adaptations in detail, pointing out that the tongue in symphilic beetles becomes short, broad and spoon-like and that the palpi, especially those of the labium, become shorter and have a reduced number of joints. Precisely this condition is seen in the labium of *Coccidotrophus* as shown in the figure of Schwarz and Barber (Pl. VI, fig. 1). The greater development of the maxillary palpi indicates that they may occasionally function like the antennæ in soliciting honey-dew.

Coccidotrophus larvæ of all stages, from those just hatched and less than a millimeter in length, to those almost four millimeters long and nearly ready to pupate, likewise solicit and obtain food from the coccids by stroking them with the antennæ. The small beetle larvæ show no preference for small coccids since just hatched larvæ are often seen on the backs of adult female coccids, feverishly stroking their waxen surfaces and full grown larvæ may often devote themselves to coccids smaller than their heads. The movements of the larva's antennæ, though similar to the antennal strokes of the beetles, cover a smaller portion of the coccid but the larvæ reinforce the titillation by a simultaneous use of the maxillæ and maxillary palpi. The larva is almost or quite as persistent as the beetle and drinks up the periodic globules of honey-dew with quite as much gusto. Both beetles and larvæ, however, stroke the dorsal surfaces of the coccids so gently that their waxen bloom is neither removed nor diminished even after the most prolonged solicitations.

In connection with the behavior of the larva, Dr. Böving's figures of its mouthparts and antennæ are very interesting and

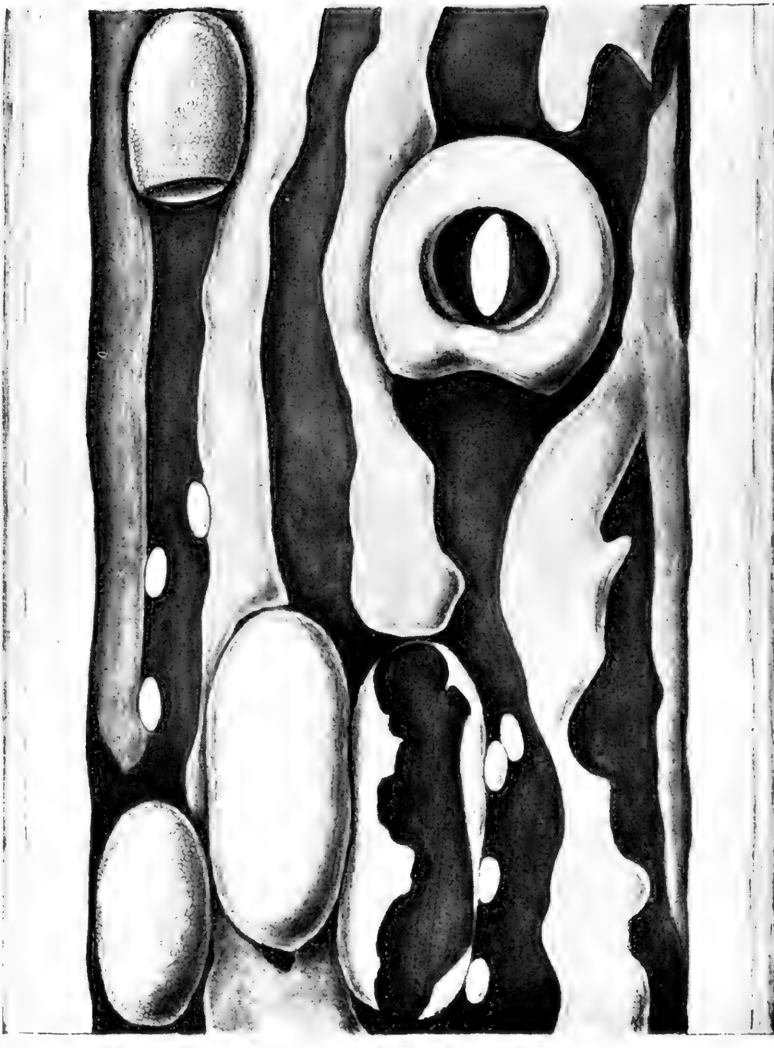


FIG. 11. ENLARGED DRAWING OF A PART OF THE WALL OF A *TACHIGALIA* PETIOLE INHABITED BY *COCCIDOTROPHUS SOCIALIS.*

Showing the food grooves and frass ridges, the entrance with its wall, the eggs, an intact and broken cocoon of the *Coccidotrophus* and two cocoons of *Blepyrus tachigaliae*, one of them after the eclosion of the parasite.

suggestive. It will be noticed that his Figs. 1, 2, 5, 8, 16, Plates VII and VIII etc. show that the tongue is large and flat like a spatula or ladle and well-adapted for receiving the globules of coccid excrement. The labial palpi are very small and 2-jointed, but the maxilla is large, with extensive stipital articulation and a large lacinia tipped with a claw-like tooth and fringed with stiff hairs along the medial border. The maxillary palpi are long and 3-jointed and the large articular membranes of the separate joints suggest great mobility. The antennæ are unusually interesting (Plate VII, figs. 1, 2, 5, 7). Though they consist of only three joints, the second is greatly elongated and distinctly drum-stick-shaped, the apical joint being much reduced to form merely a sensory cap for the second joint. Now this drum-stick-type of antenna is precisely the one found in a long series of symphilic ant-guests of the Coleopterous family Clavigeridæ (*Fustiger, Rhynchoclaviger, Adranes,* etc.), which use their antennæ for soliciting liquid food from their hosts. Dr. Böving's figures of other larval Silvanids and of genera belonging to closely allied genera of the Cucujid complex, namely *Cathartus* (Plate VIII, fig. 12), *Nausibius* (Plate VIII, fig. 18), *Dryocera* (Plate IX, fig. 33), *Telephanus* (Plate X, figs. 34, 37) and *Scalidia* (Plate X, fig. 39), show very different conditions. Thus we may say that the antennæ and maxillæ of the *Coccidotrophus* larva are specially adapted to their active rôle of soliciting and the labium to its passive, spoon-like rôle of receiving the liquid excreta of the *Pseudococcus.*

The question naturally arises as to the function of the anterior and posterior ostioles, which, as I have shown, are highly developed in *Ps. bromeliæ,* and the probability of their secreting substances that may be ingested by the beetles. Unfortunately I did not know of the existence of the ostioles while I was at Kartabo. My attention was called to them by Prof. Mac Gillivray several months after my return. I feel very confident, nevertheless, that these organs in *Ps. bromeliæ* cannot have the function ascribed to them by Šulc in *Ps. farinosus.* I have so carefully watched the coccids of all ages that I could not have overlooked the emission of orange-yellow droplets from the ostioles or of any sticky liquid that would glue up the appendages of small insects. The smallest beetle larvæ are so delicate that they are at once immobilized or impeded in their movements when they happen to run or fall into a minute drop of water, and if the *Ps. bromeliæ* were at all hostile to the beetles or their larvæ in the manner described by Šulc, their presence would not only be a nuisance but a serious menace to the colonies. The further fact that the coccids in a petiole are frequently decimated or even exterminated by several small predatory insects (*vide infra* p. 78) is also unfavorable to Šulc's contention.

I am, of course, willing to admit that the ostioles may be glands or exudate organs which secrete substances that may be ingested by the beetles and their larvæ, but the closest observation of which I was capable showed that the only liquid visibly imbibed by the *Coccidotrophus* was the saccharine excrement, or honey-dew. If the secretion of the ostioles is a liquid, it must be emitted in droplets too minute to be visible under a Zeiss lens magnifying 20 diameters, or it must be a volatile substance like that secreted by the peculiar tubular organs which occur on the eighth abdominal segment of many ant-attended Lycaenid caterpillars and have been described by de Niceville (1890), Thomann (1901) and others.[1] That the ostioles of *Ps. bromeliæ* may actually emit some substance attractive to the beetles and their larvæ is indicated by their often very prolonged stroking of the dorsal, lateral or anterior portion of a coccid. That they prefer to stroke its terminal abdominal segments may be due to the fact that that region bears both the anus and the posterior pair of ostioles.

The attraction of the mealy-bugs, whether due solely to their ability to excrete honey-dew or because they can also secrete some delicious exudate or fascinating aroma, is so great, that in populous colonies a single coccid may often become the center of a circle of actively competing beetles and larvæ of various sizes. This is not so apparent in colonies that have just been collected and placed in glass tubes, because the petiole still contains a certain amount of sap and the coccids are able to excrete normally, but after the colonies have been kept for several days or a

[1] Conf. also the paper of Newcomer (1912), who figures a section of one of these organs in *Lycaena piasus* (Pl. 2, Fig. 3). Although he believes that the tubular organs are not glandular, the structural details certainly seem to support Thomann's contention.

week and the supply of water in the plant tissues has considerably diminished, the excretions of the coccids are less frequent and copious, so that the beetles and larvæ become more and more thirsty and therefore more desperate and exacting. Thus by the very simple device of keeping the colonies for some time in tubes, it is possible greatly to exaggerate the attentions of the beetles and their larvæ to the coccids and to witness certain peculiarities of behavior which are less obvious in recently collected colonies.

When a number of thirsty beetles and larvæ surround a large coccid, all stroking different parts of its dorsal surface and periphery, only the individual that happens to be stationed at its posterior end is able to secure any honey-dew. The beetles and larvæ all keep at work, however, till the antennæ of two of them happen to meet. Then the larger individual stops stroking for a moment and butts its competitor with the side of its head. If the group is formed by a single beetle and several larvæ, the beetle being the stronger, soon pushes any larva with which it may come in contact away, but the latter usually at once returns and resumes its stroking till contact with the beetle again occurs and the butting is repeated. When several larvæ of different sizes have preëmpted a coccid, the largest treats the others in the same manner. This behavior is so suggestive of that of a number of pigs eating out of the same trough that one can hardly doubt that something more than a mere reflex is involved in the butting. The larger beetle's or larva's indefatigable perseverance in butting is only equalled by the pertinacity with which the butted individual keeps returning and resuming its stroking movements. I can illustrate this best by transcribing a few observations from my note-book.

August 10, a beetle was seen standing over the posterior end of a large coccid and stroking it busily. At short intervals the coccid raised its anal segments and discharged a minute limpid globule of honey-dew, which was at once avidly seized and swallowed by the beetle. During 11 minutes the coccid raised its tail 25 times and the globule could be distinctly seen on most occasions, as the beetle paused suddenly in its manipulations and moved its labium and palpi each time a globule was imbibed. Sometimes the beetle would pause for a moment, before proceeding with its titillation and remain with its head flattened down, even when the coccid failed to move its anal segments. Once a large larva came up and endeavored to get some of the excretion but was promptly butted away, and once another beetle was treated in the same manner. After the 25 feedings the beetle moved away and another beetle came up and received from the same coccid four globules in less than two minutes.

August 12, I observed a beetle (No. 1), which was red and therefore immature, soliciting from a nearly full-grown coccid in a petiole collected a few days previously and already beginning to become dry. The beetle stroked the coccid for 15 minutes, during which time the latter produced only five droplets of honey-dew at intervals of two to five minutes. Then a mature, dark colored beetle (No. 2) came up and began to stroke the anterior end of the coccid, gradually moving back over it. Whenever the beetles met they butted each other with their heads or even locked mandibles for an instant and then returned to their former position and occupation. Beetle No. 1 worked for another 15 minutes without a reward. The coccid then rotated 180 deg. on its dorsoventral axis so that its anal end was now presented to beetle No. 2, and inserted its beak into another part of the nutritive parenchyma. The beetle at once became more alert and accelerated the beat of its antennæ. During the succeeding eight minutes it received seven globules of honey-dew in quick succession, probably as a result of the coccid's change of pasture. Throughout this period beetle No. 1 kept titillating the coccid's side, pausing now and then for a few seconds, and after 40 minutes from the time I began the observation, moved away. Beetle No. 2 continued to stroke the coccid for some time, but I did not follow its behavior further.

In another colony at 8 P. M. on the same day I noticed a nearly mature beetle (No 3) vigorously stroking the hind end of a small coccid, while its sides were being stroked simultaneously by two just-hatched larvæ (A and B). From time to time other beetles and older larvæ came up and joined the party. Beetle No. 3 continually butted the newcomers away and they at last rather reluctantly departed, leaving the original trio in possession of the coccid. Every few seconds the beetle gave one of the larvæ a shove with its head, but the tiny creature instantly returned and went on with its stroking. At 8.14 the beetle gave A such a vigorous knock that it stayed away from the coccid for some time. B, however, kept returning so pertinaceously that the beetle twice seized it in its mandibles for an instant and then dropped it. The larva was uninjured, however, and at once returned and went to work. Then the periodic butting continued till 8.35 when larva A returned and went to work with B on the side of the coccid. One or the other was butted away by the beetle every few seconds till 9 P. M. During the entire hour the coccid remained stationary and unresponsive, never once raising its caudal segments nor emitting a droplet. All this time the beetle had remained in the same spot and had butted every beetle or larva with which its antennæ had come in contact. The beetles soon left after receiving a few knocks but the little larvæ A and B, which seemed to be famished, persisted for a whole hour side by side, except for the 20 minutes during which A was absent. Larva B must have been struck by the beetle more than a hundred times. Finally the latter's patience seemed to be exhausted; it seized first A and then B in its mandibles, carried the latter three millimeters away from the coccid and hurled it to one side. Larva A returned, but B had fallen out of the petiolar cavity onto the moist wall of the glass tube, adhered and was unable to leave the surface. The beetle now left the coccid and another very mature beetle (No. 4) took its place. It permitted larva A to stroke the posterior end of the coccid without molestation, but beetle No. 3 soon bustled up from the opposite direction, locked mandibles with beetle No. 4 and pushed it away. During the scrimmage the coccid suddenly raised its caudal end and discharged a droplet which was eagerly inbibed by the larva, at length rewarded for its incredible pertinacity and the innumerable knocks it had received. Then beetle 3 and larva A, now in undisturbed possession of the coccid but in the reversed position, the former being at the anterior, the latter at the caudal end of the coccid, continued their stroking, interrupted every few seconds by the butting of the beetle and the temporary withdrawal of the larva. This went on till 9.20. By that time my eyes which had been following the performance under the lens for an hour and twenty minutes were so fatigued that I had to desist from further observation, just after the beetle had tossed the larva to a distance of about four millimeters from the coccid by an unusually well-aimed blow.

Scenes of this description were so frequently enacted that they could be readily observed in almost any of the colonies after they had been kept for several days and the beetles, larvæ and coccids had all grown very thirsty. In such colonies the bodies of the coccids and larvæ become visibly attenuated and somewhat shrivelled as a result of the loss of water from the tissues of the *Tachigalia* petioles. All the insects now become restless. The beetles leave the petioles, wander about on the walls of the tubes and finally collect about the plugs of cotton in an endeavor to escape to the outside. The coccids, too, withdraw their beaks from the parenchyma in the floors of the food-grooves and wander aimlessly about, vainly seeking more favorable pastures. But before this stage of demoralization is reached, both the beetles and the larvæ become cannibalistic and one may often see them, singly or in groups voraciously devouring partly dismembered larvæ or immature beetles. Within a few days all the larvæ and immature beetles are consumed, but the coccids, immune from attack, still wander about till they die of starvation.

I believe that *Coccidotrophus* is rarely or never cannibalistic under normal conditions. It is, as already stated, almost impossible to split a freshly gathered *Tachigalia* petiole containing one of the beetle colonies, without cutting some of the insects in two, and such disabled individuals are soon devoured by their fellows, but both in such cases and in the cannibalism that supervenes in dried petioles, I believe that thirst or the need of water and not a veritable carnivorous instinct, such as seems to be manifested by some species of Cucujid beetles and their larvæ, must be regarded as the true explanation. I am confirmed in this view by Heins' recent investigations (1920) on meal-worms *(Tenebrio molitor)*. He found that when the larvæ of this beetle are reared in dry meal as many as 24.2% of them may be devoured by their fellows, but that if wet slices of rusk or of vegetables are placed in the breeding jars the mortality from cannibalism is reduced to 7.5%. In this connection Bodine's observations (1921) on grasshoppers are also of interest. He finds that during starvation, the loss of water in these insects is always greater than that in body weight or in the solids. "This shows that starvation in the grasshopper results in a rapid loss in water which has a decidedly quick and fatal effect."

I have been unable to ascertain the length of the larval period or the number of larval moults of *Coccidotrophus*. As no exuviæ were found in the petioles it would seem that they must be devoured either by the beetles or by the larvæ themselves. The food of the larvæ, as we have seen, consists of the amber-colored nutritive parenchyma and of the sweet excreta of the coccids, the former evidently supplying the proteids, the latter the sugar and most of the water. So concentrated a diet should be very favorable for growth and probably the whole larval period at tropical temperatures occupies only two or three weeks. The fat-body, however, does not seem to become very voluminous till the last larval instar when the segments of the body become more convex and puffed out with the accumulations of adipocytes. Yet this condition, which immediately precedes pupation, does not tend greatly to inhibit the activities of the larva.

When a petiole containing a colony in what I have called the third stage is opened, one or more cocoons are invariably found in the cavity (Plate V). They are oblong-elliptical structures, 5-6 mm. long and 2-3 mm. broad and seem to consist of the same chocolate brown substance as the frass-ridges. Their walls are of uneven thickness, with smooth inner and roughened outer surfaces, and are easily fractured. These cocoons do not lie loosely in the cavity but are attached to some flattened surface of the wall where the lumen of the petiole is rather broad, i.e., away from the pointed ends, and always have their long axes parallel with the long axis of the cavity. They are sometimes single but more frequently occur in pairs or in groups of three or four. When in pairs, the two cocoons lie abreast of each other, when in threes or fours, the third and fourth cocoon are often built on top of a basal pair. Such groups of cocoons are so voluminous that they obstruct the lumen of the petiole and leave only a narrow passage for the beetles to move between the more roomy spaces at either end of them.

One naturally infers that either the larvæ must make the cocoons of frass or the beetles must envelop the pupæ with this material, but observation shows that both inferences are incorrect. The larva does, indeed, build the cocoon, but utilizes neither the frass nor the materials of old, abandoned cocoons in its construction. I have not seen the earliest stages in the process but it is evident that the larva selects a flat surface and begins to build a wall around an elliptical area, which thus becomes the floor of the cocoon. Little material is added to the wall at the end of the ellipse compared with the sides, where the material is built up as a pair of folds like those shown in Fig. 16*a*. I have seen several cocoons that had been abandoned in this or a somewhat more advanced stage, but on two occasions I was able to observe the completion of the structure from a stage like the one figured. Since in both cases the insects behaved in essentially the same manner I shall describe only one of them.

The larva was first seen working inside the cocoon in the stage of Fig. 6*a*, but it soon came out, wandered away to a distance of a few millimeters and, after careful search, bit off a minute particle of the living tissue of the petiolar wall, avoiding any frass-covered surface, returned, entered the cocoon at one end (left hand side of Fig. 6*a*), carefully masticated the particle with its maxillæ, while mixing it with saliva, applied it to the border of one of the folds, pressed it into place, crept out of the other end of the cocoon and went in search of another particle. Then it returned, entered the cocoon as before and repeated the building process. Excursions were made every few minutes and within a radius of 8 to 10 millimeters from the cocoon. The particles, which were selected with the greatest care and often after what seemed like some hesitation, were very minute and greenish when first bitten off but had become brown (by a process of oxydation?) by the time they had been incorporated in the walls of the cocoon. The particles were applied now to one fold of the wall, now to the other so that the edges became rather irregular (Fig. 6*b*), but as most of the particles were added to the middle of the folds, they began to approach each other. Still, their growth was very slow, owing to the minute size of the particles and the time consumed in their selection. The larva labored incessantly, making trip after trip and choosing every particle with the same diligence and avoiding the remains of empty cocoons in the immediate vicinity, although their materials, one would suppose, might have been easily appropriated and quickly built into the cocoon under construction. The two folds or side-walls slowly approached as the work progressed and eventually fused with each other, the larva always entering at the same end, applying the particle to one of the edges from the inside and leaving by the opening at the opposite end. Then it set itself to building the walls around this latter opening, which grew smaller and smaller (Fig. 6*c*), till the larva could no longer squeeze through it and was compelled when about to leave the cocoon to turn back on itself, bending its body in a loop with the two limbs in contact, and crawl out of the opening by which it had entered. This feat seemed to be accomplished with considerable effort but had to be performed after each particle had been built into the wall of the cocoon. Eventually the small opening was closed and the cocoon had only a single large elliptical orifice at one end (Fig. 6*d*). The larva now began to contract this orifice, but after a time, as it grew smaller, the insect on returning, no longer entered the cocoon and reversed its body in order to apply the particles to the edge of the orifice, but merely thrust its head and a few of its anterior segments into the cocoon and left the remainder of its body outside. At such times it used as a support or fulcrum a structure which I had not seen used at any previous stage of larval life, namely, the proleg which terminates the conical tenth abdominal segment. This structure is described by Dr. Böving (Zoologica III, No. 7) and clearly shown in his figures (Pl. VII, figs 1 and 2). When the size of the orifice had been reduced till the larva could only just squeeze through it, the insect entered the cocoon, reversed its position and continued building along the edges of the orifice with particles scraped from the inner surface of the structure. The orifice thus soon grew too small to permit the egress of the builder. (Fig. 6*e*). Then the imprisoned creature slowly closed the opening and the cocoon was completed (Fig. 6*f*).

A few days after the larva has thus immured itself, it sheds its cuticle and becomes a pupa which lies loosely in the cavity of the cocoon and has the appearance of Dr. Böving's Plate IX, figs.

19-21. Owing to the minuteness of the particles used in building the cocoon, the care with which they are chosen and the many trips necessary to secure them, the time consumed in completing the structure is considerable. The earliest stage figured (Fig. 6*a*) was first seen at 8 P. M., July 25. By 6 A. M. the following morning the cocoon was in the stage shown in *b*. By 12.30 P. M. the small opening had been closed and the large opening was being contracted (*c*). At 6:30 P. M. a small opening remained (*e*), and the cocoon was completed an hour later (*f*). As the first stage must have been the work of the greater part of a day, the structure was probably begun not later than 7 A. M. on July 25th. At least 36 hours of continuous labor, requiring hundreds of trips back and forth between the cocoon and exposed patches of living parenchyma on the petiolar wall, were therefore consumed in completing the cocoon. The second larva observed in the act of building its cocoon was even slower, since the latter was first seen on the evening of July 26 in a stage corresponding to Fig. 6*a* and was not entirely completed till after 10 A. M., July 29th. There was nothing to indicate that the first larva rested during the whole period of cocoon construction. While it was working in the manner described, it was occasionally annoyed by some young or half-grown larva entering the cocoon and using it as a hiding place while its architect was away gathering building materials. It was interesting to see the latter on its return oust the intruder, which scampered away with comical alacrity. When the cocoon is completed it is rather smooth externally but may later become rough through the beetles' plastering their frass over its surface. This certainly strengthens the walls of the structure.

I endeavored to keep the two pupæ enclosed in the cocoons which I had seen built, in order to determine the length of the pupal period, but both died when the petioles dried out. The pupal period as inferred from other cases covers, at least, seven days. The callow emerging beetle under normal conditions gnaws a round or elliptical opening at one end of the cocoon and joins the other members of the colony. At first it is yellowish white and etiolated, with the legs, dorsal surface of head and prothorax and a transverse band on each segment of the venter pale red. It runs about very actively, nevertheless, and in the course of several days gradually takes on the deep chestnut brown color of the mature insect. But before this stage is reached, and while the male and female are still of a bright red or pale chestnut red color, they mate. On two of the three occasions on which I witnessed copulation both the male and the female were immature. The third couple, observed August 10, consisted of an immature female and a mature male. It would seem, therefore, that mating occurs not only among immature beetles of the same generation soon after they leave the cocoons, but that old males of a preceding generation at least occasionally fecundate the recently emerged females.

The observation of August 10 is here transcribed from my note-book. The female was distinctly immature but uniformly red, i.e. no longer in the white, callow stage, and distinctly smaller and more slender than the male. The latter was certainly very nearly or quite mature. When first noticed the female was eating the parenchyma of the petiolar wall. The male mounted her back and remained for 18 minutes, clasping her sides with his legs and occasionally attempting to insert his aedoeagus. Now and then he rubbed her occiput from side to side with his mandibles and antennæ and sometimes shifted his position very much to one side. The antennal movements were precisely like those employed in titillating the coccids. The female kept on feeding and pressed the tip of her abdomen against the wall of the petiole so that the male was unable to introduce his aedoeagus. He then dismounted and ran away but soon returned and attempted to mount and grasp the female again, but she was unwilling, slipt out from under him and escaped. He permitted her to go only a very short distance, however, before he again seized her just as she had stumbled on a coccid and had begun to stroke its posterior segments. While the male was strenuously endeavoring to copulate she continued to stroke the coccid and on this occasion kept the tip of her abdomen tightly pressed upward against the tips of her elytra. Then the male again dismounted and left her and she and another immature beetle turned their attention to a partly eaten larva which they proceeded to devour. In a moment the male, apparently in a high state of excitement, returned, mounted the female and this time succeeded in introducing his ædoeagus by forcing the tip of the female's abdomen downward and away from the tips of her elytra. During coitus, which lasted a little more than six minutes, the female continued to partake of the larva, but the male remained motionless.

B. The Enemies of the Beetles and Coccids and the Decay of the Colonies.

Attention has been called to the decay of the *Coccidotrophus* colonies when the flow of sap to the petioles is artificially cut off by severing the latter from the plant and both coccids and beetles are deprived of their nourishment. But even under the natural conditions of the jungle the colonies are doomed to decay, though from very different causes. As has been shown, *Coccidotrophus* lives only in the petioles of young Tachigalias growing in the shade and in these plants inhabits the petioles only till they are taken over by the obligate ants of the genera *Pseudomyrma* and *Azteca*. The beetles are not permitted, so to speak, to occupy their apartments after the rightful owners of the plant have become sufficiently numerous and aggressive to eject them. Sometimes this may occur even in rather young plants four to six feet in height. Still the period during which the beetles may be allowed to inhabit the young Tachigalias must cover several months. I infer this from the fact that during the more than two months of my stay at Kartabo I saw little change in the plants, which grew very slowly notwithstanding the almost daily, drenching rains, and their growth is probably almost *nil* during the dry season. Since the leaves are persistent, at least during the rainy months, there is ample time for the development of the beetle colonies, even if the growth of the larval broods and the coccids requires more than the three weeks above suggested. Throughout the latter part of July, August and the first half of September colonies were found in all stages, from those represented by a single pair of beetles to those comprising numerous beetles, larvæ, pupæ and herds of coccids. It would seem, therefore, that although the individual colony may live for only a few months, new colonies must be formed continually, at least during the rainy season, by emigration of pairs of young beetles from old colonies to other plants which have attained a sufficient size, i.e. have produced at least three or four fully developed leaves.

Still neither the beetles nor the coccids are permitted to live in perfect security till the obligate ants take possession of their quarters. Where competition among insects is so very keen as it is in the Neotropical jungle it is not surprising to find that several predators and parasites are continually gaining access to the petioles and decimating or even completely destroying their occupants. The greatest enemy of the beetles is the small thief-ant *Solenopsis altinodis* Forel (See p. 48 and Zoologica III, No. 4, p. 154), and the coccids have at least three formidable enemies. All of these insects enter the petiole through the openings made by the beetles and must therefore elude their watchfulness. We should expect the beetles to keep one of their number constantly on guard at the entrance, but they are neither sufficiently constant in this behavior nor sufficiently discriminating to keep out all intruders. When the petioles are taken into the laboratory the beetles are often seen to remain for hours with their heads in the entrances and their bodies at right angles to the longitudinal axis of the cavity, and even after the petioles have been split longitudinally and placed in vials the insects still exhibit this behavior, though it is now absurdly futile, since their domicile is wide open. But not infrequently even the single opening of a petiole may remain unguarded for long periods, and when the petiole has several openings some of them are apt to have no sentinels, so that predators and parasites small enough to pass the narrow orifices, have no great difficulty in gaining access to the colony. Moreover, a beetle that is guarding an opening may fight off certain intruders but back away and allow others to enter. On several occasions I held a beetle with its head to a guarded entrance. The sentinel at once grasped the stranger's head with its mandibles and pushed it away. But when I placed a worker *Solenopsis altinodis* in the same position, the beetle beat a hasty retreat and the ant climbed into the petiole. From these experiments we may infer that the beetles are more intent on keeping alien beetles of their own species than dangerous pests like the *Solenopsis* out of their nests. More probably some peculiar odor of the ant induces the beetle to withdraw. Thus while it seems to be probable that alien beetles are often kept out of the colony, the fact that the beetles of two or more colonies occupying different petioles, will, when the latter are split open and placed in the same tube, mingle without the slightest signs of hostility, would seem to show that even strange beetles may occasionally enter an unguarded colony and become members of it in good standing. It has since occurred to me that female beetles, at least, might be permitted to pass the sentinels unchallenged. Unfortunately I failed to dissect and determine the sex of the beetles with which I experimented.

The laxity of the beetles in guarding the entrances is, indeed, amply proved by the presence in their nests of several species of insects, some of which are harmless or indifferent while others are injurious either to the beetles and their larvæ or to the coccids. From analogy to the guests of ants, those of the former category may be called "synoeketes," or indifferently tolerated guests, the latter "synechthrans" (predators) and parasites. To the synoeketes belong a Collembolan, a mite and a small Phorid fly. The Collembolan is most frequently seen, especially in large petioles containing small colonies of beetles and therefore allowing ample space for its movements. It is a minute silver gray species, which Prof. Folsom has described and figured as *Entomobrya wheeleri* (Zoologica III, No. 11), and occurs in droves of individuals of all stages, running hither and thither over the walls of the petiole, like certain species of the same genus (*E. myrmecophila* Reut. and *dissimilis* Mon.) and *Cyphodeirus* (*C. albinos* Nicol), which are often abundant in the nests of ants. Like the ants the *Coccidotrophus* pay no attention to these diminutive insects and are probably not even aware of their existence. The mites (*Hypoaspis* sp.) and Phorid flies (*Aphiochæta scalaris*) were more rarely seen. They probably breed in the accumulations of refuse at the ends of the petiolar cavity and may therefore be regarded as scavengers, like the mites and Phorids which occur in many ant-nests.

Careful examination of the alimentary tract of the *Coccidotrophus* would probably show that the beetle harbors a number of entoparasites, at least certain bacteria, but I could not find the time to make such an examination when fresh material was available and my alcoholic specimens are worthless for the purpose.

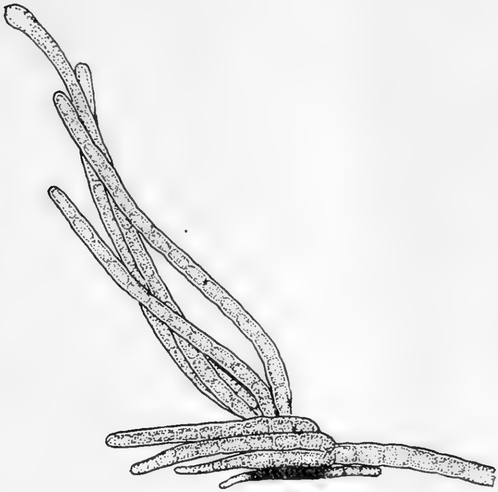


FIG. 12. HYPHOMYCETOUS PARASITE ON *COCCIDOTROPHUS SOCIALIS.*
From a drawing by Prof. Roland Thaxter.

It seemed probable, nevertheless, that the beetle, living as it does in dark, moist cavities, might be infested with ectoparasitic fungi, especially of the group Laboulbeniales. I therefore requested Prof. R. Thaxter, the leading specialist in this group, to examine a large number of the beetles. After carefully scrutinizing their external surfaces he reports that he found no Laboulbeniales, but only a sterile Hyphomycete, growing on the elytron of one of the specimens. Referring to his work on the similar fungi of other insects he writes me as follows: "The fungus on the *Coccidotrophus* probably belongs to the group spoken of at the bottom of p. 237 in my first paper (1914), the most striking form of which (*Aposporella elegans* Thaxter), found on the wings of a small fly from the Kamerun, is figured on Plate III, Fig. 30 of the second paper (1920). These fungi seem to produce no spores and to reproduce by a kind of fragmentation; pieces breaking off with little or no differentiation, and starting to grow where they adhere. I have seen a considerable number of them on a variety of tropical insects, and ran across one of them a few days ago growing on a *Laboulbenia* from Kamerun. It has seemed hardly desirable to give names to such nondescript forms till it is quite certain that they have no differentiated type of reproduction." Prof. Thaxter kindly enclosed a drawing of the *Coccidotrophus* Hyphomycete which is here reproduced as Fig. 12.

The various organisms just described can, of course, have little or no effect on the health of the beetle colonies. Their decay and eventual extinction is due to ants destroying the beetles and their larvæ or to predators or parasites destroying the coccids on which they depend for an important part of their diet. Colonies in all stages may be invaded by the tiny *Solenopsis altinodis,* which I believe to be the most persistent and deadly enemy of the beetles. I have opened petioles containing both beetles and *Solenopsis* workers, but no beetle larvæ or only fragments of them, showing that the ants begin their depredations by slaughtering the offspring of the beetles. In such petioles the coccids remain uninjured, and the same is true of the pupæ immured in their cocoons. Many other petioles reveal conditions from which the last stages in the history of the colony may be inferred. In such petioles only dead beetles and a number of dead *Solenopsis* are found, indicating that the ants, after destroying all the larvæ, attack the beetles and that they, in the ensuing bitter conflict, often defend themselves with their powerful jaws to such good purpose that they succeed in killing many of the ants. But as more *Solenopsis* are probably continually entering the petioles as auxiliaries the beetles finally succumb and the colony is exterminated, with the exception of such pupæ as may be present in their protective cocoons. The beetles emerging from these may, conceivably, after the *Solenopsis* invasion is over, start a new colony in the same petiole or emigrate to other petioles. If no pupæ are present the petiole is sooner or later entered by a pair of young migrant beetles, which pack the dead bodies of the previous occupants, together with the ants they have slain, into the ends of the cavity and establish a new colony. In some of the colonies in the last stages of devastation above described, I failed to find any coccids. They may have been either eaten or carried away by the *Solenopsis.* Sometimes they remain undisturbed, however, and may, perhaps, be taken over by the beetles emerging from the cocoons or by any pair of young beetles entering the petiole and establishing a new colony.

We can picture to ourselves the fierce battles which rage in the petioles between the beetles and the *Solenopsis* workers, probably mostly at night, for the *Solenopsis* is a nocturnal species, and the precarious life of the beetles in parts of the jungle where the ant is abundant. The beetles must live, in fact, like the ancient Greeks, always in danger of invasion from the warlike hords of barbarians. Yet even in quiet recesses of the jungle, where the *Solenopsis* may happen to be rare or absent, the attachment of the *Coccidotrophus* colonies to the *Tachigalia* is sure to be severed as the plant grows and the workers of the colonies started in one or more of the petioles by deälated queens of *Azteca* or *Pseudomyrma* have become sufficiently numerous to take possession of every petiolar cavity and patrol the whole surface of the plant. Perhaps some of the inquiline ants may occasionally kill or oust the beetles, but as these ants merely occupy a petiole here or there on the young trees, they cannot be regarded as very serious enemies. Many of them, too, are small, timid ants, which probably have their own battles to fight with the insidious *Solenopsis* and are destined to be supplanted, like the beetles, by the obligate Pseudomyrmas and Aztecas.

During the struggles between the beetles on the one hand and the *Solenopsis, Pseudomyrmas,* and *Aztecas* on the other, the poor coccids evidently play somewhat the same defenceless rôle as the cattle in a country overrun by contending armies—they merely change masters and are either eaten, or carried off or permitted to remain and produce honey-dew for the victors. But before any such change of masters occurs they are often decimated or even exterminated by three enemies of their own, which may be briefly described *seriatim.*

In a few of the beetle colonies I have seen a number of larvæ of a very small Coccinellid beetle, described by Schwarz and Barber as *Scymnus xantholeucus* (Zoologica III, No. 6). These larvæ when full-grown resemble the larger coccids so closely in size, form and color and are covered with such a similar layer of snow-white wax, that I frequently overlooked them in my living colonies and detected their presence only in the preserved material after my return to the United States. They move slowly about among the beetles and their larvæ and devour the coccids. I am inclined to believe that by the time they are ready to pupate, they have also devoured all the beetle larvæ since I found two petioles each containing nothing but a pair of *Scymnus* pupæ, a few shrivelled remains of coccids and the kitchen-middens at the ends of the cavity. The pupæ were attached to the wall by their caudal ends and with their longitudinal axis parallel with that of the petiole. They were of a waxy yellow color, with their surface studded with short, blunt hairs. Several days later the imaginal beetles emerged. They measured 1.7 mm. in length and 1.2 mm. in width and were pale yellow, with the basal two-thirds of the elytra, the meso- and metasternum and the median third of the first and second abdominal segments fuscous.

A much more abundant enemy of the the coccids is a peculiar predacious Itonidid (Cecidomyid) fly, which Dr. Felt has described as *Diadiplosis pseudococci* (Zoologica III, No. 8). The larvæ of this insect are orange red and are often found in clusters of as many as eight to a dozen around groups of coccids. The whole mass is covered by a tough, dense, white web, or tent, which is spun by the larvæ in such a way as to shut them and the coccids off from the cavity of the petiole and therefore from contact with the beetles or their larvæ. Thus secure from interference the *Diadiplosis* larvæ devour the coccids at their leisure, attacking them from the ventral side where their integument is thinest and free from wax. The coccids are eventually reduced to their dorsal integument. When mature the *Diadiplosis* larva pupates where it has been feeding, often in the midst of a group of young or full-grown larvæ, and without orienting itself with respect to the longitudinal axis of the petiole. Just before eclosion the pupa forces its body, head foremost, through the silken tent and projects into the cavity. The fly then emerges and probably either lays its eggs among any surviving coccids or emigrates from the petiole and enters other beetle colonies. The adult fly is a very delicate little midge measuring only 1.25 to 1.5 mm. and of a reddish-brown color, with the abdomen red internally and the sclerites somewhat infuscated.

Considerable interest attaches to this insect, because, unlike the great majority of Itonidids and the species noticed above (p.50), it does not make plant galls but is predaceous. The genus *Diadiplosis* was originally established by Felt (1911a), for *D. cocci* Felt, a species reared in the island of St. Vincent from larvæ preying on the eggs of a coccid, *Saissetia nigra* Nietn., on stems of Sea Island cotton. In another paper published during the same year (1911b) he gives a list of 19 species of known zoophagous American Itonidids. The list includes species of *Endaphis, Arthrocnodax* and *Mycodiplosis* feeding on mites, an unidentified species of *Cecidomyia* feeding on the eggs of *Cicada septemdecim*, several species of *Aphidoletes* and *Lestodiplosis* preying on aphids and of *Lestodiplosis, Dentifibula, Diadiplosis, Coccidomyia, Cecidomyia, Lobodiplosis, Mycodiplosis* and *Dichrodiplosis* preying on various coccids. The *Diadiplosis* from British Guiana seems to be closely related to the type of its genus. According to Küster (1911), certain European Itonidid larvæ have been described by Rübsamen (1899) and Kieffer (1902) as preying on the larvæ of gall-makers of the same family.

Almost as abundant as the *Diadiplosis* in the beetle colonies is a Hymenopterous parasite of the *Pseudococcus*, namely *Blepyrus tachigaliæ* Brues (Zoologica III, No. 9), a small Encyrtid of the family Chalcididæ. The white larva of this insect lives in the coccid and grows with it, eventually becoming so voluminous that the coccid's body is very convex both dorsally and ventrally. The coccid grows increasingly sluggish and inert and its wax-glands cease to function so that its integument takes on a dull brownish color and the wax-pencils disappear from its periphery. The beetles and their larvæ are, of course, quite unaware of these profound changes in their parasitized cattle and still continue to stroke them, often for long periods, although there is no honeydew forthcoming as a reward for their efforts.

When full-grown the larval *Blepyrus* does not escape from the coccid but remains within it and forms an amber-colored, regularly elliptical cocoon about 2 mm. long and therefore very nearly as large as the coccid, which is now reduced to a mere skin enveloping the huge parasite. The cocoon seems to consist of a hard, glassy substance, possibly a modified silk, and is covered except on its ventral side with small circular spots which represent thinner, depressed areoles in its wall. Where these areoles are lacking on the ventral side the wall is homogeneous and distinctly thinner than elsewhere, but has a number of small pointed projections which seem to pierce the ventral integument of the coccid and to attach the cocoon rather firmly to the wall of the petiole. Since the parasitized coccid remains in the food-groove with its body in the usual position the cocoon necessarily has the same position and orientation, i.e. with its long axis parallel with the long axis of the petiole. The cocoon gradually grows darker, passing from amber-yellow to dark brown and by the time it has reached this stage, the dead tissues of the coccid enveloping it, except those on the ventral side, between the cocoon and the wall of the petiole, disappear, leaving the lateral and dorsal surfaces of the cocoon fully exposed. I am inclined to believe that the dead tissues of the coccid are eaten away by the beetles or their larvæ, but as they are very soft and disintegrate easily, they may perhaps be rubbed off merely by the attrition of the insects as they move back and forth in the petiole. Two of the denuded cocoons in the stage and with the orientation just described are shown in Fig. 11.

When the completed *Blepyrus* cocoon is cleared in carbol-xylol, mounted in balsam and examined as a transparent object, the larva is found to have pupated within it, after extruding a number of large meconial pellets, the undigested remains of all the food it swallowed while it was living on the tissues of its host. In most cases, at least, the head of the pupa is at the caudal end of the coccid. The imago, when mature, cuts a large round hole in the end of the cocoon (see upper part of Fig. 11) and emerges as a short, thickset, broad-headed fly, only 1.5 mm. long, with a metallic green face, a black, more or less bronzed body, black and yellow antennæ and legs and basally infuscated wings. It is very active, and like other small Encyrtids skips about by using the long saltatory spurs on its middle tibiæ. After mating the female undoubtedly oviposits in the young coccids either in the same or in some other beetle-inhabited petiole.

This parasite seems not to be nearly so serious a menace to the *Coccidotrophus* colonies as the *Scymnus* and *Diadiplosis*, since the infested coccids are probably able to supply the beetles and their larvæ with honey-dew till both host and parasite are nearly mature. Hence one often finds several infested coccids and *Blepyrus* cocoons in petioles inhabited by flourishing beetle colonies. In one such colony I counted more than fifty cocoons and a dozen large coccids swollen with parasites that were still in the larval stage.

I have failed to find more than one of the three species of coccid enemies in a single petiole. Their combined action, if they actually ever occur together, would, of course, not only greatly hasten the extermination of the coccids, but would seriously interfere with their own development. It may be noted incidentally that none of these enemies occurs in the petioles of the large Tachigalias inhabited by the obligate Pseudomyrmas and Aztecas. In such plants the coccids are free from all predators and parasites and are not only more numerous but attain a larger size than in the petioles of the small shade trees tenanted by the *Coccidotrophus.* The ants are undoubtedly much more efficient than the beetles in keeping small miscellaneous guests and synoeketes out of their nests. This is particularly true of the Pseudomyrmas. Although I have collected the entire colonies of many of these ants on several different trips to the American tropics, the only synoekete I have ever seen associated with them was a *Microdon* larva described many years ago (1901) from the nest of *Pseudomyrma mexicana* Roger. Even coccids are kept and attended by only a few species of *Pseudomyrma.*

Before concluding my account of *Coccidotrophus* I may introduce a few statistical data, which are probably valid only for the particular time and locality of my observations. While at the Tropical Laboratory I noted roughly the condition of the contents of each of the *Tachigalia* petioles I opened on a particular day. On some days only a few petioles were opened and the results are not worth transcribing. The following collection, however, gives a more interesting picture owing to the number of petioles examined:

August 9. Collected 253 petioles from young Tachigalias 1½ to 7 ft. high growing along the Cuyuni Trail. Of these 37 or about 14% were either too young to have inhabitants or contained solitary *Pseudomyrma* queens founding colonies or small colonies of inquiline ants; 203 or about 86% either contained or had contained beetle colonies. Of the latter number, 50 contained incipient colonies, i.e., a single pair of beetles or more rarely single beetles which had just entered the petioles and were busy "cleaning house." In one petiole one of the beetles of a pair was guarding the entrance while the other was shovelling frass and the remains of previous occupants with the top of its head into the pointed ends of the cavity. Sixty-four of the beetle colonies had larvæ and were in what I have called the second and third stages. In nearly every case coccids were seen. Eighty-nine of the colonies were either moribund or extinct. *Solenopsis altinodis* workers either living or dead, were present, sometimes in considerable numbers, in 35 of these petioles, and 10 of them still contained large coccids that had been shut off by webs and were being devoured or had been already devoured by *Diadiplosis* larvæ. In one petiole two of the flies had emerged. In 6 of these petioles the *Solenopsis* workers had destroyed the beetles and their larvæ and were still running about. When I tore away the webs covering the *Diadiplosis* larvæ the ants at once seized and killed them. The webs serve, therefore, not only to protect the Itonidids from the beetles and their larvæ, but also from the *Solenopsis*.

C. Eunausibius wheeleri Schwarz and Barber.

This beetle, though superficially very similar to *Coccidotrophus socialis*, can be easily distinguished in all its postembryonic stages. The adult beetle (Plate III, fig. 1, Plate VI, figs. 6 to 10) is distinctly smaller, measuring only 3-3.5 mm., permanently of a red color like the immature *Coccidotrophus* and therefore never deepening into the dark chestnut color of the latter. The antennal clubs are larger and broader and much more distinctly marked off from the more proximal joints, the eyes are much larger, the anterior border of the front is much less deeply emarginate, the femora are less incrassated and the posterior pair has a small tooth on the flexor side. The surface of the body is smoother, the punctation being less pronounced. The larva is more slender, with the head and dorsal surface distinctly gray, owing to a deposition of fine pigment granules in the integument. The pupa can be at once recognized by the presence of four large, equidistant tubercles on each of the parallel lateral borders of the pronotum (Fig. 8*a*, Plate IX, fig. 23). For many of the less obvious differences between the various instars of the two beetles the reader may be referred to the excellent descriptions and figures of Schwarz and Barber (Zoologica III, No. 6) and Böving (Zoologica III, No. 7).

The prominent tubercles on the sides of the pupal pronotum of *Eunausibius* merit somewhat fuller consideration, because they present a striking instance of the retention in an earlier ontogenetic stage of a character which may be completely lost in the adult. An examination of the common saw-toothed grain-beetle, *Oryzæphilus* (formerly *Silvanus*) *surinamensis* L., represented in Fig. 7, and other species of the same genus, shows that the adult beetle has six acute teeth on each of the lateral borders of the pronotum, corresponding to and arising within as many large, blunt tubercles of the pupa. These structures were long ago noticed by Coquerel (1849) and Perris (1852) and by the former erroneously supposed to be portions of some tracheal system peculiar to the pupa. In *Nausibius* (*N. clavicornis*) the pronotum of the beetle bears six obtuse teeth on each side. In other Silvanid genera, such as *Silvanus* and *Cathartus* as well as in *Eunausibius* and *Coccidotrophus* these teeth are either altogether absent in the imago, or reduced to the first pair, which form the anterior corners of the thorax. *Eunausibius* has well-developed teeth in this position but in *Coccidotrophus* the anterior corners of the pronotum are merely rectangular. It is therefore interesting to find that the pupa of *Eunausibius* has four well-developed pairs and a fifth vestigial pair of tubercles, that these tubercles decrease in size anteroposteriorly, and that only the first pair gives rise to teeth that persist in the adult. In *Coccidotrophus* the reduction of the pupal tubercles is carried much further since there are only small vestiges of the three anterior parts of *Eunausibius,* none of which gives rise to teeth in the imago. Moreover, the second and third pairs of pupal tubercles may be represented by only a single tubercle on one side of the pronotum, as Böving observed (Zoologica III, No. 7). The tubercles are, in fact, so evanescent that they have become very variable, like vestigial organs in general. This is seen in Fig. 8—*b* to *f*, representing the prothoraces of five *Coccidotrophus* pupæ selected from a series of fifty specimens. We may safely conclude, therefore, first, that *Eunausibius* and *Coccidotrophus* are derived from ancestors which had a 12-toothed pronotum like the species of *Oryzaephilus;* second that this condition disappeared first in the imago and still tends to linger on in the pupa, and third, that the tubercles have a tendency to disappear in sequence in a posteroanterior direction. There can be little doubt that the dentation of the sides of the thorax is a very ancient character not only in the Silvanids but also in the Cucujids (as restricted by Böving), since vestiges of the teeth can also be clearly seen in the imagines of certain genera of the latter family (*Cucujus, Brontes*).

I have already alluded to the fact that *Eunausibius* colonies are much rarer at Kartabo than those of *Coccidotrophus* though both species may occur in the same localities and even in different petioles of the same young *Tachigalia.* And not only are all the instars of *Eunausibius* smaller than those of *Coccidotrophus* but the colonies are also much less populous. The largest I have seen consisted of less than a dozen beetles and not more than two dozen larvæ. The habits, so far as I have been able to observe them, are much like those of *Coccidotrophus.* The *Eunausibius* also feed on the nutritive parenchyma in the walls of the petiole but they do not dig long grooves in the tissue but only narrow elongate pits, nor do they build up their frass in parallel or vermiculate ridges but plaster it in a thin layer over the walls of the petiole, so that the latter are smooth and even. The elongate entrance to the petiole seems not to be provided with a wall of frass. In one petiole I found that the pair of parental beetles had entered through a large hole about 2.5 mm. in diameter which had evidently been made by some larger insect. The beetles had plugged the opening with frass, leaving a small elliptical opening in the center just large enough to fit the head of the beetle when acting as a sentinel. Coccids are found in the elongated pits in the nutritive tissue but are few in number and of small size, though the *Eunausibius* solicit and drink their saccharine excretions in the same manner as *Coccidotrophus.* The cocoons of *Eunausibius,* apart from their smaller size and somewhat more delicate walls, are very much like those of *Coccidotrophus* and are, in all probability, constructed in the same manner.

I have seen so few colonies of *Eunausibius* that I can give no account of its enemies nor of those of its coccids. In all probability it is even less able than the more vigorous and more prolific *Coccidotrophus* to withstand the insidious attacks of *Solenopsis altinodis.* The whole appearance of the beetle and its colonies is that of a feeble, anæmic and harried species on the verge of extinction.

General Considerations

The behavior of the social Silvanids described in the preceding pages and the conditions under which they live are sufficiently startling to stimulate reflection and a comparison with other species of the same and allied families. Such comparison, as an ethological method, has so often thrown light on what appeared at first sight to be unique and incomprehensible instincts and their settings that we may hope by resorting to it to trace the peculiar conditions in *Coccidotrophus* and *Eunausibius* to simpler and more general phenomena. Since both the setting, or environment and the responses, or behavior of the beetles are rather complicated it will be best to consider them separately and to begin with the setting, i.e. with the *Tachigalia* biocoenose.

The general ethological concept of the 'biocoenose' was, of course, more or less clearly recognized by many of the early zoologists. Although the term seems to have been first used by Möbius (1877), even Rèaumur had an inkling of the value of studying insects in association with their host plants. He says: "I would that the observers who busy themselves with the history of insects gave catalogues of those that feed on every plant." In the middle of the last century Perris (1852-1862) devoted many years to the study of the insects associated with the maritime pine and the chestnut in France, and Kaltenbach (1874) attempted to list all the phytophagous insects of Germany according to their host plants. In the United States Packard's volume (1881) on the forest and shade-tree insects and Mrs. Dimmock's paper (1885) on the insects of the birch represent more modest studies of the same kind. Perhaps none of our entomologists has been more thoroughly convinced of the advantages of studying insects and other animals as components of biocoenotic complexes than Forbes. Forty years ago he expressed his general convictions on this subject in his paper on the food of fishes and insects (1880) and he has returned to the subject in a recent address (1915). His fine papers on the strawberry and maize plants and their associated organisms (1884, 1894-1905) also clearly illustrate the great value of biocoenotic investigations.

Picard (1919) has recently published an interesting paper on the insects of the fig in Southern France.

As a mere record of the insects associated with a tropical plant my study of the *Tachigalia* biocoenose is necessarily fragmentary, owing to the few weeks I could devote to it, but it acquires considerable interest from the fact that the *Tachigalia* is a myrmecophyte, or one of those plants which are supposed to be peculiarly adapted structurally to association with battalions of protecting ants. The only organs which can be cited, however, as such an adaptation are the fusiform enlargements of the petioles, which undoubtedly furnish excellent lodgings for all the various ants, both inquiline and obligate. The plant is utilized also as a source of food by the obligate species through the instrumentality of the coccids, which are kept in the petioles and draw their food by preference from the strands of nutritive parenchyma. The beetles also use the petioles as lodgings and not only utilize the species of coccid as a copious source of sugar and water but also feed directly on the tissues of the plant. The plant is therefore more completely exploited by the beetles than by the ants and might be said to be more perfectly adapted to the former than to the latter. But the question as to whether the peculiar structure of the petiole is really an adaptation to either of these groups of insects is one which I shall leave to the botanist. Prof. Bailey will no doubt deal with it in connection with the same problem in the other South American myrmecophytes which he has investigated. That both the ants and the beetles have adapted themselves to the plant cannot be doubted and this adaptation, as I have shown, is exhibited in three degrees, the inquiline ants merely using the petiolar enlargements as lodgings, the obligate ants as lodgings and through their herds of coccids as indirect sources of food, and the beetles as lodgings and as both direct and indirect sources of nutriment.

Of course, a particular biocoenose is not an isolated, perfectly self-contained association of organisms but shares some of its components with other biocoenoses. Thus the *Tachigalia* is part of a large association, or biocoenose of jungle trees growing under certain conditions of soil, humidity, light, temperature, etc. The *Atta cephalotes,* which occasionally defoliates the young tree is the center of an elaborate biocoenose of its own, comprising all the trees it habitually defoliates, its fungus gardens, its myrmecophiles of the Blattid genus *Attaphila,* the toads, lizards and ant-eaters which feed on the foraging workers, the Amphisbaenians which live in the penetralia of the huge nests, etc. The two ants, *Camponotus femoratus* and *Crematogaster parabiotica,* which attend Membracids on the young shoots of the *Tachigalia,* are really characteristic members of the very peculiar "ant-garden" biocoenose, which I have described in another paper (1921), and the *Dolichoderus attelaboides* belongs to still another biocoenose of which many Melastomaceous plants and their Membracid parasites are important components.

A particular biocoenose must also, of course, have a phylogenetic history, i.e. we must conceive it to have been gradually built up, integrated and organized in time from components which detached themselves from other biocoenoses and attached themselves as satellites to an organism which furnished more congenial conditions of life. Owing to the basic nutritive interdependance of animals and plants, a particularly favorable plant usually constitutes the primary focus of a biocoenose. The various parasites, scavengers and synoeketes, which live with the insects that immediately depend on this plant merely use the former as so many secondary or tertiary foci. Thus in the *Tachigalia* biocoenose the primary focus is the young plant and the center of the focus the leaf-petiole, the secondary focus is represented by the coccids and the tertiary foci by the ants and beetles to the extent that they attract predators, parasites and scavengers.

It is permissible, perhaps, to reconstruct the phylogenetic sequences of the various organisms that have become associated to form the *Tachigalia* biocoenose. Not improbably the tree, like many other trees of the Neotropical jungle, was originally peopled throughout its life by a certain number of miscellaneous, inquiline ants. Among these were several species of *Pseudomyrma* and *Azteca,* both large genera comprising numerous forms which still habitually inhabit any available hollow twigs or petioles of the most diverse trees and shrubs. Later the number of these ants was reduced, through the advent of the coccids and their definitive association with the *Tachigalia,* to a very few species, the putative ancestors of the present *Ps. damnosa* and *maligna* and *A. foveiceps,* because the coccids enabled them to acquire very intimate trophic relations to the plant. The coccids present an unsolved problem in this connection. It would seem that the *Tachigalia* must be their true host-plant, and that the various other plants on which they are known to live, are subsequent, or secondary hosts, possibly acquired when the natives of British Guiana and of the surrounding countries took to making clearings in the jungle and growing in them various introduced plants such as pine-apples, *Hibiscus,* etc. The truth of this statement can, of course, be established only by further investigation of *Pseudococcus bromeliæ* throughout its range. When the obligatory ants had thus acquired their definitive attachment to the tree, the miscellaneous inquilines necessarily became restricted to its youngest stages since they were no longer able to compete with the obligates for the possession of nesting sites on the adult plant. The Silvanid beetles were probably relatively late intruders which found that they could inhabit the young tree for a considerable period before the queens of the obligate ants had succeeded in maturing their broods of belligerent workers. At first the beetles merely used the petiolar cavities as lodgings and fed on the nutritive parenchyma in their walls, but later they discovered the coccids and learned how to obtain their honey dew and came to depend more and more on this saccharine nutriment. The various parasites, scavengers, etc., which infest the beetle colonies and their droves of coccids obviously represent still more recent accessions to the biocoenose. The other insects, such as *Atta cephalotes,* the Membracids and their attendant ants, the caterpillars and gall-flies of the leaves, etc., may belong to the ancient miscellaneous fauna which originally attacked or frequented the *Tachigalia* in all its stages, when it was quite as "unprotected" as the great majority of jungle plants.

Turning now to a consideration of the beetles themselves, it would seem to be desirable to review their activities in the light of what is known concerning the other members of the natural family to which they belong. Here, however, we encounter difficulties, for the family Cucujidæ (*sensu lato*) has been more neglected by taxonomists and students of insect behavior alike than any other family of equal size in the order Coleoptera.

As understood by Coleopterists the family Cucujidæ belongs to the huge and very inadequately analyzed Clavicorn complex of families, but its characters are so striking that they have arrested the attention of some of the specialists. Thus Leconte and Horn (1883) long ago remarked: "This family is evidently an antique and synthetic type, which exhibits alliances with both Heteromera and Rhynchophora more than any other Clavicorn family." And Handlirsch (1908) says: "The family Cucujidæ, which Ganglbaur places in the midst of typically Clavicorn forms, exhibits many primitive characters and at the same time high specialization. I do not believe that their antennæ can be derived from those of the Clavicorn type, although the Cucujids agree with this group in the number of their Malpighian tubules (six). Perhaps the Cucujids branched off very near the base from the Cantharid stem, but possibly, and I regard this as more probable, they form an independent series." In his phyletic tree (opposite p. 1278), Handlirsch therefore depicts the family as arising from the Protopolyphaga as far back as the beginning of the Coenozoic. Several species of *Silvanus* and one of *Passandra* are, in fact, known from the Baltic Amber (Lower Oligocene Tertiary), and Wickham (1920) cites *Laemophloeus vestitus* Scudder from the Green River Eocene and three species of *Lithocoryne* and a *Pediacus* from the Miocene of Florissant. That the family must be an old one is indicated also by the fact that New Zealand possesses some 20 indigenous species of Cucujidæ, distributed over 12 genera, mostly peculiar to the islands, which are said to have been separated from Australia during the Jurassic.

Kolbe (1910) is also of the opinion that the Cucujids are a primitive group. He says: "The very lowly organized Cucujids are not only in part characterized by a prothorax of very primitive structure (as in the Adephaga) but primitively inserted (inframarginal) and primitively constructed (filiform or moniliform) antennæ." Leng (1920) places the Cucujids in the lower portion of the series of Clavicorn families, near the Rhizophagidæ and Erotylidæ. In a brief study of the larvæ of Cucujids, de Peyerimhoff (1902-'03) calls attention to their great diversity and their resemblance on the one hand to the larvæ of *Cryptophagus* among the Clavicorns and on the other to *Pyro-*

chroa among the Heteromera. Hamilton (1886) long ago noticed the resemblance of the larval *Cucujus clavipes* to the Pyrochroid *Dendroides canadensis* larva. As shown in his very valuable paper on the larvæ of *Coccidotrophus* and other genera (Zoologica III, No. 7) Böving divides the Cucujidæ *auctorum* into four families, the Silvanidæ, Cucujidæ (*sens. str.*), Læmophlœidæ and Scalariidæ. The last of these he relegates to the group Cleroidea, and states that they are closely connected with the family Bothioderidæ of Craighead (1920).

Apart from several species of considerable economic importance, the little that is known concerning the habits of these four families of beetles is scattered through the literature. Such data as I have been able to glean in regard to the European, North American and cosmopolitan species have been brought together in condensed form in Zoologica III, No. 5. From these data it will be seen that the Cucujids, taken as a whole, exhibit certain tendencies which are not without significance in connection with the peculiar behavior of *Coccidotrophus* and *Eunausibius*. If we exclude the Scalariidæ, which Fiske (1905) has shown to be parasitic in their larval stages—resembling in this respect the Bothrioderidæ—we notice that the various genera and many of the species of the remaining families show an extraordinary diversity, one might say versatility of behavior. They occur in a great variety of habitats such as stored human foods of vegetable origin, under bark, in decaying wood, in the burrows of bark-beetles, under dead leaves and rubbish, and feed on all sorts of substances mainly of a vegetable and especially of a concentrated or highly nutritious character. Many of the species are scavengers, others are undoubtedly predaceous and prey on the larvæ of other insects. The adult beetles seem to be rather long-lived and usually, if not always, live gregariously with their larvæ, all the active stages feeding on the same substances. The developmental period is certainly very brief in some species, as e.g. in *Cathartus advena,* the whole life-cycle of which, from the egg to the imago may require only three weeks and in the saw-toothed grain beetle *(Oryzæphilus surinamensis)* less than a month. As a rule both the beetles and the larvæ of the vegetarian and detritivorous species are very tolerant of the presence of other insects and actually seem to seek their companionship, especially when the food supply is abundant. Thus *O. surinamensis* is often found living with the rice weevil (*Calandra oryzæ*), *Cathartus advena* with the Indian meal moth (*Plodia interpunctella*) and *O. mercator* with a Tenebrionid grain-beetle, *Palorus subdepressus*. Many of the species of *Læmophloeus* constantly live in the burrows of Scolytid beetles and feed on their dejecta. Owing to these peculiarities and especially to their very diverse and plastic feeding habits many of the Silvanids and Læmophloeids have become cosmopolitan household pests capable of doing considerable damage to many of the staple stored foods of our own species.

If with this general complex of behavioristic tendencies exhibited by the European and North American Cucujids (*sens. lat.*) we compare the activities of *Coccidotrophus* and *Eunausibius*, we find that the latter while retaining many of the ancient and primitive family traits nevertheless exhibit several of them in a peculiar and highly specialized form. Thus the merely gregarious habits of the adults and larvæ of the northern and cosmopolitan Cucujids have become more definitely social in the *Tachigalia* beetles, and their toleration of alien insects has increased; the feeding of the ancient Cucujids on various vegetable substances has become specialized to the point of concentration on a particular tissue of a particular plant and both adult beetles and larvæ have become coccidophilous. The construction of the cocoon, too, exhibits peculiarities not found in any other Cucujids. Owing to the unusual interest of these various specializations they may be discussed at greater length under separate captions.

1. Social Life Among the Coleoptera

If we regard as truly social only those insects in which the parent or parents live with their offspring, protect them and either feed them directly or prepare materials for their sustenance, there seem to be only three groups of beetles that meet these requirements, namely, the Platypodidæ, the Scolytidæ (Ipidæ) and the Passalidæ. The Platypodidæ and that portion of the family Scolytidæ, comprising, according to Hagedorn (1910) the tribes Corythalinæ, Xyleborinæ and Spongiocerinæ, with some 400 described species, mostly tropical, are commonly known as ambrosia beetles, because like the Attiine ants of the Neotropical Region and many Old World termites they cultivate fungi as food for themselves and their larvæ. The remarkable social organization and the food-fungi of these beetles have been studied by Eichhoff (1881), Hubbard (1897a, 1897b), Hopkins (1898), Neger (1908a, 1908b, 1909, 1911), Schneider-Orelli (1911a, 1911b, 1912, 1913) and others, Hubbard's account of the habits of *Platypus compositus* of our Southern States is so interesting that I quote it at length:

"These social instincts reach their highest development, apparently in the genus *Platypus*. The species of this genus are readily known by their very long cylindrical bodies, their prominent head, flattened in front, the flattened and spur-tipped joint of the front legs, and in the males the spine-like projections of the wing cases behind. They are powerful excavators, generally selecting the trunks of large trees and driving their galleries deep into the heartwood.. The female is frequently accompanied by several males, and as they are savage fighters fierce sexual contests take place, as a result of which the galleries are often strewn with the fragments of the vanquished. The projecting spines at the end of the wing cases are very effective weapons in these fights. With their aid a beetle attacked in the rear can make a good defence and frequently by a lucky stroke is able to dislocate the outstretched neck of his enemy. The females produce from one hundred to two hundred elongate-oval pearly white eggs, which they deposit in clusters of ten or twelve in the galleries. The young require five or six weeks for their development. They wander freely about in the passages and feed in company upon the ambrosia which grows here and there upon the walls. The chitinous ridges upon the thoracic segments, together with the row of tubercles upon the other segments, enable the larva to move as rapidly through the galleries as if it were possessed of well-formed legs. The mouthparts of the larva are also provided with strong cutting mandibles, but the inner jaws are not adapted to masticating hard food, such as particles of wood. The older larvæ assist in excavating the galleries, but they do not eat or swallow the wood. The larvæ of all ages are surprisingly alert, active and intelligent. They exhibit curiosity equally with the adults, and show evident regard for the eggs and very tender young, which are scattered at random through the passages, and might easily be destroyed by them in their movements. If thrown into a panic, the young larvæ scurry away with an undulating movement of their bodies, but the older larvæ will frequently stop at the nearest intersecting passageway to let the small fry pass, and show fight to cover their retreat. When full grown the larva excavates a cell, or chamber, into which it retires to undergo its transformations. The pupa cells are cut parallel with the grain of the wood and generally occur in groups of eight to twelve along some of the deeper passages. The older portions of the galleries are blackened by the long-continued formation of the food fungus. In the ambrosia of *Platypus compositus* the terminal cells are hemispherical, and are borne in clusters upon branching stems."

The habits of several genera of ambrosia beetles of the family Scolytidæ were investigated by Hubbard, and one of our species, *Xyleborus xylographus*, which has an extensive circumpolar distribution and is common in the wood of fruit-trees, has also been studied by Eichhoff (1881) and Hopkins (1898). I quote the latter's account of this insect which may serve as a paradigm of the whole group:

"The fertilized females pass the winter in their brood chambers and emerge in the spring (April and May, near Morgantown, W. Va.). They are then attracted to sickly, dying or felled trees, in the living or moist dead wood of which they prefer to excavate their brood galleries. A crevice or opening in the bark, such as may be made by other insects, or, as I have observed, those made by the yellow-bellied woodpecker, but more commonly the edge of a wound, in a dead place on a living tree, is selected as a favorite point of attack. Here a female will commence the excavation of a mine, and after she has penetrated the wood a short distance, another female (as I have observed) will come to her assistance, one working at the excavation, while the other guards the entrance and assists in expelling the borings. The primary or main gallery is usually extended into the heart-wood before eggs are deposited. When the primary gallery is completed (according to Hubbard) a bed is provided on the sides of the gallery for the propagation of the special species or variety of ambrosia fungus which is to furnish food for the future broods. The first set of eggs are few in number (five to ten) and are placed without any protection on the sides near the end of the main gallery, or in cavities or short branching galleries, one-half to one inch from the end, where upon hatching, the young larvæ find a supply of ambrosial food. After the first set of larvæ have attained considerable size, another set of eggs are deposited, and so on at intervals until a large family is reared, in which eggs, larvæ of all stages of development, pupæ, and young and old adults are found crowded promiscuously in leaf-like brood-chambers which are continually broadened or extended by the adults and possibly by the larvæ, to make room for the increase. It appears that the brood-chambers are broadened and extended by the adults, and that the borings, mixed with the fungus, are softened and furnish additional food for the larvæ and young beetles." At this point in his account Hopkins introduces the following note: "In a brood-chamber before me just cut from a nearby apple tree, I find a pupa minus an abdomen. No predaceous enemies can be found, but two or three half-grown larvæ are in such a position as to make the circumstantial evidence quite plain that they are to blame for the multilation. The remaining portion of the pupa is in a normal condition, which would indicate that the attack had been recent and when the victim was alive. This would also indicate that the helpless pupæ may furnish food for the larva in case of a scarcity of ambrosia, or that they may be thus disposed of to prevent an overcrowded brood-chamber."

The account of *Xyleborus* continues: "Mr. Hubbard records the discovery of a death chamber, or a kind of catacomb, in which the dead mother beetles and other dead friends or foes of a large colony are consigned by the survivors. In some fresh specimens of galleries before me I find the same thing, but it appears that in addition to a resting place for the dead, it is also utilized for the disposal of all objectional and refuse matter, which owing to the crowded condition of the chamber, cannot be conveniently expelled from the entrance. One of the males found in this set of chambers was excavating a burrow in the mass of material in the death or garbage chamber. Whether he was excavating his own tomb, or simply providing bachelor quarters, I cannot say. The proportion of males in this, as in all other species of the genus *Xyleborus*, is remarkably small. There are usually not more than three males in the largest colonies, or groups of brood-chambers. It would appear from observations made by Swiner and Eichhoff in Germany, and the numerous colonies I have examined in this country that there is, on an average, about one male to twenty females. The males have no wings, therefore probably do not leave the brood-chambers, but remain with the over-wintering colony until all have emerged in the spring. They are then left to be smothered in overabundant ambrosial food, or to the tender mercies of predatory insect enemies which had previously been prevented from entering the brood-chambers by one or more female sentinels at the entrance. A few females may emerge from time to time during the summer to start new colonies, but from the excessively crowded condition of the brood-chambers during the fall and winter months, it would appear that the older adults of the broods excavate branching chambers in which new broods are developed, and that in these old and new chambers they pass the winter."

The third group of social beetles comprise the large Lamellicorns of the family Passalidæ, abundant in the tropics of both hemispheres but represented in the United States by only a single species, *Passalus cornutus* Fabr., which ranges as far north as Massachusetts and Illinois. None of our Coleopterists seem to have taken the trouble to study the habits of this common and conspicuous insect, so that it was left to Ohaus (1899-1900, 1909) to discover the social behavior in certain Brazilian species. He found that they live in rotten logs in colonies, each consisting of an adult male and female with their larvæ. The beetles excavate spacious galleries, comminuting the wood and probably treating the particles with some digestive enzyme, so that they can be eaten by the larvæ, which slowly follow along the galleries just behind their tunneling parents. Owing to the structure of their mouthparts the larvæ are quite unable to break down the wood, and when removed from their parents soon die. The beetles not only guard their greenish eggs and diligently provide food for their larvæ, but also protect the pupæ and feed the imaginal young till their chitinous integument is completely hardened. In a former paper (Wheeler and Bailey,

1920) I have published an account of the stridulatory organs of the larval and adult *Passalus* and have given reasons for believing that all the members of colony are kept together by the shrill sounds they are able to emit.

During the summer of 1920 while in Trinidad and British Guiana my son Ralph and I made a few observations on several of the species of *Passalus* which are very common in rotten logs throughout the jungle. Just under the bark the beetles make large, flat cavities, which are later very often occupied by the fungus-growing ants of the genera *Apterostigma, Myrmicocrypta* and *Cyphomyrmex,* and evidently furnish just the right places for their more or less globular gardens. In each of the *Passalus* colonies examined during July and August there were only two adult beetles, usually accompanied by a troop of larvæ varying little in size and evidently belonging to a single brood. In one log, however, we found a pair of the beetles guarding a batch of about 40 large, olive-green, broadly elliptical eggs, some of which had just hatched. The young larvæ closely resembled the older individuals in the structure of the peculiarly modified paw-like metathoracic legs, which are rubbed over the finely ridged middle coxæ during stridulation, but the hairs on the body were conspicuously longer and coarser. Our observations on the beetles and their larvæ both in the field and in the laboratory, confirm the statements of Ohaus.

The preceding account of the Platypodids, Scolytids and Passalids will suffice to show that they have reached a more advanced stage of social development than *Coccidotrophus* and *Eunausibius,* though the latter exhibit certain interesting resemblances to such ambrosia beetles as *Xyloterus.* The two Silvanids really represent a stage in social development intermediate between that of the families mentioned and the merely gregarious *Silvanus, Oryzæphilus, Nausibius* etc. Although the colonies of *Coccidotrophus* and *Eunausibius* are founded by pairs of parent beetles and in the climax stage of their development may comprise a considerable number of offspring in all stages of development, yet the latter do not seem to be the recipients of any special care on the part of the parents, unless we interpret as such the guarding of the petiolar cavity and the deepening of the food-grooves which would seem to render the nutritive parenchyma more accessible to the larvæ. And although all the members of the colony, beetles and larvæ alike, seem to be very indifferent to one another, except when they are competing for the honey-dew of the same coccid or when larvæ occupy cocoons in process of construction by other larvæ, yet under normal conditions there are no signs of hostility on the part of the beetles and larvæ even when other individuals are very annoying. Moreover, the use of the petiolar cavity as a common domicile, with its kitchenmiddens and more or less definite arrangement of the frass-ridges and wall about the entrance, the droves of coccids and the definite orientation of the eggs and cocoons, all show a much more socialized condition than anything that has been hitherto observed in other Cucujids. I believe, therefore, that I am justified in regarding the two *Tachigalia* Silvanids as representing a fourth group of social beetles, of a more primitive type than any of the three families above considered and differing in the absence of any definite preparation of larval food by the parents. No such preparation is necessary, in fact, owing to the peculiar conditions under which the *Coccidotrophus* and *Eunausibius* live, since both the young and the adults feed on the same substances and these are furnished by the plant and the coccids, which in turn feed on the same specialized parenchyma as the beetles.

No doubt the toleration by the beetles and larvæ of such different insects as the coccids, the *Scymnus* larvæ, the larval and adult *Diadiplosis,* the *Entomobrya, Aphiochaeta* and probably also of the adult *Blepyrus,* is due to the same causes as the toleration by so many ants and termites of numerous myrmecophiles and termitophiles. Such guests, parasites and synoeketes can, of course, manage to live only among insects which through long association with individuals of their own species have come to tolerate or even to seek the presence of insects belonging to alien, or unrelated species.

2.—The Development of the Feeding-Habits of the Social Silvanids.

There would seem to be little doubt that the primitive food of *Coccidotrophus* and *Eunausibius* is the nutritive parenchyma of the *Tachigalia* petioles. But this is a very specialized diet compared with that of other Silvanidæ. Although such genera as *Silvanus, Oryzæphilus, Cathartus* and *Nausibius* eat by preference vegetable substances with high protein, starch or sugar content, none of these forms is known to devour the tissue of growing plants, and it is even doubtful whether White's statement (1872) that the Cucujid *Dendrophagus crenatus* feeds on the inner bark of conifers, is correct (see Zoologica III, No. 5). The *Tachigalia* beetles are primarily attracted by the tree and there is every reason to regard this peculiar Leguminous plant as their only host, so that in this respect, also, they are highly specialized, for while some of the Silvanids, Læmophloeids and Cucujids (*sens. str.*) prefer particular trees, they seem nevertheless to thrive equally well in trees of different species, probably because they do not eat the living plant tissues but merely require special moisture conditions or the presence of certain other insects. We must suppose, furthermore, that the social Silvanids are primarily attracted to the *Tachigalia* by certain chemical substances in the petioles, a supposition which seems to offer the only satisfactory explanation, as Picard (1919) has shown, for the selection of particular host plants by particular insects. We should have to suppose also, that the beetles can discriminate between the petiolar substances of young shade—and older sun-trees, since they confine their attentions to the former. This is not surprising when we consider that some insects, e.g., certain Cynipid gall-flies exhibit even more delicate powers of discrimination since, when ovipositing, they seem to be able to distinguish between the viability of different buds or leaves on the same branch.

An even more interesting problem is presented by the coccidophily of *Coccidotrophus* and *Eunausibius,* for nothing like it has been observed in any other beetles, and apart from the ants, few insects are known to have developed the ability to solicit honey-dew from any of the Homoptera. I find only the two following cases in the literature, the first an observation by Belt in his "Naturalist in Nicaragua" (1884, p. 228), on wasps attending Membracids: "Similarly as, on the savannahs, I had observed a wasp attending the honey-glands of the bull's horn acacia along with the ants, so at Santo Domingo another wasp, belonging to quite a different genus *(Nectarinia)*, attended some of the clusters of frog-hoppers, and for the possession of others a constant skirmishing was going on. The wasp stroked the young hoppers, and sipped up the honey when it was exuded, just like the ants. When an ant came up to a cluster of leaf-hoppers attended by a wasp, the latter would not attempt to grapple with its rival on the leaf, but would fly off and hover over the ant; then when its little foe was well exposed, it would dart at it and strike it to the ground. The action was so quick that I could not determine whether it struck with its fore-feet or its jaws, but I think it was with the feet. I often saw a wasp trying to clear a leaf from ants that were already in full possession of a cluster of leaf-hoppers. It would sometimes have to strike three or four times at an ant before it made it quit its hold and fall. At other times one ant after the other would be struck off with great celerity and ease, and I fancied that some wasps were cleverer than others. In those cases where it succeeded in clearing the leaf, it was never left long in peace. Fresh relays of ants were continually arriving, and generally tired the wasps out. It would never wait for an ant to get near it, doubtless knowing well that if its little rival once fastened on its leg, it would be a difficult matter to get rid of it again. If a wasp first obtained possession, it was able to keep it; for the first ants that came up were only pioneers, and by knocking these off, it prevented them from returning and scenting the trail to communicate the intelligence to others."

The second case is more remarkable and refers to a Gerydine Lycænid butterfly of India, described by Bingham (1907, p. 287): "A remarkable habit in one member of the subfamily, viz., *Allotinus horsfieldi,* has been communicated to me by Colonel H. J. Barrow, R. A. M. C. He writes: 'I don't know whether you have observed the habits of a small plain butterfly which I caught in Maymyo. I watched it often in the jungle, sometimes for an hour at a time. It puzzled me at first to know why it took such an immense time to settle. It would keep within one yard of a spot and almost settle, twenty times perhaps, before it actually did. Its legs are immensely long and I discovered why. It settles over a mass of Aphides and then tickles them with its proboscis, just as ants do with their antennæ and seems to feed on their exudations.' The butterfly would settle over rather large ants that were attending the aphids 'and did not mind one or two actually standing up and examining its legs to see who was there. The ants did not attack it in any way.'"

A comparison of the behavior of the insects considered in the foregoing paragraphs is very instructive. The predilection of ants for various Homoptera (aphids, coccids, membracids, cercopids and psyllids) is well known. Though never observed among the predatory Dorylinæ and Cerapachyinæ and rare among the Ponerinæ and Pseudomyrminæ this predilection is, nevertheless, so prevalent among the higher subfamilies (Myrmicinæ, Dolichoderinæ and Formicinæ) that it has not escaped the most casual observer. When this type of behavior is highly developed, as in our species of *Lasius,* the ants display not only an exquisite deftness in stroking their trophobionts but also a decidedly proprietary interest in them, most clearly evinced by building peculiar carton or earthen shelters over them, aggressively defending them from their foes, or even collecting them and their eggs in the nests, distributing them over the surfaces of suitable plants and conveying them to places of safety when the colonies are disturbed. The whole performance is so elaborately adaptive as to suggest on the part of the ants an intimate acquaintance with the requirements and habits of their wards. This is also indicated when the latter fail to respond to stroking, for the ants do not wear themselves out by prolonged solicitation after their cattle have discharged their honey-dew, but stand around as if waiting for more of the saccharine liquid to accumulate.

The wasp described by Belt and the butterfly described by Bingham are really robbers, the former having learned to dispossess the ants of their wards, at least temporarily, the latter to overreach the ants and obtain the honey-dew by stealth. Though very different, the relations of the beetles to their coccids are no less extraordinary. The case is, indeed, so far as known, unique among the Coleoptera. Unlike many species of ants, the beetles have not yet learned to pick up the coccids and carry them about, but merely accept them as an integral part of the normal environment or as members of the colony. The fact that the beetles clearly recognize the signal of the prospective emission of the honey-dew by the coccids, when they raise their caudal segments, and the fact that they devote more attention to the posterior than to the anterior end of the larger coccids, implies a delicate discrimination, because both ends of the coccid's body are so very much alike. Furthermore, the beetle's antennæ and mouthparts seem to be so clearly adapted to dealing with the coccids as to indicate that the trophobiotic relations between the two species have been in existence for a very long time. The beetle's extraordinary perseverence in stroking individual coccids after they have been exhausted by repeated emissions of honey-dew might be interpreted either as a very thorough and hence highly adaptive method of exploiting the coccids, or as due to a very imperfect discernment of their physiological peculiarities.

Obviously the most remarkable item of behavior in *Coccidotrophus* and *Eunausibius* is the stroking of the coccids by the larvæ of all stages, as well as by the adult beetles. No one has even considered the possibility of a similar performance by the larvæ of ants, wasps or butterflies, since it is difficult to imagine creatures more unfitted for such behavior. Nevertheless, Mr. W. F. Fiske informs me that while he was investigating certain injurious insects in British East Africa, he saw small worker ants climbing a tree with their larvæ and holding them to the posterior ends of aphids, so that they could feed on the honey-dew voided in response to the antennal solicitations of their nurses! Unfortunately no specimens of the ants were preserved, and from Mr. Fiske's description I am unable to determine even the subfamily to which they belonged, but I have no reason to doubt the statement of an entomologist so competent and so keenly observant. I surmise that the ant must have been some Myrmicine which is unable to feed its larvæ by regurgitation, as otherwise such behavior would be superfluous.

So specialized a habit as the coccidophily of the two genera of social Silvanids calls for some consideration of its possible phylogenetic origin. Under existing conditions, the beetles either find the coccids already established in petioles that have been previously inhabited by other beetle colonies or by other insects, or the coccids enter the young petioles just after they have been perforated by the beetles,. for insects with sucking mouthparts cannot, of course, gain access to the cavities in any other way. That they migrate into the petioles as very young individuals is certain. Later, after completing their growth, they are often too bulky to escape through the entrances made by the beetles, and as such imprisoned coccids contain eggs, they might be supposed to breed in the petioles. I have never been able to find either the males or the deposited eggs in the petioles, and as the total number of coccids in a petiole is too small to indicate the survival of many of the young, I suspect that the beetles, though averse to devouring the young or mature coccids, nevertheless consume many of the eggs. How the coccids manage in the first place to reach the individual *Tachigalia* plant is a problem which presents itself also in the case of any of the other often widely distributed species of the family. That ants have much to do with carrying certain species of coccids to their host-plants is very probable. The only other active agents in such distribution would seem to be birds or the wind.

Soon after they enter the petioles the coccids seek out the strands of nutritive parenchyma, and sink their slender beaks into the tissue. And as the beetles keep gnawing at the same strands, grooves or narrow depressions are soon made in which the coccids settle, one behind the other, in rows, with the long axes of their bodies parallel with the long axis of the petiole. Thus the coccids naturally and inevitably come to lie in the paths of the feeding beetles, so that these can hardly avoid continual contact with the waxy creatures and their excrement. Probably at first the coccids simply voided their excrement in the grooves, thus drenching the surface of the nutritive parenchyma, so that the beetles found their bread spread with syrup. But this could hardly be an unalloyed blessing, because a sticky liquid spread on the walls of the petiole would almost certainly be injurious or fatal to the eggs, pupæ and younger larvæ of the beetles. We may therefore conjecture that the latter soon learned to stroke the coccids and to swallow the honey-dew at its very source, and that they have even acquired so keen an appetite for the liquid that it has now become a very important if not an essential constituent of their diet. The exploitation of such a constant and energizing supply of syrup, moreover, would surely tend not only to lengthen the original life-span of the adult beetles but also to increase the number of their progeny and hence the size and vigor of their colonies. This is suggested by the conditions in certain ants, *e. g.*, our yellow, hypogæic species of *Lasius*, which are able to develop populous colonies mainly, if not exclusively, on a diet of honey-dew derived from root-aphids and root-coccids.

Inasmuch as the larvæ, from their very youngest stages, no less than the adult beetles, continually stroke the coccids, the question arises as to whether the habit was first acquired by the larvæ, or by the beetles, or whether both instars developed it simultaneously. An answer to this question might, perhaps, be forthcoming if we could determine whether the larva or the adult beetle shows the greater structural adaptation of the antennæ and mouthparts to dealing with the coccids. The larvæ as I have shown, use both their antennæ and maxillæ in the process, the adults only the antennæ, but although the beetles are able to cover a greater area of the coccid's surface with their antennal clubs, the larger larvæ at least, by combining both pairs of organs, can probably produce a stimulus no less intense and effective. The larvæ are certainly more alert, restless and inquisitive than the beetles and the mandibles in the youngest stages seem to be very poorly adapted to feeding on the nutritive parenchyma. It is therefore quite as probable that the habit of stroking the coccids was first acquired by the young larvæ and later continued in the adult as that it originally appeared in the latter and was inherited in earlier and earlier ontogenetic stages till it came to be manifested by the just-hatched larva less than a millimeter in length. As shown by the observations recorded on p. 70 such larvæ show an even greater avidity for the honey-dew than the adult beetles. Since the stroking of the female beetle by the male during the courtship is precisely like the stroking of the coccids, we might be tempted to conjecture that the habit had arisen first in the adult as a modification of the sexual appetite, but this is, perhaps, rather far-fetched.

3.—The Building of the Cocoon.

The few data I have been able to gather concerning the processes accompanying pupation in the beetles allied to *Coccidotrophus* and *Eunausibius* are reproduced in Zoologica III, No. 5. The pupating larvae of some Læmophloeids, Silvanids and Cucujids are described as attaching themselves by the last segment to the substratum, and pushing back the larval skin to the tip of the abdomen which remains fixed to the exuvium. In *Oryzæphilus surinamensis* the larva before pupating makes a rude cocoon by agglutinating particles of food or detritus with an oral secretion, but I have seen no circumstantial account of the process which may be of considerable interest in connection with the cocoon-building of *Coccidotrophus*. The *Cucujus* larva also makes a rude cocoon (see p. 177).

The construction of a substantial cocoon by the larvæ of the social Silvanids would seem to be necessary, because a nude pupa, even if attached to the petiolar wall by its anal end, would be exposed to injury by the numerous beetles and larvæ moving about in the narrow cavity. But the way in which the cocoon is constructed is, to say the least, very unusual. So far as known, the larvæ of Coleoptera and other insects, when engaged in making such structures, remain *in situ* and build the cocoon as an envelope around the body, using for the purpose extraneous particles of earth, detritus, wood or frass, or threads of silk spun from the sericteries or more rarely a secretion of the Malpighian tubules, as in ant-lions and certain weevils, as described by Knab (1915a, 1915b) and others, or several secretions as described by Böving for *Donacia* (1910). The *Coccidotrophus* larva, however, laboriously collects minute particles of living plant-tissue, mixes them with saliva and builds them up in a very definite manner, repeatedly leaving the structure to go afield for the purpose of collecting the necessary materials. When the cocoon is all but completed the larva enters, and becoming a voluntary prisoner, closes the aperture at the end with materials scraped from the inner surfaces of the walls. I have failed to find in the entomological literature any account of such a method of cocoon-building, which in many particulars resembles the nest-building of certain birds and rodents.

The only suggestion I can make in regard to the possible origin of this behavior is that it may be derived in some way from the beetle's habit of building up its frass in more or less regular ridges, or welts between the food-grooves or immediately around the entrances to the petioles. I have been unable actually to witness this performance as the beetles never exhibited it after the petioles were cut open. I am inclined to believe that the feces are not simply voided in the spaces between the food-grooves but actually built up with the aid of the mouthparts. This seems to be clearly indicated by the circular wall around the entrances (Fig. 11). Perhaps the larvæ have quite as much to do with the construction of the ridges as the beetles.

4.—Concluding Remarks On the Behavior of the Social Silvanids

All modern observers of insects have been deeply impressed by the highly mechanized character of their behavior, but it is equally true that those who have most closely studied these organisms both under natural and experimental conditions have failed to find that the behavior of any one of them can be completely reduced to a rigid system of automatic or stereotyped reactions. While the behavior of certain forms such as the larval ant-lion, according to Doflein (1916) or the larval worm-lion *(Vermileo)*, as shown by my unpublished studies, seems to consist almost entirely of a small number of reflexes, the behavior of other insects, such as the solitary wasps, termites and social Hymenoptera, often exhibits considerable plasticity, modifiability or adaptability. Between these extremes we find the majority of insects with a certain modicum of the latter type of behavior. To this group we may assign the social Silvanids. The interpretation of their various activities necessarily involves some reference to the behavior of insects in general and the assumption of a definite attitude towards certain intricate and much discussed questions. The limitations of space compel me, therefore, either to leave the whole matter unconsidered or to treat it in a very brief and sketchy manner. I prefer to adopt the latter course.

The fashion which required one to explain as much as possible of the behavior of an insect in terms of tropisms, or taxes, and measured the value of one's work by the success achieved in the endeavor, seems to be rapidly passing. Thirty years ago I followed the fashion with some enthusiasm, but continued observation of the ways of insects has made me very dubious in regard to the whole subject of the tropisms. My present position concerning them is not essentially different from that of Jennings (1904, 1906, 1909), von Buddenbrock (1915), Claparède (1912, 1913), and others. I should, therefore, interpret them as adaptive, secondarily developed reflexes and not as unique, primitive elements in the genesis of instinctive behavior.

There are, nevertheless, in the behavior of *Coccidotrophus* certain phenomena, which some might be inclined to interpret as tropisms, especially the reactions to contact, light and chemical stimuli. The reader who has followed my account of the beetle will have noticed the peculiar orientation of some of its stages and of some of the associated insects with respect to the walls of the long fusiform petiolar cavity which they inhabit. Thus the eggs, cocoons and pupæ of the beetle are always placed with their long axes parallel with the long axis of the petiole, and the coccids, while feeding, the cocoons of *Blepyrus,* which are formed within the bodies of the coccids, and the nude pupæ of *Scymnus* assume the same orientation. The food grooves which are excavated by the beetles and the frass-ridges which they build, as well as the longer axis of the entrance are all longitudinal. Moreover, the beetles spend much time lying in the food-grooves with their narrow bodies longitudinally oriented and with as much as possible of their surface in contact with the floor and walls of the grooves.

At first sight this striking series of orientations would seem to be best described as tropistic, perhaps as due to some form of thigmotropism, but it is evident that the only behavior which might be legitimately regarded as such is that of the adult beetle when resting or moving in the food grooves. The Collembolans and the larvæ of *Scymnus* and *Diadiplosis* exhibit not the slightest tendency to assume a similar orientation, and the *Coccidotrophus* larvæ show no traces of it till they start their cocoons. Even then, though they orient their cocoons, they assume a position with their long axes parallel with the long axis of the petiole only while actually adding particles to the walls and after they have pupated. It is evident, furthermore, that nearly all the orientations mentioned can be traced more or less directly to peculiarities in the structure of the petiole, i.e., to the shape of its cavity and the histological structure of its walls, and especially to the singular arrangement of the nutritive parenchyma in long, narrow strands. The beetles gnaw these out and thus form grooves, which in turn orient the coccids and their internal parasites. The orientation of the frass ridges and beetle cocoons is also determined by the grooves, and the position of the *Coccidotrophus* eggs is very probably due to their being laid and attached by the beetles while they are lying in the depressions between the frass ridges. Thus the various orientations are merely so many direct or indirect adaptations to the nutritive parenchyma and the long narrow petiolar cavity. The latter clearly determines to some extent the longitudinal arrangement of the bulky cocoons, just as a long Pullman car makes it advisable for us to arrange the berths in a similar manner.

One orientation, that of the entrance, is not so easily explained. In all the petioles I have examined, the long axis of the entrance is parallel with the long axis of the petiole. It is evident that it precisely fits the head of the beetle and that the latter while gnawing it must stand on the outer surface of the petiole at right angles to its long axis. When the surface is longitudinally grooved, as is sometimes the case, the entrance can, of course, have no other orientation, but often the surface is quite smooth and it is difficult to see why it should be easier for the insect to gnaw through the tissue lengthwise rather than crosswise of the grain. It is also evident that while guarding the entrance the beetle has its long axis at right angles to the long axis of the petiole, but since a tubular wall is built around the inside of the orifice (Fig.11) the insect's reaction might be regarded as thigmotropic, like its reactions to the walls of the food grooves.

Nevertheless, I am convinced that the responses of the adult beetle to contact stimuli may be more properly interpreted as typical and highly adaptive reflexes. This is clearly indicated by the structure of the insect. The long, parallel-sided, subcylindrical form of the body and the shortness of the legs are merely so many adaptations to living in narrow tubular cavities. The same type of structure reappears as an independent development in each of many different families of beetles, which live in cylindrical cavities or burrows, e.g., the Scolytidæ, Platypodidæ, Brenthidæ, Bostrychidæ, Buprestidæ *(Agrilus)*, Cleridæ, Trogositidæ, Histeridæ *(Teretrichus)*, Colydiidæ *(Colydium)*, Lyctidæ, Lucanidæ *(Ceruchus)*, Elateridæ, Parandridæ, many Cerambycidæ, Lymexylondidæ, etc. This type of body and one more extremely flattened and adapted for living under bark *(Cucujus, Brontes)*, are very common among the Cucujidæ *sens. lat.* The peculiar conformation of the front and of the mandibles of *Coccidotrophus* and *Eunausibius*, so strikingly like that of many ants *(Cryptocerus, Cataulacus, Colobopsis*, etc.) is, moreover, a definite adaptation to guarding elliptical or circular entrances to solid-walled nesting cavities. It is interesting to note also that the general shape of the body of *Coccidotrophus* and *Eunausibius* reappears in several genera of ants which regularly live in narrow plant cavities, e.g., *Colobopsis, Simopone, Cylindromyrmex, Metapone, Pachysima, Tetraponera and Pseudomyrma* (see Plate III, figs. 1 and 2). Even the larvæ and pupæ of these ants have assumed a similar form. (See Wheeler, 1918, and Wheeler and Bailey, 1920). We may say, therefore, that the whole general bodily structure of the various insects I have mentioned has been adaptively modified during their phylogenetic history and that such a modification can hardly be anything but an expression of a concomitant adaptation of their nervous system and reflexes.

Equally unsatisfactory from an ethological point of view is the reference of other behavioristic peculiarities of the social Silvanids to simple tropisms. Let us take as an example the attraction to the *Tachigalia.* I agree with Picard (1919) in his contention that phytophagous insects are attracted to their respective host-plants by particular chemical substances in the latter. Entomologists have always believed this but have usually described the phenomena as due to "odor" or "taste." To designate them as chemotropism really adds nothing to our knowledge but a technical term. The ethological question remains: Why is a particular insect species or sex attracted to a particular part of a particular species of host plant, or, in the case of the social Silvanids, why do they fly to and bore into the swellings of the petioles of young individuals of a certain species of *Tachigalia?* Undoubtedly the exquisite sense-organs in their antennal clubs enable the beetles to detect certain very delicate effluviæ emanating from the young *Tachigalia* as a whole or perhaps even from the nutritive parenchyma in its petioles, but the attraction of these odors is probably due to their having acquired a "meaning" for the beetles, because the latter throughout their larval and early imaginal stages fed on these very substances, and had, in fact, long been familiar with the petiolar cavities, the coccids, etc. The latter part of this statement also applies to the young queens of the obligate *Tachigalia* ants of the genera *Pseudomyrma* and *Azteca* and would account for the rather unusual attachment of these insects to a definite host-tree. Hence in these cases organic memory, or "mneme," or even individual memory yields a more satisfactory explanation of the phenomena than a naked tropism.

A consideration of the responses to light leads to similar results. The beetle colonies, as we have seen are "photophobic," or live in the dark, and when the petioles are opened in the light the insects are at first much agitated but soon settle down and continue the regular routine of their existence even when the pieces of petiole are kept exposed to artificial or diffuse day-light in the laboratory. The adult beetles have well-developed eyes and the larvæ have three pairs of small simple eyes on each side of the head. (Plate VII, fig. 2, Plate VIII, fig. 10). And since a certain amount of light enters the petiole through the entrance, at least when it happens to be unguarded, it is probable that under ordinary conditions the eyes are mainly useful in enabling the insects and particularly the larvæ, to stay in the dark. There is nothing to show that the young beetles, which leave the petioles to establish new colonies, do so because they become positively phototropic. The emigration may, perhaps, take place at night and even if it occurs during the day the light in the parts of the jungle where the young Tachigalias are growing, is very subdued. I believe that the young beetles must emigrate either because the space in the petiole has become too greatly reduced by the growth of the colony or because the food-supply has for the same reason become insufficient. In either case emigration would be due to internal stimuli ("physiological states"). These may also be important factors in the swarming of ants, bees and termites. We might, perhaps, even suppose that the guarding of the entrance by the beetles is due to an abortive or inhibited emigration impulse due to feebler or vaguer internal stimuli comparable with those which sometimes impel a person who has been sitting for hours in a dimly-lighted room, to stand at the window or open door or to step out into the sunlight.

Thus while it is easy to interpret many of the activities of the social Silvanids as adaptive reflexes it is difficult to assign to such stimuli as light, contact, chemicals, etc., the leading rôle which they have in the theories of Loeb and Bohn. Much of the behavior of the beetles, such as their treatment of the coccids, the building of the cocoon, mating, the guarding of the entrance, etc., so obviously depends on internal or physiological states that, in so far it has not become completely mechanized, we may more properly regard it as made up of cyclical activities like those recognized by Herrick (1910), Craig (1918) and others in birds. Craig especially has shown how much of the behavior of birds can be interpreted as cycles of appetence, or appetite and aversion, which he defines as follows: "An appetite (or appetence, if this term may be used with purely behavioristic meaning), so far as externally observable, is a state of agitation which continues so long as a certain stimulus, which may be called the appeted stimulus, is absent. When the appeted stimulus is at length received it stimulates a consummatory reaction, after which the appetitive behavior ceases and is succeeded by a state of relative rest. An aversion is a state of agitation which continues so long as a certain stimulus, referred to as the disturbing stimulus, is present; but which ceases, being replaced by a state of relative rest, when that stimulus has ceased to act on the sense-organs."

Rignano (1920) gives this same conception a more general physiological formulation in the following passage: "Every organism is a physiological system in a stationary condition and tends to preserve this condition or to restore it as soon as it is disturbed by any variation occurring within or without the organism. This property constitutes the foundation and essence of all "needs," of all "desires," of all the most important organic "appetites." All movements of approach or withdrawal, of attack or flight, of taking or rejecting which animals make are only so many direct or indirect consequences of this perfectly general tendency of every stationary physiological condition to remain constant. We shall soon see that this tendency in its turn is only the direct result of the mnemic faculty characteristic of all living matter. This single physiological tendency of a general kind, accordingly, is sufficient to give rise to a large number of the most diversified particular affective tendencies. Thus every cause of disturbance will produce a corresponding tendency to repulsion with special characteristics determined by the kind of disturbance, by its strength, and by the measures capable of avoiding the disturbing elements; and for every incidental means of preserving or restoring the normal physiological condition, there will be a quite definite corresponding tendency such as "longing," "desire," "attraction" and so forth. Even the instinct of self-preservation—when understood in the usual narrow sense of "preservation of one's own life"—is only a particular derivative and direct consequence of this very general tendency to preserve physiological invariability." This tendency, however, as Rignano remarks, is supplemented by another, "for as soon as the previous stationary condition cannot be restored by any means, that is by any movements or change of location, the organism disposes itself in a new stationary condition consistent with its new external and internal environment. In this way there originate a large number of new phenomena called 'adaptations'."

Of course, the contention that the appetites are fundamentally important in animal behavior is not new. It is merely astonishing that they have been so consistently ignored by many modern observers. The rôle of appetency, or appetite, was set forth with great acumen by the philosopher Fouillée, especially in the third book of his "Evolutionnisme des Idées Forces" (1920, first edition 1890). The germ of the conception, however, can be traced back to Reimarus (1798) and Leibnitz (Dwelshavers, 1908, p. 181), to the "appetitus sensitivus" of the schoolmen (see Maher, 1903, Chap. 10), and the ὄρεξις and τὸ ὀρεκτικόν of Aristotle (De Anim. 3, 10; Eth. Nic. 1, 13, 18). Recently the behavioristic psychologists, psychopathologists and students of the sympathetic nervous system and internal secretions, Mosso (1899), Drever (1917), Smith and Guthrie (1921), Goddard (1919), Kempf (1918), Crile (1915), Cannon (1915), and others, have emphasized the importance of the appetites and others have stressed their peculiarities in such terms as "tumescence" and "detumescence" in sexual psychology and "enhancement," "relief" and "catharsis" in art. Kempf (1921) in his valuable contribution to psychoanalysis has used the term "craving" instead of appetite, avoiding the "libido" of the Freudians which embodies the same notion. In a recent volume[1] Bertrand Russell takes essentially the same view of the phenomena of appetite but uses the word "desire." Most of the authors cited deal, of course, with man, but one can hardly overestimate the value of their work for the animal behaviorist and entomologist. It is certain that insects have well-developed sympathetic and glandular systems and that their alimentary and sexual behavior presents quite as definite a picture of appetites as does the corresponding behavior of the higher animals.

Fouillée believes that every appetition involves a rudimentary cognition and that automatic behavior like that of the habits and reflexes is merely lapsed appetition. If it could be shown that the latter really can have this derivation and that such ontogenetic mechanisms as habits can acquire representation in the germ-plasm and hereditary transmission, we might be in a position to give a consistent account of all animal behavior, and one which would lead us to regard the reflexes and the tropisms as ultimate, highly specialized end-stages instead of primitive, elemental components of behavior.

[1] "The Analysis of Mind," London and New York, Allen, Unwin & Macmillan, 1921.

POSTSCRIPT.

Just as the final proof of this paper was being returned to the printer Prof. I. W. Bailey received a letter from Col. David Prain, Director of the Royal Botanical Gardens of Kew, with the identification of the Tachigalia. It proves to be *T. paniculata* Aublet. Col. Prain compared our specimens with Aublet's type in the British Museum Herbarium.

Among the various social beetles considered in the latter part of my paper I should have included *Phrenapates bennetti* Kirby, the habits of which were studied by Ohaus (1909) in Ecuador. I shall have occasion to return to this insect in a future publication.

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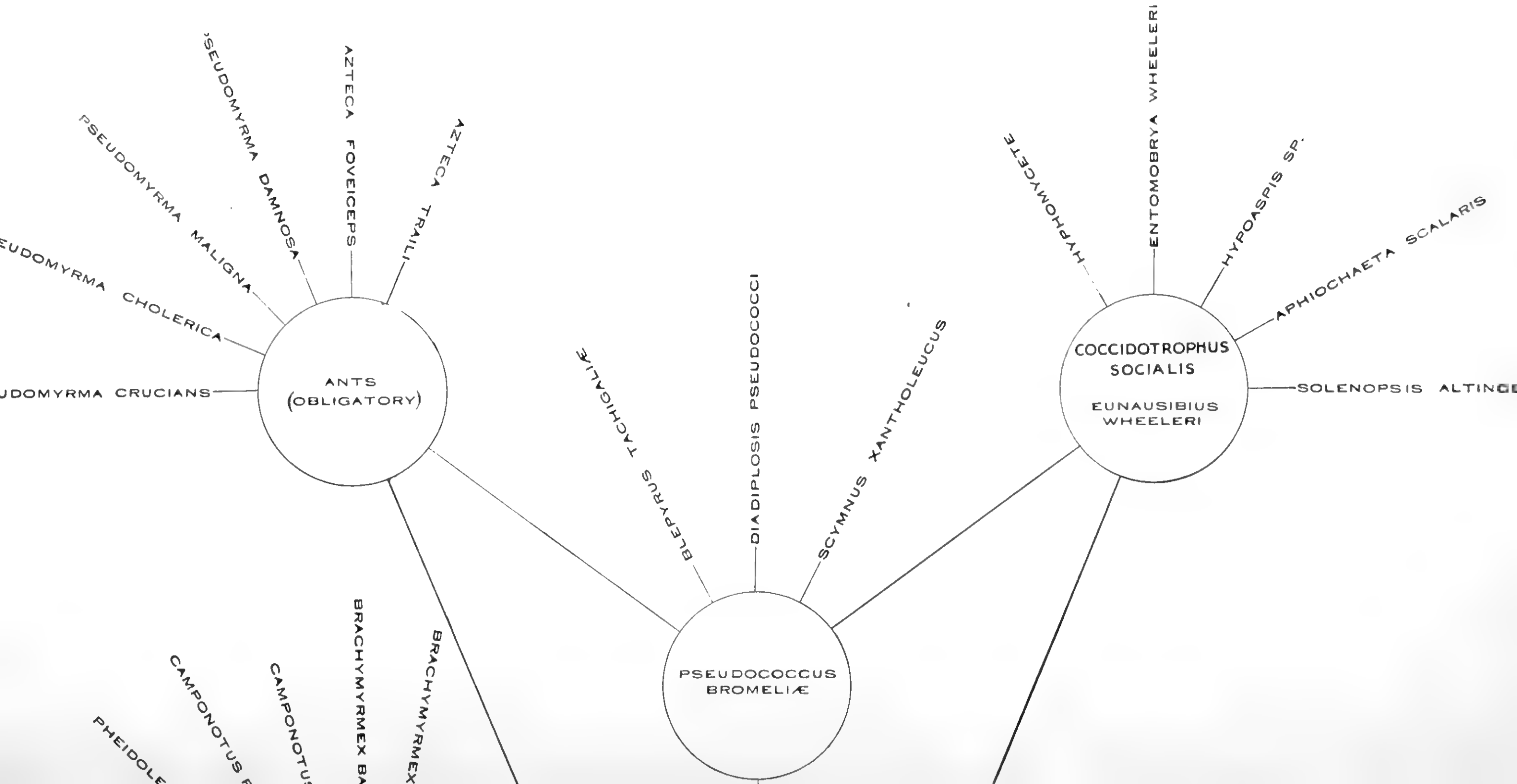
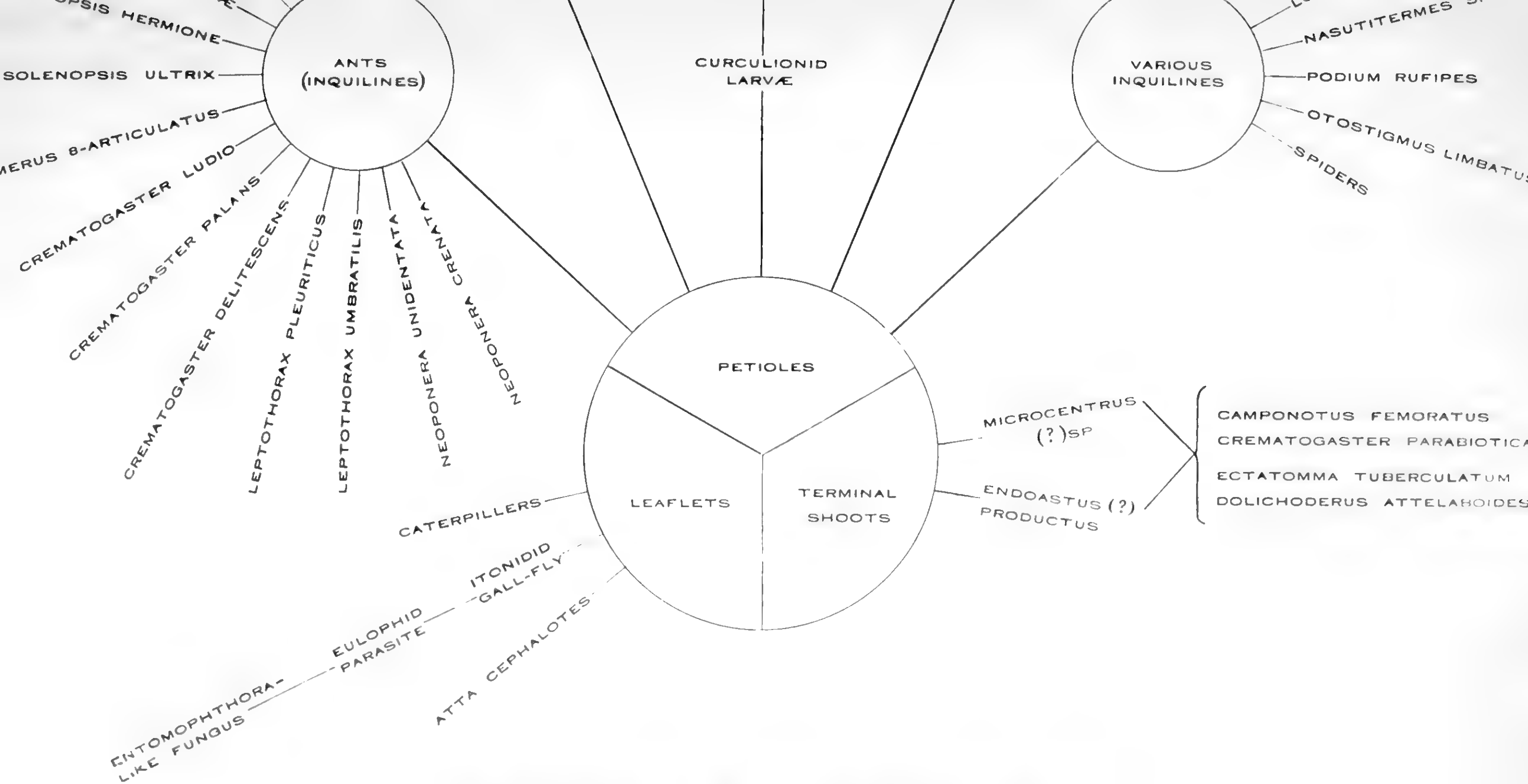
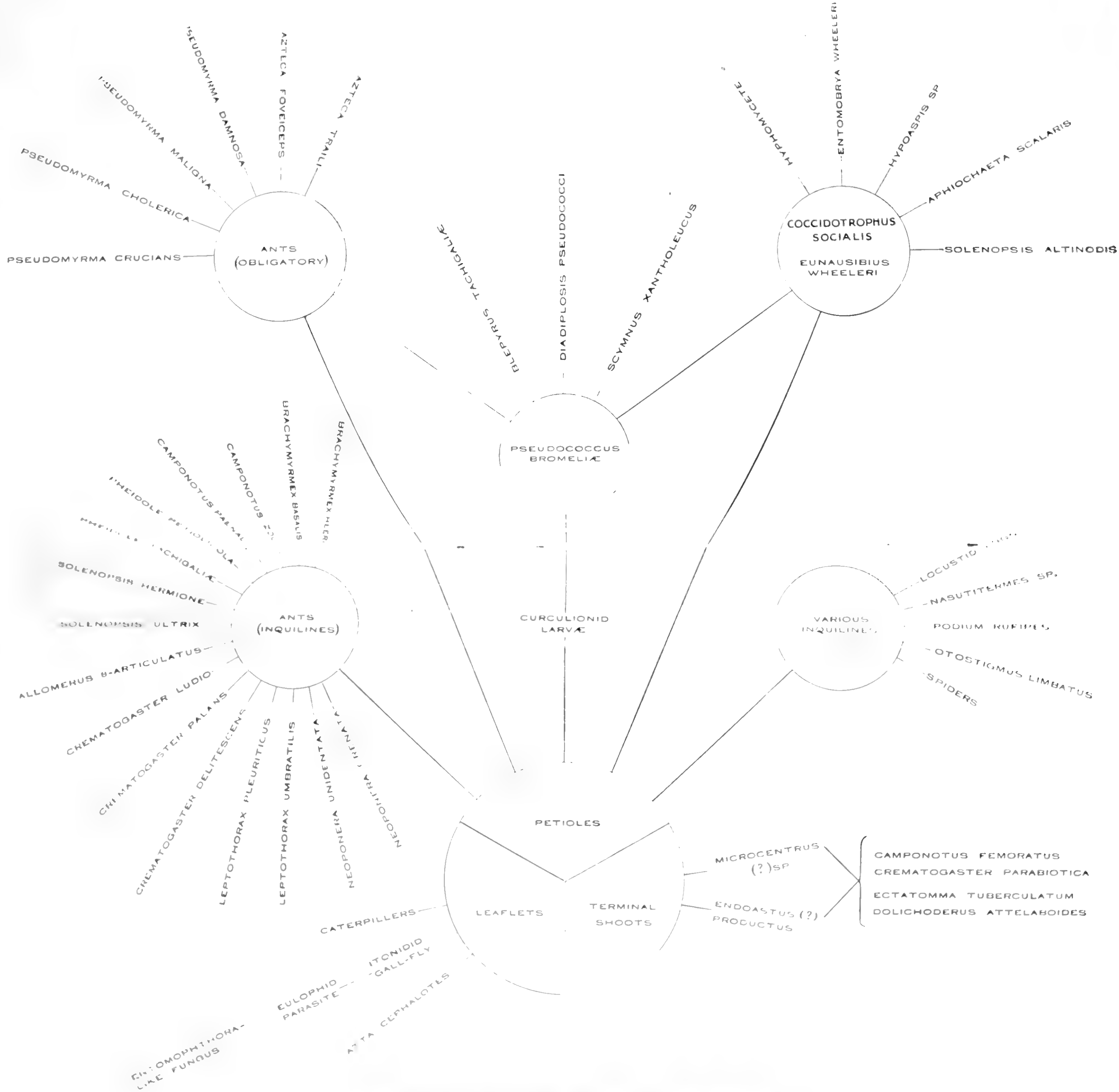
PLATE I. YOUNG *TACHIGALIA FORMICARUM* HARMS, FROM LETICIA, PERU.
From a photograph taken by E. Ule and reproduced from Plate V of his article in Kartsen and Schenck's Vegetationsbilder 4. Reihe, 1907.


ANTS (OBLIGATORY)
AZTECA TRAILI
AZTECA FOVEICEPS
SEUDOMYRMA DAMNOSA
PSEUDOMYRMA MALIGNA
EUDOMYRMA CHOLERICA
UDOMYRMA CRUCIANS
PSEUDOCOCCUS BROMELIÆ
BLEPYRUS TACHIGALIÆ
DIADIPLOSIS PSEUDOCOCCI
SCYMNUS XANTHOLEUCUS
COCCIDOTROPHUS SOCIALIS
EUNAUSIBIUS WHEELERI
HYPHOMYCETE
ENTOMOBRYA WHEELERI
HYPOASPIS SP.
APHIOCHAETA SCALARIS
SOLENOPSIS ALTINGE
BRACHYMYRMEX
BRACHYMYRMEX BA
CAMPONOTUS
CAMPONOTUS
PHEIDOLE



TACHIGALIA BIOCOENOSE



TACHIGALIA BIOCOENOSE

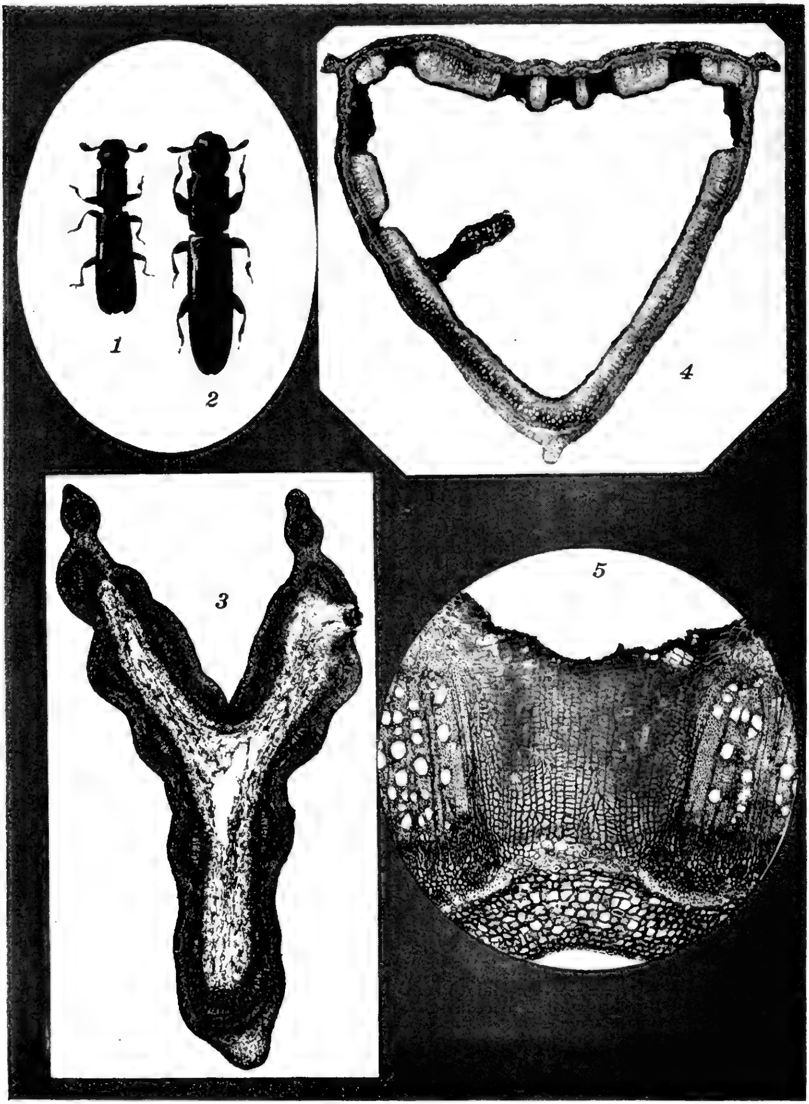


PLATE III.

Fig. 1. *Eunausibius wheeleri* Schwarz and Barber. X 8.
Fig. 2. *Coccidotrophus socialis* Schwarz and Barber. X 8.
Fig. 3. Cross section of base of very young petiole of adult *Tachigalia*, showing pith still in the cavity. Photograph by Prof. I. W. Bailey.
Fig. 4. Cross section of base of large petiole of *Tachigalia* inhabited by *Pseudomyrma damnosa*. The dark areas in the wall are nutritive parenchyma, which is not disturbed by the ants but nourishes their coccids. A portion of one of the carton partitions is shown on the left side. Photograph by Prof. I. W. Bailey.
Fig. 5. Cross section through one of the strands of nutritive parenchyma showing the cells with their homogeneous, amber-colored contents. Photograph by Prof. I. W. Bailey.

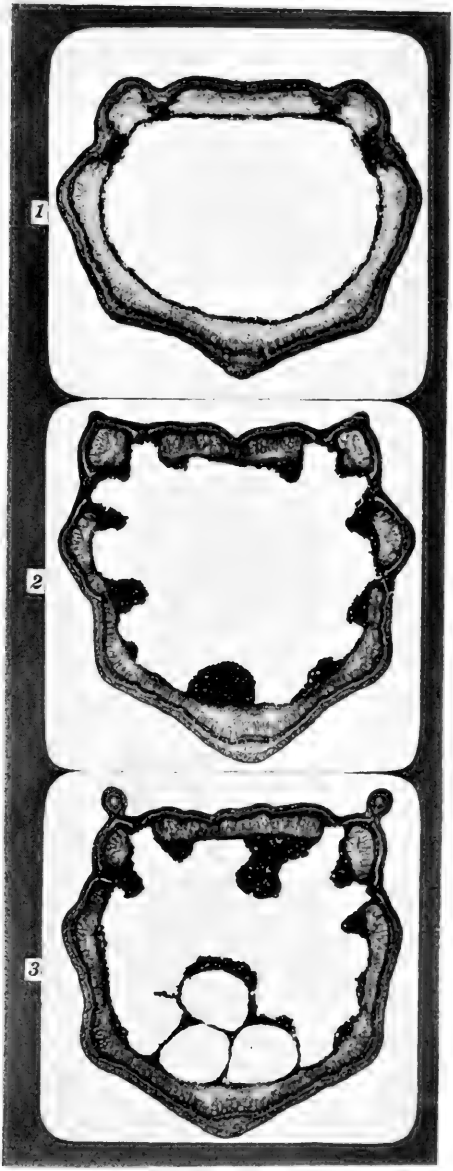


PLATE IV.

Fig. 1. Cross section of an as yet uninhabited petiolar swelling of a young *Tachigalia*, showing the intact nutritive parenchyma, large pith cavity, and thin layer of pith cells lining it. Photograph by Prof. I. W. Bailey.

Fig. 2. Cross section of a petiolar swelling inhabited by *Coccidotrophus socialis*, showing the gnawed nutritive parenchyma and the frass ridges. Photograph by Prof. I. W. Bailey.

Fig. 3. Section similar to that of Fig. 2 but showing three *Coccidotrophus* cocoons in cross section. Photograph by Prof. I. W. Bailey.

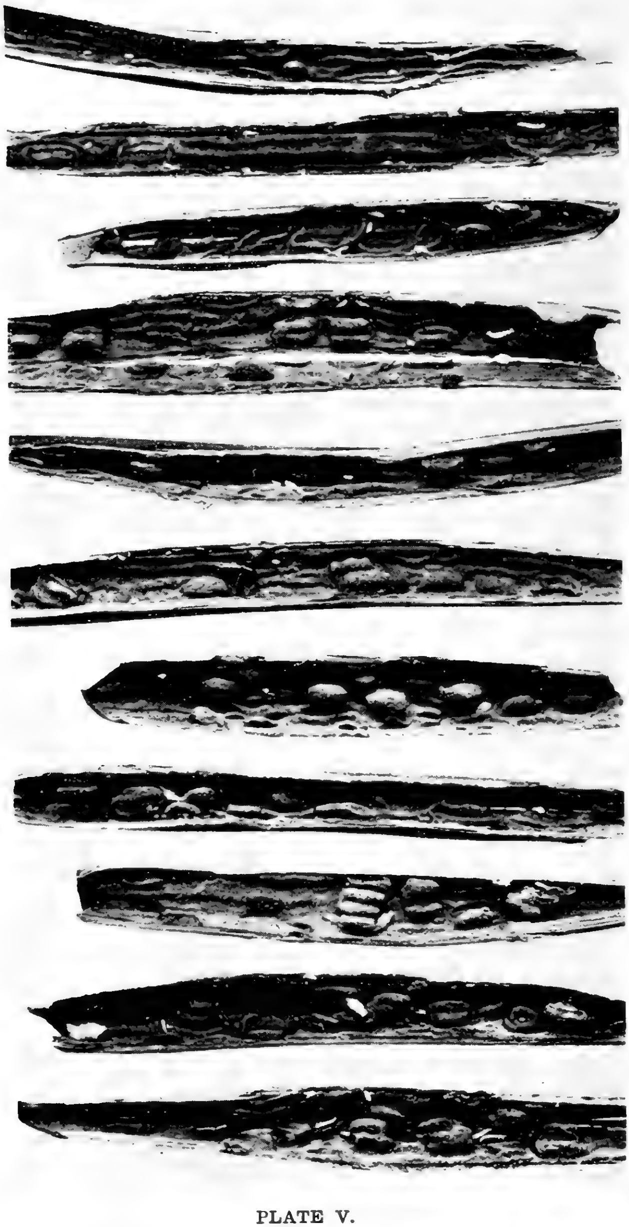


PLATE V.

Halves of various *Tachigalia* petioles seen from the inside, showing the arrangements of the cocoons, frass ridges, entrances, and in some cases also the beetles, larvæ and coccids and a pupa (second figure from below).

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THE TACHIGALIA ANTS

By WILLIAM MORTON WHEELER

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THE TACHIGALIA ANTS

By William Morton Wheeler

The early botanists Aublet (1775) and Spruce (1869, 1908), who first observed and collected *Tachigalia* in the forests of the Guianas and adjacent regions mentioned ants as inhabiting the swollen petioles but made no effort to have the species identified. As we have seen, Aublet coined the name of the plant from "tachi," the general native-name for the stinging ants of the genus *Pseudomyrma.* The white settlers of British Guiana call them "long John ants," but since the term "long John" is applied to the trees of the genus *Triplaris,* the "palo santo" of the Latin Americans, I have been unable to ascertain whether the name of the tree is derived from that of the ant or *vice versa,* for the tree is very tall and slender and the ants which inhabit its cavities are long and narrow. "Tachi," which is also used by the natives of Brazil for various species of *Pseudomyrma,* would seem to be the best name to introduce into the vernacular for all the species of *Pseudomyrma.*

For more precise knowledge of the ant-fauna of *Tachigalia* we are indebted to Ule (1907), who carefully collected the ants of this and many other myrmecophytes and turned them over to Forel to describe. In 1904 the eminent Swiss myrmecologist published a comprehensive paper on Ule's material, comprising ants from various species of the following genera of myrmecophytes: *Tococa, Maieta, Pseudocatopsis, Triplaris, Sapium, Cordia, Coussapoa, Duroia, Tachigalia, Platymischium, Pterocarpus,, Pterocladon, Schwartzia* and a peculiar *Polypodium*-like fern. He described, however, only two ants from *Tachigalia, Pseudomyrma latinoda* Mayr subsp. *tachigaliæ,* from the petioles and flower-bearing branches of *Tachigalia formicarum* Harms (Plate I.), collected by Ule at Tarapoto, Amazonas, and *Azteca tachigaliæ* from the petioles of an undetermined *Tachigalia* from Cerro de Escaler, in the mountains of Peru. Forel (1906) also recorded the *Ps. tachigaliæ* from the upper Rio Purus, Amazonas

(A. Goeldi and Huber). In 1912 he added *Ps. latinoda* var. *endophyta* from the Rio Ariramba, near the Rio Trombetas, Amazonas, basing the variety on specimens taken by A. Ducke in an unidentified *Tachigalia*. Stitz in 1912 records two additional ants taken by Ule in *Tachigalia* petioles: *Ps. picta* Stitz from Alto Acre, Brazil, and *Azteca brevicornis* Mayr from Rio Branco, Sierra de Maivasy, Brazil. I have been unable to find any other records of *Tachigalia* ants in the literature. Strangely enough, none of the five forms cited above occurs in the trees at Kartabo, but instead, the following forms, 28 in number, half of them belonging to new species, subspecies and varieties. I have no doubt that I could have greatly increased the number of species, had I been able to examine Tachigalias in other parts of British Guiana, or even in the Bartica District, had I been able to prolong my stay.

Subfamily Ponerinæ.

1.—*Ectatomma tuberculatum* (Oliver).

This large, rather sluggish, yellow-brown ant, the well-known "kelep," which Dr. O. F. Cook several years ago attempted to introduce into Texas from Guatemala for the purpose of preying on the cotton-boll weevil, was occasionally seen resting on the terminal shoots of young Tachigalias along the Puruni trail at Kartabo. It evidently feeds on the honey-dew of the Membracids, but more frequently it visits other plants, and especially the conspicuous saucer-shaped nectaries on the petioles at the junction of the leaflets of various species of *Inga*.

2.—*Neoponera unidentata* (Mayr).

A single deälated female founding a colony in a *Tachigalia* petiole. This species nests normally in the hollow twigs of various other trees.

3.—*Neoponera crenata* (Roger).

A single deälated female founding a colony in a *Tachigalia* petiole. This species nests in the hollow twigs of other trees. It is very common at Kartabo.

Subfamily Pseudomyrminæ.

4.—*Pseudomyrma damnosa* sp. nov.
(Fig. 13, a-c)

Worker. Length: 4.5-5 mm.

Head about one-quarter longer than broad, subrectangular, slightly narrower in front than behind, with feebly and evenly convex sides, and straight or very feebly convex posterior border, somewhat flattened above, in profile about three-fifths as high as long. Eyes rather small, only as long as their distance from the anterior border of the head, feebly convex. Mandibles stout, evenly convex, with two large apical and two or three indistinct basal teeth. Clypeus small and very short, convex but scarcely carinate in the middle, depressed on the sides, its anterior border very feebly sinuate in the middle, more strongly on each side. Frontal carinæ straight, subparallel, closely approximated, extending back to a line joining the anterior orbits. Antennæ short and rather slender; scapes scarcely incrassated apically, scarcely more than a third as long as the head, their tips reaching only to the anterior third of the inner orbits; first funicular joint longer than broad, constricted basally; joints 2-8 twice as broad as long, 9 and 10 somewhat longer in proportion to their width; terminal joint as long as the two preceding together. Thorax rather robust, shaped much as in *latinoda* Mayr and *arboris-sanctæ* Emery; pronotum with the neck as long as broad, evenly rounded above, concave on the sides but the dorsal surface not marginate laterally. Mesonotum flattened, broader than long, its anterior border strongly arcuate, its posterior border nearly straight. Mesoëpinotal constriction deep and abrupt. Epinotum longer than broad, a little broader in front than behind, in profile with the base horizontal and on a level with the pro- and mesonotum, distinctly longer than the sloping declivity, into which it passes through an even curve. Petiole from above subtriangular, about one and one-half times as long as broad, with straight sides; in profile about half again as long as high; the dorsal outline in profile concave anteriorly, the node evenly rounded and convex above, abruptly truncated behind; ventrally the surface is nearly straight, at its anterior end with a strong, compressed, acuminate tooth, directed downward but not backward. Postpetiole from above twice as broad as the petiole, nearly twice as broad as long, very convex above, but strongly narrowed and constricted anteriorly where it bears on the ventral surface an acute downwardly directed projection, smaller than that on the petiole; middle of the ventral surface strongly protuberant. Gaster elongate; sting long. Legs rather slender.

Smooth and shining, especially the head, which is very sparsely punctate; on the thorax the punctures are smaller and somewhat denser, and the gaster is very finely and superficially punctate and therefore appears somewhat less shining than the head and pronotum. Mandibles at their tips very finely striate and with coarse, elongate punctures; cheeks and pleuræ finely and superficially punctate.

Hairs sparse, golden yellow, erect or suberect on all parts of the body, rather short on the whole, longest on the petiole. Pubescence fine, distinct on the gaster, postpetiole, petiole, pleuræ, tarsi, tibiæ, funiculi and gula, not concealing the surface but rendering it somewhat less shining.

Brownish yellow; mandibles reddish brown, with black teeth; ocellar region, sutures of thorax, petiole, postpetiole, a patch on the center of each segment of the venter, the mesopleuræ, the femora, except their bases and tips and sometimes portions of the tibiæ, varying from pale to dark brown or blackish, clypeus and adjoining portions of head pale, clear yellow.

Female. Length: 7.5-9 mm.

Resembling the worker, but the head longer, with less convex sides and somewhat larger and more convex eyes and ocelli. Mandibles convex as in the worker, their external borders not geniculate at the base. Thorax rather long, in the region of the wing-insertions scarcely as broad as the head. Mesonotum rather convex, as long as broad. Epinotum sloping, the base one and one-half times as long as the declivity, which is even more abrupt than in the worker. Petiole and postpetiole somewhat longer in proportion to their width. Wings narrow and rather short, only 6.5 mm. long.

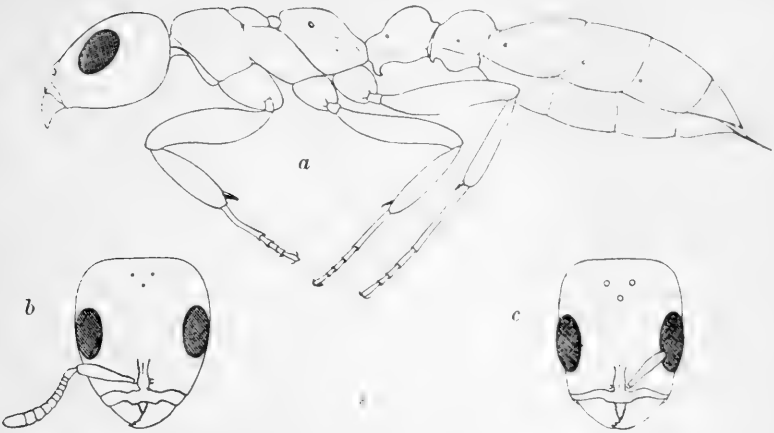

FIG. 13. *PSEUDOMYRMA DAMNOSA* SP. NOV.
a, worker in lateral view; *b,* head of same from above; *c,* head of female from above.

Head less shining, the fine punctures anteriorly and the larger punctures on the vertex deeper and more conspicuous. Gastric segments with large scattered punctures.

Hairs and pubescence much as in the worker but the pubescence decidedly longer and more dilute, so that the gaster appears more shining.

Color yellow, like the worker, but with more numerous and more extensive spots. There is a brown spot on the middle of the pronotum anteriorly, one on the mesonotum posteriorly, the sides of the thorax have an irregular brown pattern, the petiole is sometimes entirely brown, more often with the surface of the node yellow; the ventral and anterodorsal portion of the postpetiole, a broad band on each gastric segment above and a large spot on each ventral sclerite, dark brown. All the femora and the middle and hind tibiæ, except their tips and bases, are also dark brown. In some specimens the dorsal banding of the gaster is more indistinct, in others the gaster may be described as dark brown with yellow posterior borders to the segments, less frequently the dark brown spot on the mesonotum becomes a Y with its branches extending to the anterior border of the sclerite. The scutellum and postscutellum are usually dark brown throughout. Wings pale fuscous, iridescent, with dark brown veins and pterostigma.

Male. Length: 5.5-6 mm.

Head through the eyes as broad as long, narrowed behind, with broadly concave posterior border; eyes and ocelli large; cheeks very short; mandibles well developed, with two larger apical and several indistinct basal teeth. Clypeus advanced and convex in the middle, its anterior border deeply sinuate on each side. Antennæ short; scapes twice as long as broad; first funicular joint as long as broad; joints 2-10 about twice as long as broad, terminal joint longer. Thorax shaped much as in the female, but the epinotum evenly rounded and sloping, without distinct base and declivity. Petiole and postpetiole like those of the worker but their ventral teeth are smaller. Gaster broadened, or clavate at the tip. Legs slender.

Surface of body less shining and less distinctly punctate than in the worker.

Pilosity and pubescence as in the female but less abundant.

Color of a duller brownish yellow; mandibles not darker; posterior portion of head, large spots on pleuræ, a large spot at the anterior end of the pronotum, lateral borders and a Y-shaped spot on the mesonotum, the epinotum, except its disc, the petiole, postpetiole and gastric segments, except the anterior and posterior border of each segment, the femora and tibiæ, except their tips and bases and the anterior tibiæ, dark brown. Venter yellowish, at least posteriorly; tips of genitalia infuscated. Wings colored as in the female.

Described from numerous specimens taken at Kartabo and the Penal Settlement, in the petioles of large specimens of *Tachigalia* growing in the sun.

This species is very closely related to *Ps. latinoda* Mayr and *arboris-sanctæ* Emery. The worker differs from that of the former, however, in its longer head, smaller and more flattened eyes, more approximated frontal carinæ and smoother and more shining surface. The var. *nigrescens* Mayr of *latinoda* approaches *damnosa* more closely, to judge from three workers from Pará received from Forel. The form described as var. *tachigaliæ* Forel, of which I possess a couple of cotypes, is much more opaque, more brownish, with longer head and antennæ, larger eyes, more slender thorax, much more angular epinotum and feebler pilosity. The var. *endophyta* Forel resembles *damnosa* in coloration, but the description is very brief. In *arboris-sanctæ* the body and eyes are larger, the antennæ decidedly longer, the petiolar node more strongly truncated behind, with submarginate sides, the postpetiole is smaller and narrower, the color uniformly brownish yellow. *Ps. damnosa* is also closely related to *dendroica* Forel, but this form is larger, with a different sculpture and color, a different petiole, etc. Stitz's *Ps. picta*, too, is an allied form but, to judge from his figure, has very large eyes and a very different thorax, petiole and postpetiole. It is certain, nevertheless, that all the forms mentioned—*damnosa, latinoda, arboris-sanctæ, dendroica* and *picta*—as well as *triplaridis* Forel and the species *maligna*, described below, constitute a peculiar group of very closely related tachis confined to living myrmecophytes. One might regard the whole complex as a single highly variable species, but in the present state of our knowledge it is advisable not to indulge in too much "lumping" in the genus *Pseudomyrma.*

5.—***Pseudomyrma maligna*** sp. nov.

(Fig. 14 a-c)

Worker. Length: 4-4.6 mm.

Very similar to the preceding species but slightly smaller, head somewhat broader and shorter, eyes distinctly smaller, less elongate and more flattened; ocelli smaller and further apart; mandibles more flattened with less curved external borders, frontal carinæ less approximated, antennal scapes shorter and more incrassated towards their tips. Clypeus sharply carinate, depressed on the sides, its anterior border emarginate laterally, produced in the middle as a short, transverse lobe, with feebly concave margin and sharp corners. Thorax shorter and more robust than in *damnosa;* pronotum broader, more convex on the sides and above; mesoëpinotal impression shorter but quite as deep; epinotum decidedly shorter, the base from above subhexagonal, broader behind than in front, and almost marginate on the sides, more flattened, appearing straight in profile, the declivity of the same length and forming with the base a more

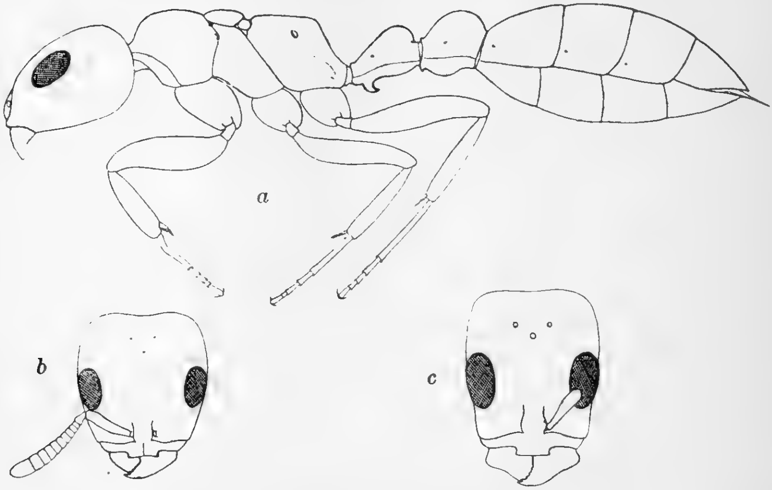

FIG. 14. *PSEUDOMYRMA MALIGNA* SP. NOV.
a, worker in lateral view; *b*, head of same from above; *c*, head of female.

distinct angle. Petiole shorter, only one and one-half times as long as broad, the node more rounded and more abruptly truncated behind, the spine at the anterior end of the ventral surface longer, more curved and hook-like. Postpetiole more convex above and at the sides, its anteroventral tooth less acute. Gaster more slender; legs somewhat shorter.

Surface of body even smoother and more shining than in *damnosa;* mandibles, head and thorax very smooth, with very small, shallow, uniformly scattered punctures; pedicel and gaster with even smaller and more indistinct punctures.

Hairs pale yellowish, short, uneven and similar to those of *damnosa* but much less numerous. Pubescence shorter and more dilute, so that it does not dim the shining surface of the gaster, longer and more distinct on the tibiæ and tarsi.

Deep castaneous; mandibles, clypeus, cheeks, antennæ, pronotum usually, sides of epinotum, petiole and postpetiole, wholly or dorsally, sides and bases of the gastric segments, legs, except the middle portions of the femora of all the pairs and of the tibiæ of the middle and hind pairs, yellowish brown. In some specimens the pronotum is also more or less castaneous above and in some the fore legs are brownish yellow throughout. There is also considerable variation in the coloration of the petiole, postpetiole and gaster. In some specimens the petiole is entirely castaneous and only the node of the postpetiole is yellowish brown, or the yellowish brown at the bases of the gastric segments may be much reduced. The whole epinotum may also be castaneous in dark individuals.

Female. Length: 7.5-8.5 mm.

Head one and one fourth times as long as broad, subrectangular, slightly narrower in front than behind, with rather straight sides and feebly and broadly excised posterior border. Eyes and ocelli larger and more convex than in the worker. Mandibles short, with the external borders, abruptly geniculate at the base, the upper surface flattened, their apical borders with two sharp terminal and no basal teeth. Epinotum rounded, but with distinct, subequal base and declivity. Petiole one and two-third times as long as broad, the node somewhat depressed above, its sides rather bluntly submarginate, its ventral tooth large; postpetiole nearly as long as broad, less than twice as broad as the petiole. Gaster elongate. Wings narrow and short (6 mm.).

Sculpture much as in the worker, but mandibles striatopunctate and anterior portion of head more opaque and more densely punctate.

Pilosity and pubescence as in the worker.

Black; mandibles castaneous red; antennæ brownish yellow; the scapes sometimes slightly infuscated in the middle; clypeus, gula, pronotum and sutures of the thorax more or less castaneous; lateral borders of the ventral and dorsal sclerites of the gaster, tarsi and tibiæ brownish yellow; the middle and hind tibiæ infuscated in the middle of their extensor surfaces; femora blackish, with brownish tips and bases. Wings grayish hyaline, iridescent, not infuscated, with very distinct blackish veins and pterostigma.

Male. Length: 7.4-7.6 mm.

Head through the eyes as long as broad, eyes and ocelli larger than in *damnosa;* antennal scapes and first funicular joint, decidedly longer. Clypeus strongly carinate, slightly projecting in the middle, its sides impressed, their anterior borders bisinuate. Head behind the eyes narrowed but more convex and rounded than in *damnosa.* Epinotum somewhat longer and slightly more angular in profile, the ventral spine of the petiole much larger, nearly as large as in the female, the terminal dorsal segment of the thorax of a different shape, its posterior border produced as a narrow blunt point in the middle.

Shining, like the worker; even the mandibles and head very smooth and shining, the former striolate at the tips, punctate at the base, the head more densely punctate anteriorly as in the female.

Pilosity and pubescence much as in the worker.

Black; mandibles testaceous, infuscated at the base; antennæ fuscous, first funicular joint and tips and bases of scapes yellowish. Thoracic and abdominal sutures brown. Legs yellowish or pale brown, the femora, except their tips and bases, dark brown, the extensor surfaces of the hind tibiæ infuscated. Wings as in the female.

Described from many specimens from Kartabo, nesting, like the preceding species, in the petioles of large Tachigalias. Though closely related to *damnosa, arboris-sanctæ,* etc., this species seems to me to be specifically distinct. It also resembles *triplaridis* Forel and another species, which is found in *Triplaris surinamensis* near Kartabo and will be described elsewhere. Among my material there are also two varieties of *maligna* found nesting in some of the smaller Tachigalias; namely:

6.—*Pseudomyrma maligna* var. **cholerica** var. nov.

Worker. Length: 3-3.5 mm.

Distinctly smaller than the typical form and similarly colored, but the lighter parts are more extensive and often of a more washed-out, sordid yellow, whereas the darker parts are more piceous or blackish. The clypeus, cheeks, petiole and postpetiole are pale yellow, as are also the thorax, except the base of the epinotum and a fuscous cincture in the mesonotal region. The gula and first gastric segment are apt to be paler than the upper surface of the head. Except in size, this variety is not very sharply marked off from the type.

7.—*Pseudomyrma maligna* var. ***crucians*** var. nov.

Worker. Length: 3-3.5 mm.

Of the same size as the preceding variety but with a decided tendency to melanism, the whole thorax, pedicel and gaster being very dark brown or black in mature specimens. The middle of the scapes is infuscated and there may be occasionally pale markings on the node of the postpetiole and at the bases and sides of the gastric segments.

Subfamily Myrmicinæ.

8.—*Pheidole cramptoni* Wheeler subsp. ***petiolicola*** subsp. nov.

Soldier. Length: 2.3-2.6 mm.

Decidedly smaller than the type, which measures 4 mm., and differing as follows: head with the anterior corners even more decidedly turned outward, anterior gular teeth more slender and more acute; eyes slightly larger and distinctly convex (flat in the type); antennæ shorter, the tips of the scapes reaching the lateral borders of the head two-fifths of their length from the anterior corners (nearly half their length in the type). Thorax shorter and proportionally stouter; epinotal spines slightly shorter; postpetiolar node hemispherical and evenly convex above, without distinct anterior angles. Interrugal spaces on the anterior portion of the head less distinctly reticulate, so that the rugæ seem to be sharper. Surface of the body smoother and more shining. Pilosity quite as well developed as in the type. Color more vivid but the dark and light areas distributed in the same manner. Mandibles and clypeus red, with dark brown borders; anterior two-thirds of head clear ivory yellow, with a large elongate castaneous spot between the frontal carinæ; posterior two-thirds of head with a band extending forward on each side to the eye; the thorax, petiole, postpetiole and gaster rich castaneous, the first gastric segment, femora and pleuræ somewhat paler; frontal carinæ, tibiæ and antennæ reddish; tarsi yellowish.

Worker. Length: 1.4-1.6 mm.

Slightly smaller than the worker of the typical form, somewhat darker brown, with distinctly shorter antennæ, the scapes reaching back beyond the border of the head only to a distance equal to their greatest diameter. Head shorter, with more distinct posterior corners. Epinotal spines somewhat smaller.

Described from several specimens found with brood in a young *Tachigalia* petiole near Kartabo. The types of the species were collected by Dr. F. A. Lutz at Kaieteur, British Guiana.

9.—*Pheidole tachigaliae* sp. nov.

Soldier. Length: about 2 mm.

Head large, subrectangular, about one-quarter longer than broad, as broad in front as behind, with rather straight, subparallel sides and deeply, angularly excised posterior border, vertex with a large and rather deep impression, without a median groove between it and the frontal area where the head is uniformly convex. Gular teeth small and blunt. Eyes small and moderately convex, only about their own length distant from the clypeus. Frontal carinæ long, very far apart, curved, gradually diverging behind towards the posterior corners of the head, forming the inner borders of broad, shallow, but distinct scrobes for the antennæ. These scrobes and the frontal carinæ reach nearly to the posterior corners of the head. Mandibles stout and very convex, with a pair of blunt, apical teeth. Clypeus flat, ecarinate in the middle, its anterior border somewhat retuse, feebly sinuous in the middle and on each side. Frontal area rather large, triangular, shallow, with a small median pit. Antennæ slender, scapes curved, not incrassated or flattened but slightly enlarged distally, reaching nearly to the middle of the lateral borders of the head; antennal club somewhat shorter than the remainder of the funiculus, its two basal joints subequal, broader than long, together equal to the terminal joint; first funicular joint large; joints 2-6 small and transverse. Thorax very short, broad through the humeri which are prominent and subangular; promesonotal suture distinct but not impressed. In profile the pro- and mesonotum form together a high hemispherical mass, the mesonotum descending abruptly behind to the pronounced mesoëpinotal constriction. Epinotum small and low, subcuboidal, broader than long, in profile with subequal base and declivity, the former straight and horizontal in profile, the latter very steep and concave, the spines very small and acute, scarcely longer than broad at their bases, directed backward and very slightly upward. Petiole slender, pedunculate, the node at its posterior end abrupt, anteroposteriorly compressed, its border moderately sharp, transverse and very feebly sinuate in the middle. Postpetiole slightly broader than the petiolar node, transverse, with rounded sides. Gaster oval, about as large as the head, convex above and below. Legs moderately long, with thickened femora and tibiæ.

Shining; mandibles and middle of clypeus smooth, the former with coarse, scattered, piligerous punctures; antennal scrobes reticulate; remainder of head longitudinally rugose, the rugæ rather straight and subparallel extending to the posterior corners, the interrugal spaces and posterior part of the head rather loosely reticulately rugose. Pro- and mesonotum smooth and shining above; pleuræ and epinotum more opaque, finely reticulate or punctate, as are also the ventral portions of the petiole and postpetiole; the nodes of the latter, the gaster and legs smooth and shining.

Hairs pale, golden yellow, erect, of uneven length, moderately abundant, rather uniformly covering the dorsal surface of the body. Pubescence almost absent.

Reddish yellow; gaster and appendages paler yellow, the former with a brown transverse band or cloud on the posterior portion of each segment. Mandibles red, with black borders; clypeal border also blackish. Impression on the vertex with a small, indistinct brown spot.

Worker. Length: 1-1.1 mm.

Head subrectangular, as long as broad, its sides rather rounded, its posterior border feebly but distinctly emarginate in the middle. Eyes rather large, flat, in front of the middle of the head. Mandibles with oblique, indistinctly denticulate apical borders. Frontal area obsolete. Clypeus rather convex in the middle, the anterior border transverse, entire. Antennal scapes extending only very slightly beyond the posterior corners of the head. Thorax shaped somewhat as in the soldier, but the upper surface of the pro- and mesonotum more flattened. Epinotum longer than broad, with very minute, acute teeth. Petiole, postpetiole, gaster and legs resembling those of the soldier.

Mandibles smooth and shining, sparsely and indistinctly punctate. Clypeus, head, thorax, petiole and postpetiole subopaque, finely, densely and uniformly punctate; postpetiolar node slightly shining, gaster and legs very smooth and shining.

Pilosity like that of the soldier.

Brownish yellow; mandibles, appendages and gaster paler, yellow; the gaster without dark fasciæ.

Female (deälated). Length: 2.5 mm.

Head subrectangular, a little longer than broad, a little narrower in front than behind, with straight sides and posterior border. Frontal carinæ and antennal scrobes as in the soldier. Antennæ longer, the scapes reaching to the posterior third of the lateral borders of the head. Upper surface of head convex, without vertical impression. Ocelli rather far apart. Thorax elliptical, as broad as the head, the mesonotum and scutellum flat above. Epinotum very small and sloping, with small teeth. Petiole and postpetiole much as in the soldier; gaster larger and more elongate.

Sculpture, pilosity and color as in the soldier. There is a black spot on the ocellar triangle and the brown fasciæ on the gaster are broader and darker. Wing insertions blackish.

Described from specimens from a single colony with brood, taken August 23 at Kartabo from a petiole of a small *Tachigalia.*

This species is very peculiar on account of its small size and the antennal carinæ of the soldier and worker. In the latter particular it seems to approach *Ph. scrobifera* Emery of Costa Rica, but this species is decidedly larger, with much longer epinotal spines, quite different sculpture, etc.

10.—*Crematogaster (Orthocrema) limata* F. Smith var. *palans* Forel.

A single colony with two deälated females, of what I take to be this variety, was found August 6, nesting in a small *Tachigalia* petiole at Kartabo. The workers are smaller than those of the typical *limata*, possibly because the colony was young. The antennal scapes are longer than in the type from Panama, but Forel mentions specimens from Pará Brazil, with longer antennæ.

The female measures nearly 6 mm. and is very deep brown, almost black, with the mandibles, legs and antennal clubs yellowish brown, the femora and tibiæ somewhat infuscated in the middle. Head subrectangular, broader than long, nearly as broad in front as behind, with straight, subparallel cheeks as long as the eyes. Antennal scapes extending a short distance beyond the posterior corners of the head. Thorax a little more than twice as long as broad; slightly narrower than the head, elongate elliptical from above, the nearly vertical epinotum with a pair of slender, pointed spines, longer than broad at their bases. Petiole subelliptical, truncated behind, its posterior corners distinctly angular; in profile twice as long as high, with nearly flat dorsal surface and a small tooth at the anteroventral margin. Postpetiole as broad as the petiole, somewhat depressed above, truncated behind. Gaster rather large, convex on the sides and above, pointed behind and emarginate anteriorly. Legs moderately slender. Surface of body very smooth and shining. Mandibles smooth, with a few small, scattered, piligerous punctures. Cheeks, sides of front, sides and declivity of epinotum longitudinally striate; mesonotum with coarse, scattered, piligerous punctures, the punctures on the gaster quite as sparse, but smaller. Hairs golden yellow, moderately abundant, erect, of uneven length, most numerous on the head, well-developed on the scapes and legs.

12.—*Crematogaster (Orthocrema) limata* F. Smith subsp *ludio* Forel.

Two colonies with deälated females, taken August 10 and September 3 from petioles of young Tachigalias on the Cuyuni trail at Kartabo. The workers agree well with Forel's description and with specimens taken elsewhere in British Guiana by F. A. Lutz, F. M. Gaige and myself.

The female closely resembles that of the var. *palans*, but the head is longer, fully as long as broad and more narrowed anteriorly; the epinotal spines are shorter and stouter, not longer than broad at their bases, the posterior angles of the petiole are less acute, the mandibles are darker, the legs paler and more uniformly brownish yellow, the hairs on the body are whitish.

12.—*Crematogaster (Orthocrema) limata* F. Smith subsp. *parabiotica* Forel.

This subspecies was not found nesting in the petioles but attending Membracids on the shoots of young Tachigalias. As I have shown in another paper (1921) it commonly lives in parabiosis with *Camponotus femoratus* (*vide infra* p. 167) in the peculiar "ant-gardens" attached to the trunks and branches of trees in the moist jungle. Both species of ants forage together and when found on *Tachigalia* the workers intermingle on the shoots and are very friendly to one another and to the Membracids but very pugnacious when interfered with.

13.—***Crematogaster*** (***Orthocrema***) ***delitescens*** sp. nov.

Worker. Length 2-2.1 mm.

Head nearly circular, convex and rounded above, without distinct posterior corners; eyes moderately convex, situated just behind the middle of the sides, distant nearly twice their length from the anterior border of the head. Mandibles narrow, convex, their short apical borders with four small teeth. Clypeus convex in the middle, its anterior border slightly reflected, broadly and evenly rounded. Frontal carinæ short, subparallel. Antennæ slender; scapes extending a little beyond the posterior border of the head; funicular joints 2-8 as long as broad, ninth joint longer than broad; club slender, decidedly shorter than the remainder of the funiculus, its basal about two-thirds as long as its terminal joint. Thorax short; pro- and mesonotum together subtriangular from above, as broad as long; the pronotum flattened, marginate on the sides, the mesonotum very short and narrow, declivous, strongly carinate on each side. Promesonotal suture feeble; mesoëpinotal suture distinct, but very short. Epinotum very short, sloping between the spines, which are slender, straight and acute, a little longer than the sides of the base, much shorter than their distance apart and directed backward and slightly upward. Petiole oblong, a little longer than broad, with parallel sides, constricted at the anterior end, the posterior corners projecting as minute tubercles. In profile it is about one and one-half times as long as broad, with very feebly convex dorsal and ventral surfaces and without a distinct anteroventral tooth. Postpetiole small, broader than long, the node entire, anteroposteriorly compressed. Gaster elongate triangular, tapering and pointed posteriorly, concave dorsally, convex ventrally, the anterior border of the first segment straight and transverse.

Shining: mandibles smooth, with a few small, scattered punctures. Head very smooth and shining, cheeks indistinctly striolate-reticulate. Clypeus with two sharp, longitudinal rugæ on each side, smooth and shining in the middle. Pronotum with a few longitudinal rugæ on the disc, abbreviated behind; mesonotum and epinotum subopaque, regularly and evenly reticulate, except the most posterior portion of the latter, which is smooth in the middle; pronotum on the sides, petiole and gaster smooth and shining; postpetiole with short longitudinal furrows above.

Hairs whitish, long, sparse, rather blunt but not clavate on the dorsal surface of the body; anterior surfaces of antennal scapes with a row of long, rather flexuous hairs. On the legs the hairs are very short, appressed and rather sparse.

Piceous brown; head and gaster darker; base of scape and of funiculus paler; mandibles and tarsi brownish yellow.

Female (deälated). Length 4.7 mm.

Head subrectangular, nearly as broad as long, and nearly as broad in front as behind, with rounded posterior corners and straight, parallel cheeks. Eyes at the middle of the sides, elongate. Antennal scapes scarcely reaching to the posterior corners of the head. Thorax from above elongate elliptical, decidedly narrower than the head; mesonotum one and one-third times as long as broad; epinotum abrupt, without base or declivity, the spines of the worker represented by blunt angles on the sides. Gaster elongate, with subparallel sides, the first segment subrectangular, nearly as long as broad.

Smooth and shining, the epinotum between the angles reticulate, the node of the postpetiole smooth.

Hairs decidedly shorter than in the worker, more abundant on the head and thorax than on the abdomen.

Color much like that of the worker, but the thorax as dark as the head and gaster, except the anterior portion of the pronotum, the prescutellum and epinotum which are more castaneous.

Described from a female and several workers constituting a single small colony found July 24 nesting in the petiole of a young *Tachigalia* growing on the Cuyuni trail, near Kartabo.

This form approaches *C. sumichrasti* Mayr in many particulars but is, I believe, quite distinct, especially in the shape of the head, mesonotum and petiole, in the pilosity of the legs, color, etc. It also recalls forms like *limata* Smith, *brasiliensis* Mayr and *lutzi* Forel. The antennal club might be regarded as indistinctly three-jointed. The female is very small compared with the corresponding phase of the *limata* group. Mayr's *laevis* is also a closely allied form, but the petiole and median funicular joints of this species are shorter, the pro- and epinotum smoother, the color is paler, etc. I have three workers taken by Mr. F. M. Gaige at Castries, St. Lucia, W. I., which agree very closely with the types of *delitescens*.

14.—*Solenopsis altinodis* Forel
(Fig. 15, a-c).

Worker. Length 1.8-2.1 mm.

Head about one and one-sixth times as long as broad, subrectangular, as broad in front as behind, with straight posterior and very feebly convex sides. Eyes consisting of about a dozen ommatidia, well in front of the median transverse diameter of the head, and about four times their diameter from the anterior corners. Mandibles with evenly convex external borders, the

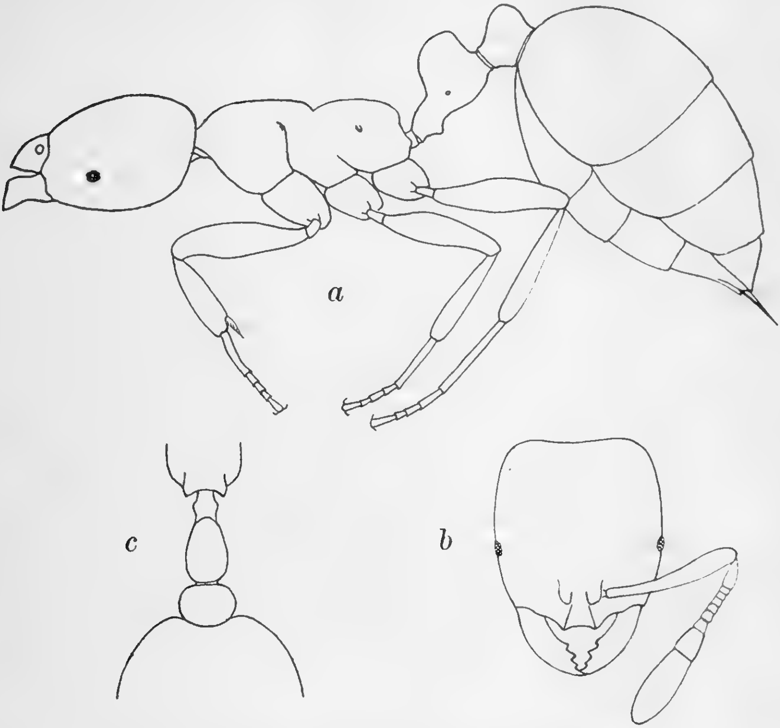

FIG. 15. *SOLENOPSIS ALTINODIS* FOREL, WORKER.
a, lateral view of body; *b*, head from above; *c*, petiole and post petiole from above.

apical borders oblique, with four distinct teeth. Clypeus projecting, with the usual pair of sharp carinæ. These do not end at the border in sharp teeth, but in small, rather blunt projections. Lateral denticles lacking. Frontal area distinct, impressed. Antennal scapes reaching nearly to the posterior fourth of the head. Funiculi about as long as the two-jointed club; joints 2-7 broader than long, 2-6 being fully twice as broad as long; basal joint of club a little longer than broad, somewhat less than a third as long as the terminal joint. Thorax slender; pronotum with subrectangular humeri and straight subparallel sides, in profile evenly and feebly convex above. Mesoëpinotal constriction short but pronounced; epinotum long, its base feebly convex, indistinctly bidenticulate behind and nearly twice as long as the declivity which is abrupt and distinctly marginate on the sides. Petiole in profile very large, with distinct peduncle and longer abrupt node, which is much higher than the epinotum, higher than long, in profile subrectangular, with vertical anterior and posterior borders and subhorizontal superior outline rounded at each end. The ventral surface is convex behind and concave in front, with an angular projection but no distinct tooth near the anterior end. Seen from above the petiole is twice as long as broad, gradually enlarged behind, so that the node is seen to be much compressed laterally. Postpetiole in profile much higher than long, the summit of its node rounded, not attaining the height of the petiole. From above the postpetiole is somewhat broader than the petiole and slightly broader than long. Gaster large, the anterior border of the first segment somewhat concave. Sting long and powerful. Legs moderately long and slender.

Smooth and shining, with minute, scattered, indistinct, piligerous punctures; cheeks and sides of front finely striate.

Hairs pale yellowish, bristly, of uneven length, moderately abundant, erect or suberect, rather long on the body, shorter on the antennæ and legs.

Dull reddish brown; head and especially the gaster dark brown; mandibles, clypeus, cheeks, antennæ and legs yellow; middle portions of scapes, femora and tibiæ more or less infuscated.

I have redescribed this species, originally described from Venezuela and Trinidad, from many specimens taken at Kartabo. It does not live in the petioles of *Tachigalia* but in the ground and often enters those inhabited by the *Coccidotrophus* and *Eunausibius* and destroys their colonies (*vide supra* p. 82). I was never able to secure the sexual forms and brood. The worker is readily distinguished from the numerous other South American species of *Solenopsis* by the peculiar, high, compressed petiolar node, marginate and subbidentate epinotum, nearly unarmed clypeus and unusual coloration.

15.—*Solenopsis helena* Emery subsp. ***hermione*** subsp. nov.

Worker. Length 1.6-1.8 mm.

Differing from the typical *helena* of Chile in its somewhat greater size (*helena* measures 1.3-1.5 mm.), in having the head slightly shorter, with more rounded sides, joints 2-7 of the funiculus very slightly longer as compared with their width, so that the club is shorter in proportion to the remainder of the funiculus. The epinotum is evenly convex, without indications of an angle between the base and declivity, and the summit of the petiolar node is not so thick in profile. The eyes, which are not figured or described by Emery for the type, are very small and consist of only four ommatidia.

Female. Length 3.3 mm.

Differing from the typical *helena* in color, being yellow, like the worker, instead of pale brown, with the ocellar triangle, a broad dorsal band and a large ventral spot on each gastric segment dark brown. Each of these spots and bands is emarginate posteriorly. In old, deälated females the wing-insertions are also dark brown. Wings gray, rather opaque, with distinct brown veins and dark brown pterostigma.

Described from numerous specimens taken from several colonies found in the petioles of young Tachigalias along the Cuyuni trail at Kartabo. It nests also in the hollow twigs of various other plants.

16.—*Solenopsis helena* subsp. ***ultrix*** subsp. nov.

Worker. Length 1.6-1.8 mm.

Of the same size as the preceding subspecies but differing in having the head still broader in proportion to its length and with more rounded sides and posterior corners, the posterior margin straight or even slightly convex. The antennal scapes are distinctly longer, attaining the posterior fourth of the distance between the eyes and posterior corners of the head. Color pale piceous brown; tarsi and funiculi, except the clubs, pale whitish yellow; gaster dark brown, with the anterior and posterior borders of the segments yellowish.

Female (deälated). Length nearly 4 mm.

Distinctly larger than the female of *hermione* and of a different color, being castaneous brown; mandibles and clypeus pale reddish brown; antennæ and legs pale yellow, with the antennal clubs and scapes, femora and tibiæ, except their bases and tips, infuscated. Piligerous punctures on the head more distinct than in *hermione*. Epinotum in profile scarcely angular, but rounded as in that form and the typical *helena*.

Described from numerous workers and a single female taken from two colonies inhabiting the petioles of young Tachigalias at Kartabo. I have attached this form to *helena* though the shape of the head and the length of the antennal scapes are different. The other characters, however, such as the shape of the thorax and petiole, the sculpture and pilosity are so similar that it can hardly be regarded as a distinct species.

17.—*Leptothorax (Goniothorax) echinatinodis* Forel subsp. *aculeatinodis* Emery var. ***pleuriticus*** var. nov.

Worker. Length 2.2-2.5 mm.

Differing from the typical *aculeatinodis* in the following particulars: Head very dark brown or piceous, like the gaster; whole upper surface of the thorax ivory or brownish yellow, only the mesopleuræ and sides of the epinotum dark brown. Petiole pale, like the thoracic dorsum; postpetiole brown, paler than the gaster; scapes, base of funiculi, tarsi, tibiæ and bases and tips of femora pale ivory yellow, remainder of femora dark brown, as are also the clubs of the antennæ. Pilosity abundant, long, erect, present also on the scapes and legs, the hairs being obtuse but neither stout nor clavate. Rugæ of the petiole somewhat concentric. Tubercles on the petiole and postpetiole small and blunt. Epinotal spines long, slender, curved downward and directed upward, backward and outward, slightly shorter than the base of the epinotum.

Female. Length about 3 mm.

Head smooth and shining only in the middle between the frontal carinæ and imaginary lines continuing them to the posterior border of the head; lateral to these lines the surface is coarsely, loosely and longitudinally rugose, with reticulate interrugal spaces. Thorax subopaque, its sides obscurely longitudinally rugose; mesonotum and scutellum longitudinally and rather regularly rugulose, the former somewhat smooth anteriorly. Epinotum punctate-rugulose, the declivity regularly traversely rugulose. Pilosity as in the worker. The spines of the epinotum are reduced to two stout teeth, as long as their width at the base. Petiole and postpetiole nearly smooth, except for their tubercles, which are decidedly smaller than in the worker. Gaster elongate elliptical, transversely truncated anteriorly. Brownish yellow; upper surface of head, except its posterior corners, antennal clubs, scutellum, postscutellum, sometimes a posteromedian spot on the mesonotum, femora, except their bases and gaster, except the anterior corners of the first segment, dark brown. Wings whitish hyaline, with very pale veins and distinct brown pterostigma.

Male. Length 2.2 mm.

Head distinctly longer than broad, with distinct posterior corners, the posterior orbits very near the median transverse diameter. Ocelli small. Cheeks very short. Clypeus with arcuate, projecting anterior border. Mandibles small, with oblique 3- or 4-toothed apical borders. Antennæ slender, 12-jointed; scapes reaching nearly to the posterior corners of the head; first funicular joint longer than broad, not broader than the remaining joints, which are somewhat fusiform; fifth joint long, representing two incompletely separated joints. Thorax long and slender, humeri distinctly angular; mesonotum with Mayrian furrows; epinotum low and sloping, moderately convex, without distinct base and declivity. Petiole smooth and slender, the node represented by a swelling in the middle, the sides with feeble traces of the lateral tubercles of the worker and female; postpetiole smooth, without tubercles, nearly as long as broad, broader behind than in front and distinctly broader than the petiole. Gaster and legs slender.

Head and thorax finely and densely punctate; vertex and mesonotum smooth and shining, as are also the pedicel, gaster and appendages.

Hairs whitish, short, less abundant and more delicate than in the worker and female; the longer hairs on the femora and tibiæ reclinate.

Piceous brown; head darker and more blackish; mandibles, antennæ, legs, genitalia and incisures of gaster pale brownish yellow. Wings as in the female.

Described from specimens belonging to a single colony inhabiting the petiole of a young *Tachigalia* at Kartabo (Sept. 3).

18.—*Leptothorax* (*Goniothorax*) *umbratilis* sp. nov.

Worker. Length 1.7-2 mm.

Head subrectangular, very slightly longer than broad and slightly broader behind than in front, with nearly straight posterior border and very feebly convex sides; the eyes moderately convex, their posterior orbits at the median transverse diameter of the head. Mandibles convex, their apical borders with five or six small teeth. Clypeus distinctly concave in the middle, without carinæ, the anterior border entire and transverse in the middle, large but rounded and lobular. Mesoëpinotal impression distinct but shallow. Frontal groove absent. Antennæ 11-jointed; scapes reaching to within a distance equal to their greatest diameter of the posterior corners of the head; second funicular joint as long as broad, joints 3-7 distinctly broader than long; two basal joints of club subequal, longer than broad, together shorter than the enlarged terminal joint. Thorax shaped much as in *echinatinodis,* flattened above, marginate on the sides, with bluntly acuminate anterior humeral angles; lateral mesonotal angles rather acute, those at the base of the epinotum quite as large but rounded and lobular. Mesoëpinotal impression distinct but shallow. Epinotal spines short, stout and curved, not longer than their distance apart at the base, directed upward, backward and outward, much shorter than the base of the epinotum. Petiole about one and one-half times as long as broad, slightly broader behind than in front, with tubercles arranged as in *echinatinodis* but much smaller. In profile the petiole is longer than high, the node rather low, the peduncle short and indistinct; the ventral surface concave, with a small, downwardly directed tooth at the anterior end. Postpetiole broader than long, broader than the petiole, high and convex above; its sides with two pairs of small tubercles, the anterior pair scarcely visible. Gaster and legs as in *echinatinodis.*

Mandibles shining, very finely striatopunctate. Clypeus nearly smooth in the middle, shining, longitudinally rugulose on the sides. Head, thorax and pedicel subopaque, the head densely and finely reticulate-rugulose, the rugules longitudinal; thorax with similar sculpture, the rugules on the pronotum somewhat more pronounced. Postpetiole with a few longitudinal rugæ. Gaster shining, the basal half of the first segment very finely shagreened and punctate, so that it appears slightly opaque or sublucid.

Hairs white, abundant, short, clavate and erect on the dorsal surface of the body. Such hairs are lacking, however, on the appendages where they are replaced by short, appressed pubesence.

Brown; upper surface of head, mesonotum, mesopleuræ, epinotum, nodes of pedicel and antennal clubs dark brown; mandibles, clypeus, scapes and tarsi yellow; pronotum and gaster brownish yellow.

Female (deälated). Length about 3 mm.

Resembling the worker. Pronotum more rectangular, its anterior border very straight and sharp, the corners acute. Mesonotum and scutellum flat; base of epinotum convex, bluntly angled on each side anteriorly, declivity longer, abrupt and concave, the spines of the worker represented by small, blunt angles. Petiole and postpetiole similar to those of the worker, but the tubercles on the sides of the latter longer and more acute. Gaster longer.

Sculpture much as in the worker; mesonotum as finely and regularly rugulose-punctate as the head; scutellum densely punctate; base of epinotum transversely rugulose-punctate. Gaster very finely striolate-punctate at base of first segment.

Pilosity like that of the worker.

Yellowish brown; mandibles, clypeus, tarsi and gaster yellow; ocellar region, scutellum and mesopleuræ dark brown.

Described from several workers and a female taken from a single colony nesting in a *Tachigalia* petiole at the Penal Settlement, near Bartica, August 10.

This species, though related to *L. tristani* Emery of Costa Rica, appears to be distinct both from it and the various forms of *echinatinodis* Forel in the structure of the clypeus, and petiole, in sculpture and coloration.

19.—*Allomerus octoarticulatus* Mayr.

Of this extraordinary little ant a single small colony with pupæ was found in a young *Tachigalia* on the Puruni trail at Kartabo. This I believe to be a very exceptional occurrence, since the species is the most typical and abundant tenant of another myrmecophyte, *Cordia nodosa,* so that I shall describe its peculiar habits in another publication in connection with the other ants which inhabit the stem-swellings of that plant and go to make up what may be called the "Cordia biocoenose."

20.—*Atta cephalotes* L.

I include this well-known leaf-cutting ant in the *Tachigalia* biocoenose, because on one occasion I found that it had completely defoliated some of the young Tachigalias growing near the Penal Settlement. The petioles of these plants were either empty or contained recently fecundated *Pseudomyrma damnosa* queens that had only begun to lay eggs, so that the plants were quite unprotected.

Subfamily Dolichoderinæ.

21.—*Dolichoderus attelaboides* Fabr.

Workers of this singular ant were occasionally seen attending Membracids on the shoots of young Tachigalias growing along the Puruni trail, at Kartabo. The ant is more common in attendance on Membracids feeding on the terminal shoots of various Melastomaceæ.

22.—*Azteca traili* Emery.

A few workers and pupæ belonging to an incipient colony of this species were taken during September from a *Tachigalia* petiole at Kartabo. The species has been recorded by Forel and Emery from other myrmecophytes (leaf-sacs of *Tococa guianensis* and other Melastomaceæ, root-stocks of *Polypodium*).

23.—***Azteca foveiceps*** sp. nov.
(Fig. 16, a-c)

Worker. Length 1.7-2.2 mm.

Closely related to *A. schumanni* Emery; practically monomorphic. Head flattened, about one and one-fifth times as long as broad, distinctly narrower in front than behind, with rather straight sides and excised posterior border. In the middle of the head above a small, shallow impression, or fovea. Eyes small, flat, less than twice their length from the anterior corners of the head. Mandibles curved, their apical borders with nine teeth, alternately larger and smaller. Clypeus feebly convex behind, flattened in front, with nearly straight, feebly bisinuate anterior border. Frontal area obsolete; frontal groove absent; frontal carinæ very short. Antennæ short and thick; scapes enlarged and somewhat flattened at the tip, reaching only to the middle of the distance between the posterior orbits and the posterior corners of the head; joints 2-10 of funiculi very short and transverse, the more basal fully three times as broad as long. Thorax short and stout, about twice as long as the transverse diameter of the pronotum. Sutures, especially the mesoëpinotal, pronounced and impressed; mesonotum as long as broad, convex but rising very little above the pronotum. Epinotum rounded subcuboidal, the base longer than the declivity, the former horizontal, the latter steep. Petiole small, the node high, squamiform, inclined forward, elliptical from behind, its border narrowed above, only moderately sharp in profile. Gaster elongate elliptical, the first segment short, with a deep impression anteriorly for the accommodation of the petiole. Legs stout.

Shining; very finely but not densely punctate; the punctures on the mandibles more distinct.

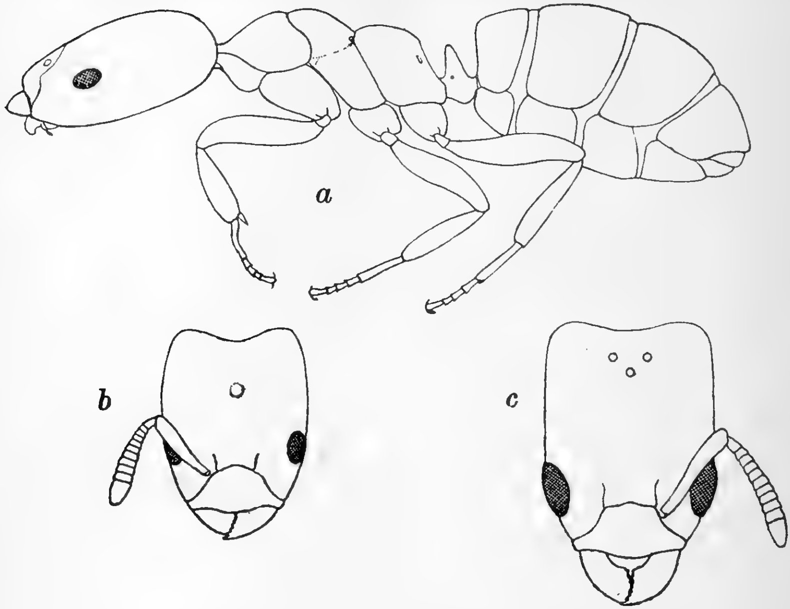

FIG. 16. *AZTECA FOVEICEPS* SP. NOV.
a, worker, lateral view; *b*, head from above; *c*, head of female.

Body and appendages covered with rather long, grayish, appressed pubescence, not sufficiently dense to obscure the shining surface; hairs yellowish, erect, rather short, abundant on the thorax, sparser on the head and gaster, short on the appendages.

Piceous black; borders of gastric segments paler; mandibles red; tarsal joints 2-5 and sides of clypeus yellowish brown; antennæ dark brown, their tips blackish, their insertions and the mouth yellowish.

Female. Length 4.5-4.8 mm.

Head decidedly longer and more nearly oblong than in the worker, about one and one-half times as long as broad, the sides straight and parallel, narrowed only near the clypeus. Eyes large, feebly convex, their distance from the anterior corners of the head less than half their length. Antennal scapes reaching only one-third the distance from the eyes to the posterior corners of the head. Thorax broader than the head; mesonotum convex; epinotum rounded, convex, without distinct base and declivity. Petiole thicker, more erect, with much blunter superior border than in the worker.

Sculpture, pilosity and color as in the worker but the erect hairs are shorter and less abundant on the thorax. Wings distinctly and uniformly infuscated, with strong, dark brown veins and pterostigma.

Male. Length 1.6-1.8 mm.

Head through the very large eyes a little longer than broad, with extremely short cheeks, growing narrower behind the eyes, where the sides are nearly straight. Mandibles very small, atrophied, bluntly acuminate, edentate. Clypeus short, convex in the middle, with broadly and evenly concave anterior border. Scapes very small and short, scarcely more than twice as long as broad, constricted basally, somewhat swollen apically; first funicular joint globose, broader than the scape, succeeding joints somewhat longer than broad, growing successively shorter and narrower, longer at the tip. Thorax shaped much as in the female, but the epinotum more sloping; petiole broader, erect with its superior border blunter than in the worker but more acute than in the female. Legs rather slender.

Sculpture as in the worker and female; pubescence and especially the pilosity much shorter and sparser; appendages without erect hairs; antennal funiculi beyond the first joint clothed with fine, dense, erect, white hairs.

Dull, dark piceous brown; head darker; mouthparts and genitalia sordid yellowish. Wings as in the female.

Described from numerous specimens taken at Kartabo from the petioles of large, vigorous *Tachigalia* trees.

This species is so close to Emery's *schumanni*, that it may prove to be merely a subspecies of that form which was taken on the Rio Guainia, an affluent of the Cassiquiare, in Venezuela, in the leaf-sacs of a Rosaceous myrmecophyte, *Hirtella guainiæ* Spruce (*ex* Hooker fil.).[1]

Emery saw only workers and a few very imperfectly preserved females of *schumanni*. His figures show, however, that the heads of both are decidedly shorter than in *foveiceps*, that the head of the worker is not so much narrowed anteriorly and that the antennæ are longer, with the median joints of the funicle less transverse, and the petiole of the worker more erect and with a smaller node.

Subfamily Formicinae.

24.—*Brachymyrmex heeri* Forel.

Colonies of this minute honey-yellow ant with brood were repeatedly found in the petioles of young Tachigalias along the trails near Kartabo. More frequently it nests in dead stems of a very common Rubiaceous weed (*Spermacoce verticillata*), or in the twigs of bushes. It also occurs under the bark of old logs.

25.—*Brachymyrmex heeri* var. ***basalis*** var. nov.

Worker. Honey yellow, like the type, except the first gastric segment, which is black.

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[1] This plant is cited by Emery in his Azteca monograph (1893) as "*Chrysobalanea hirtella* Guainiæ Hooker fil. but the "Index Kewensis" gives the name as cited above. It may be of interest to quote in this connection Spruce's remarks (1908, p. 395) on another species of *Hirtella* with ant-inhabited leaf sacs: "Examples of sac-like ant-dwellings exist in the leaves of plants of other orders, so like those already described in Melastomes, that it is scarcely worth while to do more than indicate some of the species. The solitary instance known to me in Chrysobalans is that of *Hirtella physophora* Mart., a slender arbuscle growing just within reach of inundations in the forest about the mouth of the Rio Negro. The distichous, oblong, apiculate leaves are nearly a foot long, and at the cordate base have a pair of compresso-globose sacs tenanted by ants. On cutting open the sacs I was rather surprised to find them lined with cuticular tissue and hairs, just like the underside of the leaf; which seems to show that they are produced by a recurvation of the alæ of the leaf, through the ants nestling at first (Aphis-like) under the leaf and causing it to become bullate, and that the recurved margins have at length reached and coalesced with the midrib so as to form a pair of scas." The fanciful explanation in the concluding sentence was evidently in part responsible for the unfortunate refusal of the Linnean Society to publish Spruce's very valuable paper when it was presented in 1869.

A single small colony with brood inhabiting the petiole of a small *Tachigalia* on the Puruni trail at Kartabo.

26.—*Camponotus* (*Myrmothrix*) *femoratus Fabr.*

On several occasions I found this very pugnacious ant attending Membracids on the young terminal shoots of small Tachigalias along the Puruni trail at Kartabo. As a rule the *femoratus* workers were accompanied by the workers of *Crematogaster limata* subsp. *parabiotica*. These two ants regularly live in parabiosis in the ant-gardens on the trees of the jungle, as I have shown in a previous paper (1921).

27.—*Camponotus (Myrmobrachys) zoc* Forel

This very active but timid species occasionally nests in the petioles of young Tachigalias but is more frequently found in the cavities of the dead twigs of other trees.

28.—*Camponotus* (*Myrmobrachys*) *pittieri* Forel var. ***pœnalis*** var. nov.

Worker. Of a darker, more piceous brown color than the type from Costa Rica, the gaster being concolorous with the thorax and legs and not paler and more yellowish; the darker brown area on the top of the head is deeper and more extensive. The erect pilosity on the upper surface is distinctly sparser and the hairs on the legs and especially on the scapes are much more oblique, or reclinate. The base of the epinotum is more sloping so that the thorax is distinctly lower behind than in the type.

Female. Length about 6.5 mm.

Darker than the worker; front as well as the vertex of the head and also the scutellum, pleuræ and posterior portion of epinotum, dark chocolate brown; mandibles red, with black apical borders. Antennal funiculi not infuscated at the tip. Mesonotum rather flat above. Head, pro- and mesonotum subopaque, more strongly punctate than in the worker; scutellum, postscutellum and epinotum distinctly shining. Petiole with broader, more transverse superior border when seen from behind, more acute in profile. Wings faintly infuscated, with light brown veins and conspicuous dark brown pterostigma. Pilosity similar to that of the worker but somewhat shorter, and the hairs on the funiculi and legs more appressed.

Described from specimens from a single colony found nesting with larvæ and cocoons in a petiole of a young *Tachigalia* at the Penal Settlement, near Bartica, August 10. This ant is evidently rare or very local, as I did not again take it in the vicinity of the Tropical Laboratory.

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By William Morton Wheeler

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Family Silvanidæ Böving.

Oryzæphilus surinamensis L. (Fig. 7.) The "saw-toothed grain-beetle" the most abundant, most widely distributed and best-known species of the family.[1] It is cosmopolitan and gregarious; living in nearly all stored human foods of vegetable origin; cereals (rice, wheat, maize, barley, etc.), ground or unground or in the form of paste (macaroni), bread etc.; dried fruits, nuts, copra, more rarely in sugar, starch, drugs, tobacco, snuff or dried meats. The larva, which is very active, is also gregarious, living with the beetles and evidently capable of thriving on most of the substances mentioned (Glover, 1869; Guillebeau, 1890; Chittenden, 1895, 1897, 1911; J. B. Smith, 1909; Girault, 1912). When ready to pupate it may make a rude cocoon by agglutinating particles of food detritus with an oral secretion. The pupa is sometimes free, however, i. e., not inclosed in a cocoon, and is attached by its hind end to the shrivelled larval skin which has been previously attached to the substratum (Blisson, 1849; Coquerel, 1849; Chittenden, 1895). During the summer the whole life-cycle requires about twenty-four days, in spring from six to ten weeks. There are six or seven generations a year in the latitude of Maryland, and in that latitude it winters over as an adult (Chittenden, 1895). It seems to be present wherever the Indian-meal moth *(Plodia interpunctella)* is found (Chittenden, 1897) and has often been found living with another common grain-pest, the Curculionid *Calandra oryzæ* (Perris, 1853; Ganglbaur, 1899). In England and Scotland the beetle has been repeatedly taken out of doors

[1] I find that this or one of the closely allied species is figured by Redi (1671) who refers to it as "vermiculus qui condita arrodit" and "vermis conditorum et pharmacorum." Redi also figures the grain weevil, *Calandra oryzae.*

under the bark of trees (Fowler, 1889; Champion, 1896). "As an instance of unusual trouble caused by this insect may be mentioned the case cited by Taschenberg of the beetles having invaded sleeping apartments adjoining a brewery where stores were kept and annoying the sleepers at night by nipping them in their beds" (Howard and Marlatt, 1896).

Oryzaephilus mercator Fauvel.—The "merchant grain-beetle," very similar to the preceding, cosmopolitan, and recorded as living in and feeding on pea-nuts, English walnuts, wheat, corn-meal, cereipo fruit (*Myrospermum frutescens*), candle-nuts *(Aleurites moluccana)*, and dried currants (Guillebeau, 1890; Chittenden, 1897, 1911). It has been taken under the bark of plane-trees in France, in the neighborhood of mills (Guillebeau). Champion (1896) records it as occurring in shipments of pea-nuts at Rouen in company with another grain-beetle, the Tenebrionid *Palorus subdepressus* Woll. "The close relationship of *mercator* and *surinamensis* makes reasonably certain their identity as regards development, nor is it probable that they differ in any degree in food-habits" (Chittenden, 1896).

Oryzaephilus bicornis Erich.—Cosmopolitan, but less widely distributed and more southern than *surinamensis*. Lives and breeds in wheat and dried figs in France; also taken in rubbish at the base of fig-trees (Guillebeau, 1890; Chittenden, 1897).

Oryzaephilus gossypii Chitt.—Cosmopolitan; breeding in cotton-seed (Chittenden, 1897).

Silvanus bidentatus Fabr.—Europe and United States (N. J., Ind., Conn., So. Cala., Fla.). Under chestnut bark in the United States (Glover, 1869). Recorded as occurring under bark of oaks and firs in England (Fowler, 1889), of firs in Germany (Reitter, 1911), of poplars, elms and figs in France (Picard, 1919). J. B. Smith (1909) records it as occurring under bark throughout New Jersey, as not rare, and as taken most of the season. According to Picard it has the same mode of life as the species of *Laemophloeus* (q. v.).

Silvanus gemellatus Duv.—Cuba and Southeastern States to New York. Lives and breeds in maize in the field as well as in granaries, also in wheat and over-ripe or dried fruits. It nearly always first destroys the germ of the kernel and hence causes considerable injury to seed maize in the Southern States. "It is essentially an out of doors species, but when conditions favor its increase may become a serious pest in granaries, as it is capable of breeding from egg to adult in the short period of three weeks" (Chittenden, 1897, 1911).

Silvanus unidentatus Fabr.—Europe. Perris (1853, 1876) states that the larva is common in France under the bark of oak, poplar, chestnut and willow, rarer under pine bark. It is agile and photophobic and lives gregariously with the adult beetles among the detritus left by the larvæ of *Bostrychus*, Cerambycids and Buprestids. In Germany under elm bark (Kaltenbach, 1874); in Britain under bark of beech, oak, horn-beam, etc. (Fowler, 1889), of deciduous trees in general (Reitter, 1911).

Silvanus fagi Guèrin.—Europe. Under beech bark; in England in dead branches of fir (Fowler, 1889); in Germany under fir bark and fir-cones (Reitter, 1911).

Silvanus planatus Germ.—Eastern United States (N. J., Ind., Fla.). Under pine-bark in New Jersey (J. B. Smith, 1909).

Cathartus advena Waltl.—Cosmopolitan. Lives and breeds in stored wheat, rice, corn in stack, grain, meal, middlings, flour, dates, figs, lichi nuts, table beans, cacao-beans, edible tubers, etc., but apparently only when these substances are not kept dry and clean. "In breeding experiments recently conducted by the writer it failed to develop in fresh grain or meal, but bred freely in corn-meal which was moistened and produced mold. The beetles particularly fed freely on the molds, of which there were three or four species, and it would appear that this is the normal habit of the insect" (Chittenden, 1897). Pierce (1917) cites *C. advena* among the insects infesting teak in India, stating that it "breeds in leaves, forming galls, causing leaves to drop" *(sic!)*. Perris (1876) found the larva in lichi nuts in company with larvæ of *O. surinamensis*. Fowler (1889) states that *C. advena* is sometimes found out-of-doors in England and that Waterhouse took it under cut grass. In New Jersey it is "rare under bark; more common in stored grain, fruits, nuts, etc., particularly such as are spoiled" (J. B. Smith, 1909)

Cathartus cassiæ Reiche.—Cuba and Southern States. Glover (1869) describes the larva as feeding on maize kernels, near the germ, and also on the exposed seeds of cotton bolls. Doran (1892) found this beetle breeding in bran and middlings and producing a temperature 42 deg. F. higher than that of the room in which it was living!

Cathartus longulus Blatchley.—Indiana. "Sifted from borders of Sphagnum marsh" (Blatchley, 1910).

Cathartus excisus Reitter.—Taken in Germany in Havana tobacco (Ganglbaur, 1899; Reitter, 1911).

Cathartus quadricollis Guérin.—Imported into Germany in Havana tobacco and also in the fruits of *Cassia fistula* (Ganglbaur, 1899); imported in Havana cigars (Reitter, 1911).

Nausibius clavicornis Kug.—Cosmopolitan. "Under bark and in sugar" (Glover, 1869). "Often found on ships in plant wares. It also lives in old nests of South American bees" (Ganglbaur, 1899). Introduced into Britain, found in sugar, etc. (Fowler, 1889). In New Jersey under bark and also occasionally in store-houses (J. B. Smith, 1909). In Indiana "two specimens were taken with a dozen other species at sap beneath the bark of a soft maple tree. Leconte states that it occurs usually in rice, sugar and other articles of commerce throughout the United States" (Blatchley, 1910).

Telephanus velox Haldem.—United States (N. J., Ia., Ind., Conn.). "Very common under rubbish of all sorts and as its name implies, runs with remarkable swiftness" (Casey, 1884). "Occurs more often beneath stones, chunks and dead leaves than beneath bark. When exposed it usually remains quiescent with antennæ folded against sides; but if touched it runs with great swiftness, whence its specific name" (Blatchley, 1910). "Throughout the State (N. J.) under stones and old leaves; rarely under bark; may be sifted out from fall to late spring" (J. B. Smith, 1909).

Family Cucujidæ (Böving *emend.*)

Cucujus clavipes Fabr.—Atlantic States to Illinois and Iowa; a beautiful scarlet red insect, represented in the Pacific States by the var. *puniceus* Mann. The larva is said to be predatory (Le Baron, 1874; J. B. Smith, 1909). Le Baron (1874) figures the larva; Dimmock (1884) records the adult beetle as occurring under decaying butter-nut bark. Hamilton (1886) gives the following account of the insect: "The very depressed form of this well known beetle indicates, *a priori*, its subcortical habit, and no other has power to adapt its tastes to a greater variety of timber—locust, maple, oak, hickory, gum, buckeye, etc.—are all alike to it. The larvæ do not eat the wood nor the bark, living apparently on the moisture existing between the two. They are elongate, much depressed, brownish yellow, and scarcely to be distinguished from those of *Dendroides canadensis*. Sometime in September, the larva having matured, constructs a circular cell from small particles of the decaying bark and wood, and in this completes its transformations before severe frost, but the beetle does not quit the cell till the following spring. I have never known any of these insects to be taken elsewhere than under bark, though they undoubtedly fly, being possessed of a good pair of wings. On the 10th of October, fifteen newly disclosed individuals and several pupæ were taken under the bark of a gum log; the latter are depressed like the beetle, pale at first, the eyes, antennæ and portions of the legs gradually changing to black, and the elytra becoming red after disclosure. This insect is annual."

Cucujus haematodes Erich.—Europe. In Germany under bark of maples, rarer under bark of fir-stumps (Reitter, 1911).

Cucujus cinnaberinus Scop.—Europe. Habits like those of *haematodes* (Reitter, 1911).

Dendrophagus crenatus Payk.—Europe. In Germany under oak bark; gregarious (Kaltenbach, 1874); in Britain under bark of fir *(Pinus sylvestris)*, less frequently under bark of larch *(Larix europæa)* (White, 1872; Fowler, 1889). According to White the larva has been supposed to be carnivorous, but is truly phytophagous, feeding on the decaying inner bark of dead and usually prostrate trees of the species mentioned. The beetles are agile and seem to come out at night and run about on the bark. The eggs seem to be laid in the spring by hibernating females; the larvæ feed twelve to fourteen months, becoming pupæ during the second summer, the beetles emerging in August. The larva is very quick and agile and when disturbed moves the hinder part of its body quickly from side to side. When about to pupate "it attaches itself firmly to a piece of bark by the thirteenth segment, and the pupa remains attached by its anal segment to the larva-skin." Perris (1876) believes that White is mistaken in his account of the food-habits of the insect, and that it is carnivorous or coprophagous, like *Brontes planatus* (q.v.).

Emporius signatus Frauenf.—Imported into Germany from the tropics in Havana cigars (Ganglbaur, 1899).

Pediacus depressus Herbst.—Recorded from Europe, Vancouver and the United States (So. Cala., Mich., Lake Superior, Colo., Pa., S. C.). In Britain under oak-bark, in mold-like fungus; also in stores on board a yacht (Fowler, 1899). Under bark of deciduous trees in Germany (Reitter, 1911).

Pediacus fuscus Erich.—Europe and North America, Alaska, Labrador, British America, Mich., Neb., Colo., N. Mex., Lake Superior, and probably cosmopolitan. In Germany under pine and oak bark (Reitter, 1911), and under the bark of firs (Kaltenbach, 1874). In Britain under bark and in chunks of freshly cut oak, beech and horn-beam (Fowler, 1889).

Brontes planatus L.—Europe. Perris (1853) describes the larva as livid reddish, punctate with carmine dots, and as being very agile and supple. In France it is common throughout most of the year under the bark of various trees, but most often under oak or pine bark. Perris believes the larva to be carnivorous, because it is always found among the larvæ of *Tomicus* or with Poduri or mites 'dont elle fait, sans doute, sa nourriture." "When about to pupate it attaches itself to a flat surface by means of the tubercle of its last segment, then the skin splits along the back and is pushed back to the posterior end of the body, where it remains much wrinkled." In Germany under bark of deciduous trees, especially of oaks (Kaltenbach, 1874; Reitter, 1911); in Britain under bark of dead beech trees (Fowler, 1889). According to Perris (1876) the larva is predaceous and a scavenger, living under the bark of various trees, including, chestnut, especially where the larvæ of other beetles have lived. All the stages are passed through in several months, the young larvæ being found in the spring, the adults in late summer. The latter hibernate under the bark. According to Ganglbaur (1899) the larva is "undoubtedly carnivorous."

Psammoechus bipunctatus Fabr.—Europe. Recorded in Britain from marshy places at roots of grass and in refuse (Fowler, 1889); in Germany on the banks of streams or ponds under dead rushes (Ganglbaur, 1899; Reitter, 1911).

Psammoechus desjardinsi Guérin.—Cosmopolitan (Casey, 1884); Florida (Leng, 1920).

Family Laemophloeidæ Böving.

Laemophloeus alternans Erich.—Cosmopolitan; "found everywhere" (J. B. Smith, 1909). In Germany under bark of conifers in galleries of beetles of the genus *Pityogenes* (Reitter, 1911). In France occurring occasionally in the galleries of *Hypoborus ficus,* a bark beetle of fig-trees, but also in galleries of other bark beetles in other plants (Perris, 1853; Picard, 1919).

Laemophloeus ater Oliv.—Europe. In France in dead or dying stems of broom and gorse, preying on the larvæ of the bark-beetle *Hylesinus rhododactylus* (Perris, 1853). In dead stems of broom and under elm-bark in Britain (Fowler, 1889). Rare under bark; common in bran and middlings in Germany (Reitter, 1911). Occurs in France not only in the galleries of *Hypoborus ficus* in fig-bark, but also in the galleries of other Scolytids in other plants (Picard, 1919).

Laemophloeus biguttatus Say.—United States (Ind., Neb., Fla., So. Cala., N. J.). Throughout the State of New Jersey under bark; fall to mid-summer. (J. B. Smith, 1909.)

Laemophloeus bimaculatus Payk.—Europe. Under bark of oak, beech and horn-beam in Britain (Fowler, 1889); in Germany under beech bark (Reitter, 1911).

Laemophloeus castaneus Erich.—Europe. Under birch and chestnut bark in Germany (Reitter, 1911).

Laemophloeus corticinus Erich.—Europe. Under oak-bark in Germany (Reitter, 1911).

Laemophloeus clematidis Erich.—Europe. In *Clematis vitalba.* A constant companion of *Xylocleptes bispinosus,* feeding on the refuse and dejecta in its galleries (Perris, 1853; Kaltenbach, 1874; Reitter, 1911). In dead stems of *Clematis vitalba* in Britain (Fowler, 1889).

Laemophloeus denticulatus Preysl.—Europe. "The larvæ probably merely accompany the larvæ of really injurious xylophagous beetles. According to Hartig they are found in the cones of conifers, according to Ratzeburg also under dead bark, according to Hellwig and Panzer under the bark of linden trees" (Kaltenbach, 1874).

Laemophloeus dufouri Laboulb.—Europe. The larvæ were found by Perris (1853) under pine-bark hibernating in January with the pupæ and beetles in the galleries of *Crypturgus pusillus.* He believed that the larvæ feed on those of the *Crypturgus,* but more probably they merely eat the dejecta in the burrows.

Laemophloeus duplicatus Waltl.—Europe. Under bark of beech, oak, etc., in Britain (Fowler, 1889); in Germany under beech bark (Reitter, 1911).

Laemophloeus fasciatus Mels.—United States (Ind., Pa., Minn.). In Minnesota it "is found under bark, but is also very common near saw-mills, especially in those in which hardwood is sawed. In running over persons engaged in mills it will bite, even without provocation, and may cause bad sores" (Lugger, 1899).

Laemophloeus ferrugineus Steph.—Cosmopolitan (Casey, 1884). In Britain in hay-stack refuse, rarely under bark; also in granaries (Fowler, 1889). In Germany in rice, bran, middlings and meal (Ganglbaur, 1899; Reitter, 1911; Chittenden, 1911). "Its larva, which does not differ from that of other species of the genus, has been described by Carpentier (Bull. Soc. Linn. Nord. France, April, 1877, 3 pp. 239-241). It lives under the bark of oaks, cherry trees and, it is said, in fig-trees inhabited by wood-boring insects, but also in grain attacked by *Calandra,* in bran, flour, etc." (Picard, 1919).

Laemophloeus hypobori Perris.—Europe. (France). Living only in the galleries of a bark-beetle *Hypoborus ficus*, in fig-trees. Both the adult beetles and the larvæ live gregariously and feed on the dejections, exuviæ and all kinds of detritus which they find in the empty galleries. They occur more rarely in the brood galleries that are still inhabited by the parent *Hypobori*. Both larvæ and adults are found throughout the year and both stages, but especially the adults, are found hibernating (Picard, 1919). This author gives an excellent account of the beetle and its habits.

Laemophloeus juniperi Grouv.—Europe. Under bark of *Juniperus* in galleries of the bark-beetles *Phloeosinus bicolor* Br. and *thujæ* Perris (Reitter, 1911). "At Monpellier this is the rarest species in fig-trees; I know of only one capture made in August by J. Lichtenstein. *L. juniperi* is nevertheless common in Herault, as in the whole South. I often found it under the bark of elms riddled by *Pteleobius vittatus* and *kraatzi;* it is also found in the galleries of *Hypoborus (Liparthrum) mori* of the mulberry, of *Phloeosinus thujæ* and *bicolor* infesting *Juniperus, Cupressus, Thuja* and other conifers, of *Phloeotribus scarabaeoides* of the olive, etc." (Picard, 1919). The larva, which is coprophagous and detritivorous, has been observed and described from *Thuja* infested with *Phloeosinus thujæ* by Decaux (Bull. Soc. Ent. France, June 25, 1890, p. 125) and is redescribed by Picard.

Laemophloeus modestus Say.—United States (Tex., Fla., D. C., N. J.). "Taken in hemp-seed, the interior of which had been entirely eaten out" (Glover, 1869). In New Jersey occurring under bark and in siftings (J. B. Smith, 1909).

Laemophloeus monilis Fabr.—Europe. In Germany under beech and linden bark, gregarious in the burrows of *Tachrorhychus bicolor* (Reitter, 1911).

Laemophloeus perrisi Grouv.—Europe. Occurring in the fig. "It is also known from the *Lentiscus* and pines infested with *Pityophthorus*. This is a Corsican insect, very rare in France, where it has scarcely been seen, except in the Provence" (Picard, 1919).

Laemophloeus pusillus Schön—Cosmopolitan and common (Casey, 1884). In Britain in granaries, imported with grain (Fowler, 1889). Occurs commonly in cereals, but probably in the main predaceous and scavengering (Chittenden, 1911). In rice, grocery wares, etc., in Germany (Reitter, 1911).

Laemophloeus testaceus Fabr.—Europe. Similar to *L. denticulatus* but occurring under linden bark (Kaltenbach, 1874), and under dry beech bark (Reitter, 1911). Perris (1853, 1876) found the larvæ under oak bark in galleries of *Tomicus* and under chestnut bark with the larvæ of the bark beetle *Dryocoetes capronatus* on which it was preying, but also living on the dejections and capable of developing to maturity in the absence of the *Dryocoetes.* Also found under bark of dead oaks with the larvæ of the same Scolytid and in the elm in the galleries of *Hylesinus vittatus* and *kraatzi.*

Laemophloeus turcicus Grouv.—Cosmopolitan. Imported into Germany in dried fruits, especially prunes, from the orient (Reitter, 1911).

Laemotmetus ferrugineus Gerst.—Cosmopolitan. Imported into Germany in rice (Ganglbaur, 1899; Reitter, 1911).

Laemotmetus rhizophagoides Walker.—Cosmopolitan. Found in stored rice in Berlin, Germany (Chittenden, 1911).

Lathropus vernalis Erich.—United States (Fla., Miss., N. J., Conn.). Throughout New Jersey, secured by beating dead branches, May to July (J. B. Smith, 1909).

Lathropus sepicola Müller.—Europe. According to Perris (1876) the larva lives under elm-bark in the galleries of the bark beetles *Scolytus multistriatus, Hylesinus vittatus* and *H. kraatzi* and feeds on their dejections. The perfect insect emerges in May. Reitter (1911) often beat the latter from dry wood fences.

Phloeostichus denticollis W. Redtb.—Europe. Under the inner bark of maple-trees, together with the larval stages (Weisse, 1897; Reitter, 1911).

Prostomis mandibularis Fabr.—Europe and Pacific States (Or., Nev., Cala.) and Vancouver. In very rotten, damp wood of deciduous trees. The larvæ are often present in great numbers with the beetles (Ganglbaur, 1899; Reitter, 1911). Perris (1876) found the larvæ in rotten chestnut wood and states that Curtis, Chapuis and Candèze took them in rotten oak wood.

Hemipeplus marginipennis Lec.—Cited only from Georgia and Florida (Leng, 1920). According to Schwarz a rather abundant species under palmetto bark (Casey, 1884).

Hemipeplus microphthalmus Schwarz.—Cited only from Florida (Leng, 1920), where it was taken flying at night by Schwarz (Casey, 1884).

Inopeplus praeustus Chevr.—Antilles. Adults and larvæ living gregariously in the burrows of a Scolytid in branches of cacao. The larva is peculiar in having the prolongations of the ninth abdominal segment in the form of forceps (de Peyerimhoff, 1903).

Family Scalidiidæ Bőving.

Catogenus rufus Fabr.—United States (Ind., Ia., Md., N. C., Fla.). Fiske (1905) has shown that the larva is an external parasite on the larvæ of Braconid Hymenoptera and Cerambycid pupæ; "its habits differing in no essential feature from those of many species of external Hymenopterous parasites. The adult is fairly common throughout the South, and is found beneath the loose bark of recently dead and dying trees, both conifers and deciduous. It occurs at nearly all seasons of the year, but is especially common during the late fall and early spring, and is found hibernating in situations similar to the above mentioned." Fiske seems to have overlooked a note on this beetle by Dimmock (1884), who says: "In Connecticut it is common beneath the loose bark of the trunks of hickory trees, and I have reared its larva which fed upon a pupa of *Elaphidion parallelum*, a borer in hickory."

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

FROM THE TROPICAL RESEARCH STATION IN BRITISH GUIANA

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(Tropical Research Station Contribution Number 100)

DESCRIPTIONS OF NEW SPECIES OF COLEOPTERA

By E. A. SCHWARZ and H. S. BARBER

United States Department of Agriculture

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DESCRIPTIONS OF NEW SPECIES OF COLEOPTERA

By E. A. SCHWARZ and H. S. BARBER

United States Department of Agriculture

Specimens of three species of beetles from Kartabo, Bartica District, British Guiana, have been submitted to us by their discoverer, Dr. W. M. Wheeler, for identification. Two of the species belong to the family Silvanidæ, while the third is an inconspicuous species of the ubiquitous Coccinellid genus *Scymnus*. The two first are, however, very interesting forms, and it has been necessary to erect a new genus to receive the larger and more abundant species. These, Dr. Wheeler informs us, were occupying the petioles of a tree *(Tachigalia)*.

Coccidotrophus gen. nov. (Silvanidæ).

Eyes small, not emarginate, not prominent, occupying middle fourth of side of head. Antennæ inserted laterally, in deep cavity between frontal margin and prominent gena, close to and equidistant from base of mandible and front margin of eye; compactly eleven-jointed, club not abruptly enlarged, all joints traverse except basal joint; joints 3-9 rapidly increasing in size, the three-jointed club densely covered with fine short hairs. Antennal grooves short, distinct, parallel, bordered by lower edge of eye and carina from gena. Mouthparts free, maxillary palpi four-jointed, labial palpi three-jointed. Elytra with lateral costa and nine distinct series of strial punctures. Pygidium usually covered by elytra when abdomen is contracted (when distended the pygidium is often exposed). Intercoxal process of prosternum about one-seventh as wide as prothorax, wider behind, its sides overlapping the epimera; front coxae separated from hind margin of prothorax by about their own length. Intercoxal process of mesosternum slightly narrower than that of prosternum, truncate apically and nearly reaching hind margin of coxae, metepimeron reaching the middle coxae. Hind coxae separated by strong, acute process of first abdominal sternite, which fits into median notch in metasternum. First ventral abdominal segment with coxal lines very fine, short, curved, becoming almost parallel behind, but not reaching posterior margin; four following sternites each slightly shorter than the first, the last rounded apically, concave beneath, with carinate posterior margin. Legs short, stout, femora incrassate, first three tarsal joints inflated, hairy beneath, fourth small but distinct, fifth joint as long as the three basal joints together. Genotype: *Coccidotrophus socialis* sp. nov.

This genus is so unlike other Silvanids known to us that its true affinity was not recognized until Dr. Böving's studies of its larva proved it to agree well with typical Silvanid larvæ and not to be related to *Hapalips*, with which we were trying to associate the adults. Once suggested this relationship was readily confirmed by the characters used by Ganglbauer (Die Käfer von Mitteleuropa, 1889, vol. 3, p. 577) to distinguish the adults of this family: front coxal cavities closed behind, metepimeron reaching middle coxae, etc.

We cannot identify *Coccidotrophus* with any of the genera considered by Grouvelle (Ann. Soc. Ent. Fr., vol. 81, 1912, pp. 313-386), but it seems most nearly to approach *Synoemis* Pascoe (1866), the only species of which was described from the Malayan Peninsula.

Coccidotrophus socialis sp. nov.

(Plate VI, figs. 1 to 5).

Very elongate, parallel, depressed, shining, castaneous, glabrous (except for sparse, microscropical, decumbent pubescence).

Length, 3.5-4.5; width, 0.6-0.8 mm.
Habitat—British Guiana.

Head slightly wider than prothorax, widest at the very slightly prominent eyes, one-sixth longer than wide, feebly constricted into a neck in basal fourth, sides convergent in front, front margin broadly, shallowly notched; upper surface finely granulose except a small occipital smooth area, feebly convex, transversely somewhat tumid between and behind eyes, which are situated about middle of sides; clypeus not separated from front, produced into a strong marginal carina, surface convex medially, concave laterally, especially over antennal sockets; labrum very short, transverse, feebly chitinized, emarginate in front and with a row of about six stiff hairs; gular region strongly pilose, feebly concave; mandibles moderately prominent, strongly bidentate apically; antennæ stout, shorter than width of front at their point of insertion. Pronotum three-fourths as wide as long, widest at apical angles which are subacute; narrowest just before middle and at base; sides feebly sinuate, subparallel, front margin straight, hind angles obtuse, hind margin arcuate, surface longitudinally flat, transversely feebly convex, sparsely punctate, the punctures elongate, side margins with fine marginal line. Scutellum transverse, widest behind, finely punctate. Elytra slightly wider than pronotum, more than three times as long as wide, base emarginate, humeral angles subacute, sides subparallel to apical fourth, thence conjointly rounded; surface longitudinally somewhat convex, transversely rather strongly convex, strial punctures moderate, the interstices each with a series of slightly smaller punctures supporting fine, decumbent, short hairs. Under surface shining but with irregular microscopic sculpture between the sparsely scattered, nearly obsolete punctures which bear the short, fine decumbent hairs.

Described from thirty-two examples from a large series collected by Dr. Wm. M. Wheeler at Kartabo in July and August, 1920. The sexes are almost indistinguishable unless the "palps" of the ovipositor are extruded.

Characters of legs, antennæ and mouth are shown in accompanying figures. Type, allotype and paratypes.—Cat. No. 24070, U.S.N.M.

Eunausibius Grouvelle, 1912.

Although we have seen neither of the two species *(Nausibius tenebrionides* and *N. elongatus* Grouv.) upon which Grouvelle, (Ann. Soc. Ent. Fr., vol. 81, 1912, p. 314) established this genus, his generic diagnosis applies so well to the species here described that his genus is adopted. The postcoxal lines are very feeble and difficult to see but are bent abruptly forward to the coxal cavity enclosing a small area under the trochanter:

the antennal club seems to be more abrupt and larger, and the shape of the produced clypeus differs also from the figures Grouvelle, (Ann. Soc. Ent. Fr., vol. 65, 1896, p. 193) has given of the two previously known species.

Eunausibius wheeleri sp. nov.
(Plate VI, figs. 6 to 10).

Elongate, parallel, moderately convex, smooth, shining, glabrous, pale castaneous.

Length, 3.0-3.5 mm.; width, 0.6-0.75 mm.
Habitat.—British Guiana.

Head wider than prothorax; eyes rather large and prominent, coarsely granulated, front widest in front of the rather strongly impressed fovea opposite which the margin is somewhat thickened; front margin broadly, feebly emarginate, front angles obliquely truncate; surface finely granulate, feebly convex. Labrum membranous, concealed beneath front. Gular area feebly concave, opaque, finely pubescent, the lateral carinæ bordering the antennal grooves convergent posteriorly and passing middle of eye. Antennæ as long as width of clypeus, club abruptly widened, oval. Pronotum about three-fourths as wide as long, widest at the slightly acute front angles, sides almost straight and parallel, finely carinate; front margin straight except small sinuation near angles, hind margin arcuate at middle, on each side straight, hind angles obtuse. Surface transversely convex, longitudinally flat except for a pair of feeble impressions at basal fourth. Scutellum transversely oval, twice as wide as long. Elytra slightly wider than prothorax, three times as long as wide, sides parallel, apices evenly rounded; surface nearly smooth, strial punctures feebly impressed but conspicuous by coloration below surface. Callow specimens display interstrial rows of microscopic appressed hairs. Under surface of body sparsely clothed with microscopic decumbent hairs, each set in a broad obsolescent puncture.

Described from eighteen specimens submitted by Dr. Wheeler, to whom the species is dedicated. Two of the specimens, dissected and mounted on slides, are males. One specimen, the allotype, is somewhat crushed and displays female sex organs. We are unable to distinguish the sex of the other fifteen paratypes.

Type, allotype and paratypes.—Cat. No. 24071, U. S. N. M.

The antennæ and legs are shown in accompanying figures.

Scymnus Kugelann 1794 (Coccinellidæ)

After some hesitation we have decided to offer the following description of what appears to be a new but very commonplace species of this genus, since we have failed to find any description applicable thereto. It will, perhaps, be long before the multitude of tropical species of *Scymnus* will be determinable.

Scymnus (***Diomus***) ***xantholeucus*** sp. nov.

Oval, very convex, shining, pubescent, pale yellow except basal two-thirds of elytra, meso- and metasternum and median third of first two abdominal segments, which are infuscate.

Length, 1.7 mm.; width, 1.2 mm.
Habitat.—British Guiana.

Head and pronotum finely, rather densely punctate, elytra slightly more coarsely punctured; pubescence rather dense, the short, silky, suberect hairs bent in all directions forming no pattern. Scutellum pale. Elytra piceous in basal two-thirds, apically flavescent, the pale area not sharply limited. Under surface moderately, densely and finely punctate, the pubescence decumbent and regular. Prosternum with carinae convergent anteriorly, reaching front margin and uniting in an arc; the enclosed area feebly concave and supporting moderately long hairs. Postmetacoxal line as in other species of *Diomus* (Group A of Horn 1895). Penultinate abdominal sternite very broadly and feebly emarginate in the male.

Type (male), allotype and paratypes.—Cat. No. 24084, U.S.N.M.

Described from two males and two females reared by Dr. Wheeler from larvae found among coccids in company with the two species of Silvanidæ.

Although not related to *semiruber* Casey, the foregoing species is similar in shape and plan of coloration. A prescutellar infuscate area is suggested in one example.

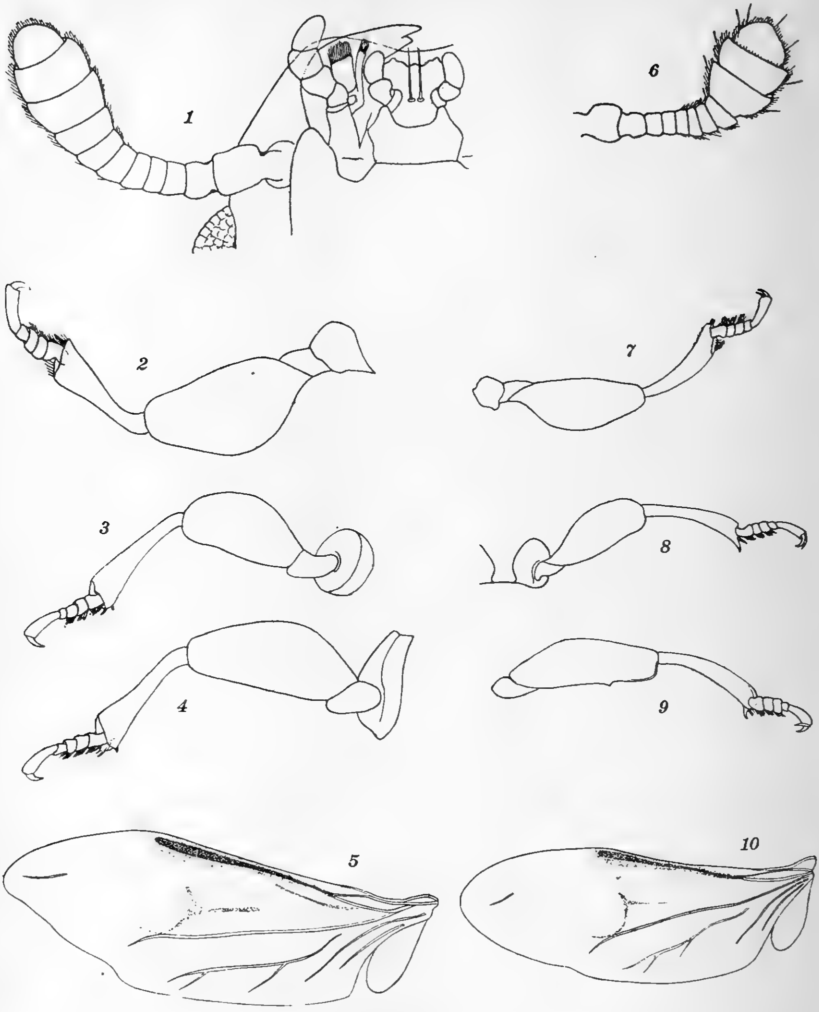

PLATE VI.

Fig. 1. *Coccidotrophus socialis* sp. nov. Right side of head, with antenna and mouth parts, ventral view. X 58.5.

Fig. 2. Fore leg of same. X 36.5.

Fig. 3. Middle leg of same. X 36.5.

Fig. 4. Hind leg of same. X 36.5.

Fig. 5. Hind wing of same. X 36.5.

Fig. 6. *Eunausibius wheeleri* sp. nov. Antenna. X 58.5.

Fig. 7. Fore leg of same. X 36.5.

Fig. 8. Middle leg of same. X 36.5.

Fig. 9. Hind leg of same. X 36.5.

Fig. 10. Hind wing of same. X 36.5.

ZOOLOGICA

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THE LARVAE AND PUPAE OF THE SOCIAL BEETLES COCCIDOTROPHUS SOCIALIS (SCHWARZ AND BARBER) AND EUNAUSIBIUS WHEELERI (SCHWARZ AND BARBER) WITH REMARKS ON THE TAXONOMY OF THE FAMILY CUCUJIDAE

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THE LARVAE AND PUPAE OF THE SOCIAL BEETLES COCCIDOTROPHUS SOCIALIS (SCHWARZ AND BARBER) AND EUNAUSIBIUS WHEELERI (SCHWARZ AND BARBER) WITH REMARKS ON THE TAXONOMY OF THE FAMILY CUCUJIDAE

By ADAM GIEDE BÖVING, PH.D.
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Professor W. M. Wheeler has kindly given me for study larvae and pupae of the two species of social beetles discovered by him in British Guiana. The material was plentiful and in excellent condition. In working out the relationship of these larvæ it was necessary to examine larvæ of several related groups and often to avail myself of studies as yet unpublished, undertaken by Dr. F. C. Craighead and myself on the classification of the Coleopterous families based on larval characters.

In addition to descriptions and illustrations of the two species, mentioned above, the present contribution therefore contains a brief discussion of the taxonomy of the entire family Cucujidae.

The different subjects are arranged as follows:

A. The family Cucujidae, *authorum;* taxonomic remarks with reference to their larvae.

B. The subfamily Silvaninae as based on larval characters.
- B. 1. Subfamily description of the larvae of the Silvaninae.
- B. 2. The genera of the Silvaninae, systematically defined by larval characters.

C. *Coccidotrophus socialis and Eunausibius wheeleri.*
- C. 1. General morphological description of the larvae.
- C. 2. Specific description of the larvae.
- C. 3. General and specific description of the pupae.

D. Bibliographical notes.

A.—The Family Cucujidae (*authorum*).

The larvae of *Coccidotrophus socialis* Schw. & Barb. and *Eunausibius wheeleri* Schw. & Barb. show remarkable identity in general morphological structures with the larvae of the genera *Oryzaephilus* Gangl., *Silvanus* Latr., *Nausibius* Redt. and *Cathartus* Reiche. All these forms differ from each other only in small details such as the proportional length of the second antennal joint, the arrangement of the individual ocelli in the two ocellar groups, the thickness and color of the chitin of the body or the number and development of the tergal setae. The larva of *Telephanus* (Plate X, figs. 34-38) has a well developed third antennal joint and differs in this and some other less important characters from the genera mentioned. However, it approaches them closely and constitutes together with them a well defined taxonomic unit distinct from the larvae of the rest of those genera which have generally been combined into the single family *Cucujidae*.

This family, however, as hitherto limited, mainly on adult characters, includes larval types which are rather heterogeneous; and according to these different larval types the family can be divided and I propose here to divide it, into several new families and subfamilies.

Thus it appears appropriate to establish the above mentioned unit of genera as a distinct family, the *Silvanidae*.

This family is, through the genus *Telephanus,* closely associated with another unit of genera, namely *Brontes* Fabr. and *Dendrophagus* Schön. (by Gilbert F. Arrow 1901 united into a single genus *Hyliota* Latr.), *Psammoecus* Latr., *Pediacus* Shuck, *Platisus* (according to description and figure by A. M. Lea of *P. integricollis* Reitter; Proc. Linn. Soc. N. S. Wales, vol. 29, 1904, p. 88) and *Cucujus* Fab., which together form a second family, the *Cucujidae* (in restricted sense) with *Brontes, Dendrophagus,* with *Psammocus* in one subfamily, the *Hyliotinae,* and the other genera in another subfamily, the *Cucujinae.* More remote is the relationship between these two families and the genera *Prostomis* Latr, and *Dryocora* (according to my own unpublished notes and figures of four larvæ of *Dryocora howitti*, from New Zealand; in Zool. Mus. Cambridge, England), which two genera form a third unit and may constitute a subfamily, the *Prostominae* (Plate IX, figs. 22, 24-26 and 27-33). As a fourth unit I consider the genera *Prostominia* (according to the excellent description and figures by M. P. de Peyerimhoff of *P. convexiuscula* Grouv., Trans. Lin. Soc. London—2, Zool.—vol. 17, 1914, p. 156), *Narthecius* Lec., *Lathropus* Erichs., *Laemophloeus* Laporte, *Dysmerus* Csy., *Hemipeplus* Latr. and *Inopeplus* Smith (according to descriptions and figures by M. P. de Peyerimhoff of *P. praeustus* Chev.), (P. d. P. Ann. Soc. Ent. Fr., vol. 71, 1902-3, p. 715). According to an imperfect description by Weisse (Deutsch. Ent. Zeitsch., vol. 41, 1897, p. 393) of the larva of *Phloeostichus denticollis* Redtb., this genus also belongs to the present unit. All these larvae are closely related to the Prostominae, but separated from this subfamily by good characters; they may constitute another subfamily, the *Laemophloeinae* and together with the *Prostominae* the family *Laemophloeidae.* The Laemophloeidae are, as the following key will show, separated from the Silvanidae and Cucujidae (in restricted sense) by exactly the same main character by which such families as the Cryptophagidae are separated from the Mycetophagidae or the Monotomidae (represented by the larva of *Europs*) are separated from the Smicripidae (represented by the larva of *Smicrips palmicola* Lec.), namely the different shape of the maxillary mala. The genera *Catogenus* Westw. and *Scalidia* Er., constituting the family *Scalidiidae,* differ to such an extent from all the genera mentioned that their larvae must be placed in another series of families, the Cleroidea, proposed by myself in a recent paper (Adam G. Böving and A. B. Champlain, Larvae of North American beetles of the family Cleridae, Proc. U. S. Nat. Mus., vol. 57, pp. 588-95). They are, according to Dr. F. C. Craighead (Biology of Colydiidae and Bothrideridae, Proc. Ent. Soc. Wash., vol. 22, pp. 1-13, pl. I, II), closely connected with his new family, the Bothrideridae, and appear also to be near to the family Cleridae, having like this family protracted ventral mouthparts, large cardo region and elongate gula region (The figs. 39-44, Plate X, are reproduced from unpublished drawings by Dr. Craighead).

The four families with subfamilies, into which the old family Cucujidae may have to be divided according to larval characters, are characterized briefly in the following conspectus:

I. Mandible with molar structure and complicated hypopharyngeal chitinizations. Ventral mouthparts retracted; cardo in some forms indistinct, fused with enlarged margin of epicranium.

A. Maxillary mala (possibly lacinia) falciform, with terminal uncus; externally to uncus a more or less sharply defined, small setose region (possibly reduced galea). Maxillary articulating area distinct.

1. Without cerci. Eighth abdominal segment normally developed; ninth small, ventrally rudimentary; tenth long, extending far behind ninth segment; six ocelli........................Fam. *Silvanidae*

a. Antenna with second joint large and clavate, third joint very small, or wanting; ocelli in two distinct groups (Plate VIII, figs. 10, 12 and 18)..............................Subfam. *Silvaninae*

b. Antenna with three well developed joints; ocelli not in two distinct groups (Plate X, fig. 34.................................Subfam. *Telephaninae*

2. With cerci......................................Fam. *Cucujidae*

a. Tenth abdominal segment long, conical, extending far behind ninth abdominal segment..................................Subfam. *Hyliotinae*

b. Tenth abdominal segment short, wartshaped, not extending behind ninth abdominal segment..................................Subfam. *Cucujinae*

B. Maxillary mala (possibly galea) obtuse, with or without well defined uncus, which when present is laterally placed on inside of mala (possibly terminating a reduced lacinia)........Fam. *Laemophloeidae*

a. Head larger than prothorax; without ocelli; maxillary articulating area present, cardo distinct; hypostoma normal (Plate IX, figs. 25, 33)........................Subfam. *Prostominae*

b. Head as large as or narrower than prothorax; with ocelli; usually having maxillary articulating area and cardo fused into a joint region, more or less amalgamated with broad enlargement of hypostoma, Subfam. *Laemophloeinae*

II. Mandible without molar structure or hypopharyngeal chitinizations; ventral mouthparts protracted; gular region large (Plate X, figs. 41, 42)..........Fam. *Scalidiidae*

B.—The Subfamily Silvaninae.

B. 1.—Systematic Description of the Subfamily Silvaninae

Three pairs of legs. Fused tarsus and claw. Body orthosomatic, dorsally not plicate. Intersegmental membrane present. Ninth abdominal segment small, ventrally reduced. Cerci not developed. Tenth abdominal segment extending farther back than ninth, conical, elongate, a locomotory organ. Holopneustic; spiracles annular; first spiracle plainly mesothoracic. Head porrect and exserted, or slightly invaginated. Clypeus large, fused with frons. Labrum small, fleshy. Antenna two- (three-) jointed, with large clavate second joint, very small or indistinct apical joint. Mandible with flat, broad, molar part; accessory condyle present; retinaculum hamate; apex tri- (or quadri-) fid. Hypopharyngeal chitinizations strong, with paired, ovate, large maxillular area carrying longitudinal series of long setae. Ventral mouthparts retracted. Maxilla with cardo small, transverse, in some forms distinctly bidivided; stipes proximally and internally attached to large maxillary articulating area; mala extending from distal end of stipes, large, simple, falciform, terminated by single uncus; externally to base of uncus with small setose region, in some forms distinctly defined, being white and membranous in contrast to otherwise brown and well chitinized rest of mala. Maxillary palpus three-jointed. Labium with broad ligula; without or with slightly indicated paraglossae; two jointed labial palp. Mentum—probably fused with submentum—large, barrelshaped, at base attached to maxillary articulating area, otherwise free. Gula large, hexagonal, transverse, interposed between postmaxillary margins of epicranium, the mental-submental area and the anterior prothoracic region.

Apart from the above mentioned, particularly close association with several genera of the old family Cucujidae, the Silvaninae also exhibit a pronounced relationship to the genera of the family Cryptophagidae, to the Monotomidae as represented by the larva of *Europs pallipennis* Lec. and to the genus *Languria,* which together with a few other genera, according to the larval structures, may constitute a distinct family. These larvae have all, like those of the Silvanidae and Cucujidae (restricted) a normally chitinized mandible (compare the Lathridiidae) and a simple and falciform maxillary mala; but they differ from the Silvanid and Cucujid larvae in having bifore spiracles.

B. 2.—The Genera of the Silvaninae Systematically Defined by Larval Characters.

The Silvaninae are represented in the collections of the U. S. National Museum by the larvae of *Carthartus advena* Waltl, *Nausibius clavicornis* Kugelann, *Silvanus quadricollis* Guérin, *Oryzaephilus surinamensis* Linnaeus, *Coccidotrophus socialis* Schwarz and Barber, and *Eunausibius wheeleri* Schwarz and Barber.

The genera which these larvae represent can be separated as follows:

1. Second antennal joint as long as head (Plate VIII, fig. 12) .... *Cathartus* Reiche
   Second antennal joint half as long as head or shorter 2
2. Second antennal joint half as long as head; upper ocellar group with four ocelli, lower group with two ocelli, or individual ocelli of each group confluent 3

Second antennal joint one-third as long as head; upper ocellar group with two ocelli, lower with four 5

3. Mandible apically quadrifid; individual ocelli in each group well separated; body well chitinized, with dark brown chitinous shields (Plate VIII, fig. 18), *Nausibius* Redt.

Mandible apically trifid; individual ocelli in each group almost confluent; body thinly chitinized, with pale yellowish shields....................................4

4. Maxillary palp with length of basal, second and apical joints as 1:1:2................................*Silvanus* Latr.

Maxillary palp with length of basal, second and apical joints as 1:2:2.......................*Oryzaephilus* Gangl.

5. Dorsal shields of abdomen with one long seta on each side; body very thinly chitinized, creamy white (Plate VII, fig. 1), *Coccidotrophus* Schw. and Barb.

Dorsal shields of abdomen with two long and a few short setae on each side; body thinly chitinized, light grey (Plate VII, fig. 3), *Eunausibius* Grouvelle

C.—Coccidotrophus Socialis and Eunausibius Wheeleri.

C 1.—General morphological description of the larvae.

(Plate VII, figs. 1-8, Plate VIII, figs. 9-11, 13, 16-17)

Orthosomatic with dorsal and ventral sides of body equally developed; thoracic segments not twice as long as seven anterior abdominal segments; lateral sides of body nearly parallel, tapering from eighth abdominal segment posteriorly. Legs ambulatory, of equal size, of medium length and strength; five-jointed, with tarsus and claw fused. Thoracic and abdominal terga not plicate, tergal areas forming shieldlike region. Segments smooth, without gills, thorns or thick pubescence, setae on both thoracic and abdominal segments. Ten abdominal segments present; ninth small, ventrally reduced (*9* Plate VII, figs. 1 and 2), without cerci; tenth (*10* Plate VII, figs. 1 and 2) elongate conical, developed as a locomotory organ with extrusible, membranous anal lobes (*l* Plate VIII, fig. 2).

Head exserted beyond, or slightly retracted into anterior portion of prothorax; type of head porrect with frons horizontal and mouthparts stretched forward; form of head subtriangular with posterior part broader. Occipital foramen posterior, annular, dorsally limited by hind margin of epicranium, ventrally by hind margin of gular plate (*gu* Plate VII, fig. 7). No collum. Frons lyriform, one pair of oblong spots where frontal sutures anteriorly begin to diverge (Plate VIII, fig. 9). Frons and clypeus fused. Clypeus large, projecting to near tip of mandible, trapezoidal with sides converging forward, chitinized. Labrum short, soft and whitish, developed as a fleshy anterior margin of clypeus (Plate VIII, fig. 9). Epicranical halves dorsally entirely separated by frons; no median, epicranical suture; hypostoma (the epicranial margin between ventral articulation of mandible and attachment of posterior tip of cardo) (*hy* Plate VII, fig. 7) longitudinal with transverse curvation below cardo; epicranial margin longitudinally continued from tip of cardo to foramen occipitale. Gula median, unpaired, hexagonal, without paragular regions, chitinous, forming the ventral base of cranium between mentum (or probably fusion of mentum and submentum), the maxillary articulating area (*r* Plate VII, fig. 7), the epicranium and the presternal region of prothorax. Hypopharyngeal chitinization (*hpy. ch.* Plate VIII, fig. 16) (= lingua, Folsom), at entrance to pharynx, strong, triangular, considerably wider than long, with tuft of long setæ at each end; between tufts surface covered with numerous small, irregularly arranged rugosities. Coming from hypopharyngeal chitinization, creating firm support for same, is the following system of five pairs of chitinous rods: First pair (= lingual stalks, Folsom) (*1* Plate VII, fig. 8, Plate VIII, fig. 16) connecting hypopharyngeal chitinization with anterior corner of gular plate, perpendicular, parallel, imbedded in membrane between articulating area of maxilla and lateral side of base of mentum (or probably submental part of fused mentum—submentum). Second pair of rods (=hypoharyngeal bracons, Hopkins) (*2* Plate VII, figs. 6, 8, Plate VIII, fig. 16) connecting hypopharyngeal chitinization with that region of epicranium which carries fossa for mandibular condyle; horizontal, transverse, imbedded in buccal membrane between mandible and dorsal side of maxillary stipes. Third pair of rods (*3* Plate VII, figs. 6, 8, Plate VIII, fig. 16) situated immediately in front of and parallel with anterior margin of hypopharyngeal chitinization; horizontal, converging anteriorly, meeting in middle line. Fourth pair (*4* Plate VII, figs. 6, 8, Plate VIII, fig. 16) supporting and externally limiting the maxillular areas, vanishing distally near glossa (= buccal surface of ligula) (*glos.* Fig. 16); horizontal, longitudinal and parallel. Fifth pair (*5* Plate VII, figs. 6, 8, Plate VIII, fig. 16) forming a posterior prolongation of fourth pair of rods, imbedded in sides of oesophagus; horizontal, longitudinal and parallel; proximally, near hypopharyngeal chitinization, with fossa for accessory mandibular condyle (*fos. a. c. m.* Plate VIII, fig. 16), distally gradually vanishing.* Maxillular areas (*sensu* H. T. Hansen, = superlingua Folsom) (*mxl* Plate VIII, fig. 16) fleshy, ovate, anteriorly fused together, posteriorly well separated, limited externally by fourth and internally by third pair of rods; along third pair with a series of well developed, closely set setæ. Glossa (= buccal surface of ligula-lingua, Schiődte) (*glos.* Plate VIII, fig. 16) unpaired, fleshy, in front of maxillular area, laterally supported and limited by a pair of longitudinal, horizontal, chitinous rods (*stp. li.* Plate VIII, fig. 16); similar to the fourth hypopharyngeal pair. Epipharynx (Plate VIII, fig. 11) consisting of anterior and posterior part. Anterior part a direct ventral continuation of labrum; soft, membranous, medially on the hind margin with a small triangular asperity, which fits in between the scissorial parts of the closed mandibles; well developed tendons (*t* Plate VIII, fig. 11) extending from each back-corner; some long setæ. Posterior part of epipharynx slightly chitinized, with several transverse, long, curved, parallel wrinkles. Tentorium an internal cranial structure, differing in that respect from the two mentioned systems of chitinizations in

* The pair of rods is not present which in many other Coleopterous larvae extends from proximal ends of fifth pair, along sides of epipharynx, towards end of large movable labrum.

the buccal membrane above labium and above the mental-submental area; consisting of a median broad and short, slightly chitinized, transverse tentorial bridge (*ten. b.* Plate VII, fig. 7), situated a short distance above gular plate and of two pairs of tentorial arms; the first pair of arms lateral (*t. l. a.* Plate VII, fig. 7), between bridge and tentorial pits (*tp.* Plate VII, fig. 7) where gular plate and epicranium meet; the second pair anterior (*t. a. a.* Plate VII, fig. 7), reaching from tentorial bridge toward the dorsal side of cranium, their external ends distally indistinct. Ocelli (Plate VIII, fig. 10) six, placed in two groups, a lower behind mandible and an upper straight behind antenna and right above first group. Antenna with large basal membrane, two- (three-) jointed; basal joint (*1* Plate VII, fig. 5) short, second joint (*2* Plate VII, fig. 5) long, claviform, with tip (*3* Plate VII, fig. 5) more or less distinctly separated as a small additional joint. Mandible (Plate VII, figs. 4 and 5) with molar part, retinaculum and accessory ventral condyle; half as long as head; apical part (*p. sc.* Plate VII, fig. 5) distinctly constricted, incurved, vertically compressed, fornicate, cleft with some toothlike ends; rest of mandible horizontally flat, subtriangular with wide base; retinaculum present (*r* Plate VII, fig. 5), hamate, short, pointed, with enlarged socket; molar part broad (*m.* Plate VII, fig. 5, Plate VIII, fig. 17), compressed, with dorsal surface smooth, ventral surface roughened by numerous granules, these being anteriorly rather large and irregularly distributed, posteriorly minute and densely placed in longitudinal rows; basal molar fringed with a series of anomalous, chitinous, stiff, filamentous processes (*fil. pr.* Plate VIII, fig. 17), which gradually diminish in length from inner corner of basis toward accessory condyle; accessory condyle (*acces.* Plate VIII, fig. 17), as mentioned above, fitting into groove (*fos. a. c. m.* Plate VIII, fig. 16) in fifth hypopharyngeal rod.* Ventral mouthparts

* This articulation between the mandibles and the whole system of amalgamated chitinous hypopharyngeal and epipharyngeal structures indicates that the side to side movements of the mandibles caused by extensor-flexor—(= abductor-adductor)—muscles, always must be coincident with the forward-backward movements of the following closely united structures: the anterior portion of oesophagus, the hypopharynx with other buccal structures, and the ventral mouthparts, and also coincident, when a free, well-developed labrum and movable clypeus are present, with their up and down nodding motions. All forward and upward directed movements are caused by blood pressure combined with special arrangements of the articulations; all backward and downward directed movements by retractor muscles.

retracted with tip of cardo articulating at considerable distance behind the ventral condyle of the mandible (*vc.* Plate VII, fig. 7); hypostomal curvation adjacent to both stipes and cardo. Maxillary articulating area large, membranous, placed between stipes, maxillae, cardo, gular plate and posterior part of the mental-submental region. Cardo maxillaris approximately transverse, bidivided, much narrower than long, tip articulating with hypostoma at distinct distance from occipital foramen. Stipes maxillaris connected with the articulating area along the proximal two-thirds of its inner margin; distal part free. Mala (=maxillary lobe) (*lac* Plate VIII, fig. 16) simple, projecting as a direct anterior continuation of stipes, apically attenuate, terminating with a single, well developed uncus (*u* Plate VIII, fig. 16); external apical part of mala (*gal* Plate VIII, fig. 16) soft-skinned with some strong, straight setae behind uncus:* inner margin of mala set with strong setae. Palpiger maxillaris (*plg. mx.* Plate VIII, fig. 16) well developed, subtriangular. Maxillary palp well developed, three-jointed. Submentum probably fused with mentum, forming together a barrelshaped, free unit (*m* Plate VII, fig. 7). Labium (proper) posteriorly limited by a chitinous bow, extending between the ends of those rods which laterally support and limit the glossa; palpiger labii not distinctly chitinized. Ligula (*lig* Plate VII, fig. 7) broad.** Labial palp short, two-jointed. Between head and prothorax there is a well developed cervical membrane, capable of being invaginated into and protruded from the anterior part of prothorax. Thoracic segments similar in size and development. Prothoracic presterna (*prst 1* Plate VII, fig. 7) large broad, oval,

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* Possibly corresponding to galea, while chitinized rest of mala is lacinia (*lac* Plate VIII, fig. 16).

** The term "ligula" (= glossa, Folsom) is here applied to the median, terminal labial lobe, which is composed of the fused right and left labial malae. For descriptive purposes it appears practical to use special terms for the ventral and buccal surfaces of this lobe; the term "ligula" is here applied only to the ventral surface (*lig* Plate VII, fig. 7), while the buccal surface is mentioned as "glossa" (*glos.* Plate VIII, fig. 16). The structure which Schiödte calls "ligula" is not identical with the entire labial lobe in question, as he designates as the ligula only a special, jointed, terminal part of the lobe; the rest, or, when no jointed terminal part is developed, the entire lobe Schiödte calls "lingua," and he applies this term both to the ventral and buccal surfaces.

adjacent to a medium, simple, elongate, suboval eusternal sclerite (*eu* Plate VII, fig. 7); furcal pits (*fur* Plate VII, fig. 7) near inside of legs. A well developed triangular poststernellum (*pstl* Plate VII, fig. 7) present. Between pro- and mesothorax and between meso- and metathorax a well developed intersternal ring consisting of the poststernellar area (*pstl.* Plate VII, fig. 7) of the anterior and the presternellar areas (*prst* Plate VII, fig. 7) of the posterior or two connected segments. Presternal areas of meso- and methathorax, subtriangular, dorsally only slightly separated from the spiracle-bearing preëpipleural areas of the segments. Hypopleural areas, above coxae, separated by a distinct, short, perpendicular, chitinous line extending from coxal hinge into an anterior subdivision, prehypopleurum (=episternum *authorum*), and a posterior one, posthypopleurum (=epimeron *authorum*). Legs inserted widely apart (*leg* Plate VII, fig. 7). Abdominal segments, from first to eighth, differing only slightly in size and shape, about as wide as thoracic segments, somewhat shorter. Intersegmental membranes, indistinctly developed dorsally and laterally, more distinctly ventrally. Each abdominal segment with tergal areas fused, with poorly defined, low epipleural area without lobe or other subdivisions, with hypopleurum large, somewhat bulging, dorsally clearly limited by a ventro-lateral suture, ventrally less sharply defined; sternal areas more or less fused. Ninth and tenth abdominal segments mentioned above (p. 204). Spiracles annular (Plate VII, fig. 2, Plate VIII, fig. 13), not very conspicuous; mesothoracic twice as large as abdominal; metathoracic rudimentary; both meso- and metathoracic spiracles—as already mentioned—located in preëpipleurum; abdominal spiracles all lateral and of same size, located in the tergal regions medially or posteriorly near the rather indistinct dorsolateral suture. One pair of small chitinous spots present dorsally on the thoracic segments; one pair dorsally and one pair ventrally on most of the abdominal segments. Rounded, soft organs, shaped like cloverheads attach internally to these spots; function unknown.

C. 2.—Specific Description of Larvae of Coccidotrophus socialis and Eunausibius wheeleri.

Coccidotrophus socialis Schwarz and Barber

(Described from specimens preserved in U. S. National Museum.)

(Plate VII, figs. 1 and 2.)

Mature Larva:

Length about 4 mm. Width of prothorax about 1 mm. Whitish, very thinly chitinized. Head with width to length as 1:1½. Length of head and thorax, together in proportion to abdomen as 3:5. Ocelli four in a lower, square group, two in an upper group. Frons with short setae sparsely scattered over the surface; the paired spots at frontal sutures yellow. Clypeal region anteriorly with transverse series of four long setae, laterally with one long seta on each side, several short setae scattered over entire surface. Labrum, with several very short setae. Another part of epipharynx with four long setae along the front margin and one long seta on each side near the attachment of the epipharyngeal tendon; posterior part of epipharynx without setae. Hypostoma about half as long as lateral outline of epicranium. Epicranial postmaxillary margin about half as long as cardo. Epicranium, with a few long and some short setae scattered over the surface. Antenna about half as long as head from front margin or labrum to occipital foramen; basal antennal joint about half as long as second joint (soft-skinned apical part excluded), subcylindrical, twice as long as wide; second antennal joint clubshaped, with end twice as wide as base, almost one-third as long as length of head; tip of antenna membranous, whitish, low, rounded, not distinctly set off from second joint; no supplementary appendix; a ring of densely set spinules present on distal end of basal joint, numerous thin and medium long or short setae irregularly scattered over the whole surface of second joint. Mandible with apical part trifid, several setae of different sizes on exterior lateral mandibular region. Each maxillular area ovate, membranous; individual setae belonging to series along inner margin of medium size, somewhat curved, bending outward. Maxilla, with end of cardo articulating at a distance from occipital foramen, somewhat more than half the length of cardo; free distal part of stipes dorsally with one long seta; mala with inner margin set with two parallel series of strong, somewhat curved setae; palpiger maxillaris with a few minute setae; maxillary palp well developed, surpassing tip of mala by one-half the length of the apical joint, with basal joint cylindrical, somewhat wider than long; second joint cylindrical, as wide as long; apical joint slightly conical, almost as long as the two other joints together, half as wide; front margin of two posterior joints with minute spines in a ring; apical joint with one long seta and terminally with several sensory papillæ. Submentum with two pairs of setae. Ligula anteriorly rounded, with several rather short setae; no paraglossae. Labial palp about as long and wide as the apical joint of the maxillary palp; basal joint about two-thirds of the entire length of labial palp; apical joint anteriorly obtusely rounded and provided with many minute sensorial projections. Thoracic segments almost equally developed, each about as wide and long as head; weak line present between furcal pits, separating an anterior eusternal region from a posterior sternellar region; poststernellar areas of pro- and mesothorax well developed, marked with a median chitinous spot. Prothorax with eusternal sclerite as wide and somewhat longer than each prothoracic presternum. Thoracic tergal shields with one seta on each side, the prothoracic rather short; meso- and metathorax with one yellow spot anteriorly to the seta. Legs with coxa about as long as clypeal region, slightly longer than thick; trochanter half as long as coxa; femur and tibia of equal size, slender, each slightly longer than second antennal joint, about four times as long as thick; clawshaped tarsus not quite as long as basal antennal joint. Eight anterior abdominal segments with tergal shields carrying along the hind margin a series of seven to eight setae on each side of middle line; one seta, externally placed, very long, the others very small; scattered all over the whole surface of shield, numerous, extremely minute setae. In front of long seta with yellow, chitinous spot. Spiracles posteriorly placed, below the shields. Epipleurum narrow, without seta. Hypopleurum with large median lobe and one long seta; sternal areas on each side with two long setae and one yellow chitinous spot. Ninth abdominal segment only represented by small tergal part, about as large as hypopleurum of eighth abdominal segment, with one small seta and some very minute scattered over whole surface. Tenth abdominal segment as long as one of the well developed abdominal segments, conical, one and one-half times as long as wide; a ring of small setae right above the truncate end; also with very minute setae scattered over whole surface. Mesothoracic spiracle about as large as base of claw, situated on top of small softskinned conical tube; abdominal spiracles half as large and not on tubes.

Newly hatched larva:

Length 1 mm. Width of prothorax 0.25 mm. Length of head and thorax together about as long as abdomen. One very long seta on each side of hind margin of tergum; setae corresponding to the small setae along hindmargin comparatively longer than those of mature larva; no setae corresponding to minute setae on the whole tergal surface.

Eunausibius wheeleri Schwarz and Barber.
(Described from specimens preserved in U. S. National Museum.)

Mature Larva:

Length, about 3.5 mm. Width of prothorax, about 0.75 mm. Length of head and thorax combined, in proportion to length of abdomen, about as 3:5. Shields thinly chitinized, light grey, shiny. Both thoracic and abdominal segments along hindmargin with a series of six to seven setae on each side; two sets very long, the others short; rest of tergal shield smooth with a few very minute setae. Abdominal hypopleurum with one long and one short seta. Otherwise like *Coccidotrophus socialis,* to which larva it is very closely related.

C 3.—General and specific description of the Pupae of Coccidotrophus socialis and Eunausibius wheeleri.
(Plate IX, figs. 19-21, 23)

General Description.

Body somewhat depressed; about five times as long as width of prothorax. Head large and wide; not to be seen from above;

with four or five very minute spinules on dorsal surface. Prothorax flat, subrectangular; with length to width at 1.25:1.00; anterior third slightly broader than rest; anterior corner somewhat rounded; posterior corner rectangular; with one setiferous protuberance at each anterior corner and a few along the sides, otherwise entirely smooth. Meso- and metathorax smooth. Abdomen with third segment the widest and as wide as prothorax; first and second abdominal segments slightly narrower; posterior segments gradually decreasing to the seventh, which anteriorly is half as wide as the third and posteriorly only two-thirds as wide as anteriorly; eighth to ninth abdominal segments small, forming together a rounded almost semicircular termination of body. Second to seventh abdominal segments laterally with small protuberances, without setae; ninth abdominal segment dorsally terminating with two small, slender, cylindrical, divergent cerci. Spiracles annuliform, located on meso- and metathorax and on the first to eighth abdominal segments, where lateral protuberances develop spiracles placed immediately above and in front of these. Pouch covering elytron extending to posterior margin of fourth abdominal segment, smooth, with four well marked longitudinal ribs. Tarsal cover of hind legs ventrally extending to middle of fourth abdominal segment; the entire leg-pouch smooth. Antennal pouch short, clubshaped, directed backward and outward; ends of the last three or four joints marked by a ring of small projections.

Specific Characterization.

Coccidotrophus socialis Schwarz and Barber.

(Pupa described from specimens preserved in the U. S. National Museum).

(Plate IX, figs. 19-21)

Length, about 4 mm. White. Prothorax with anterior lateral protuberance small, but distinct, three posterior lateral protuberances much reduced, not to be seen with naked eye or ordinary lens magnification.

Eunausibius wheeleri Schwarz and Barber

(Pupa described from specimens preserved in the U. S. National Museum)

(Plate IX, fig. 23)

Length, 3-4 mm. Grey. Prothorax with five lateral protuberances well developed, to be seen with naked eye or ordinary lens. (On specimen figured one protuberance was—abnormally—not developed on left side.)

D.—Bibliographical Notes.

A careful list of the descriptions and figures of the larvae of the family Cucujidae (*auth.*), including reference to P. de Peyerimhoff's key for the determination of the larvae of the Cucujid genera, is given by F. H. Gravely (in Records of the Indian Museum, Calcutta, vol. II, 1915, pp. 353-358).

To this list might be added the part dealing with this family in L. Ganglbauer: Die Käfer von Mitteleuropa, vol. III, part 2, 1899. Since the list of Gravely was published an important work has appeared by U. Saalas: Die Fichtenkäfer Finnlands (in Annales Academiae Scientiarum Fennicae Ser. A, vol. VIII, 1917 pp. 508-528, figs. 119-130). In Saalas' book are described and splendidly figured with habitus and detail drawings the following larvae (and pupae): *Pediacus fuscus* Er., *Laemophloeus abietis* Wank, *Laemophloeus alternans* Er.

Finally I may mention that the larva described and figured by C. V. Gernet as "Cucujiden-Larve" (*Dendrophagus crenatus* Payk) is in my opinion a *Staphylinid* larva of the group Aleocharini. The figure shows the combination of a mandible without mola and jointed cerci, movable at base, which is characteristic of the Staphylinids; and also a large movable labrum, a single ocellus and broad ligula, which characters define the Aleocharini.

The newest taxonomic arrangement of the Cucujidae is presented by Charles W. Leng in: "Catalogue of the Coleoptera of America, North of Mexico," Mount Vernon, N. Y., John D. Sherman, 1920. The arrangement of the larvae given in the present paper does not agree so well with Mr. Leng's list as with the system presented in 1899 in L. Ganglbauer's "Käfer von Mitteleuropa."

Plate VII.

(Figures drawn by A. G. Böving).

Fig. 1. *Coccidotrophus socialis.* Dorsal view of larva.

Fig. 2. *Coccidotrophus socialis.* Side view of larva.

Fig. 3. *Eunausibius wheeleri.* Dorsal view of larva.

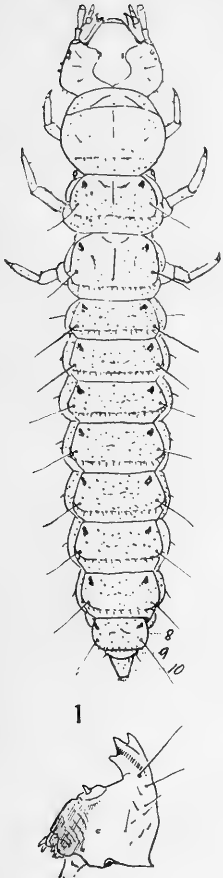
Fig. 4. *Coccidotrophus socialis.* Right mandible from above.

Fig. 5. *Coccidotrophus socialis.* Right mandible from below. *ac,* accessory condyle; *f,* chitinous appendices from base of mola; *flx,* tendon of flexor mandibulæ; *m,* mola; *psc,* pars scissoria; *r,* retinaculum; *v,* ventral condyle of mandible; *1-2-3,* first-second-rudimentary third antennal joints.

Fig. 6. *Coccidotrophus socialis.* Hypopharyngeal rods in buccal membrane. Dorsal surface of ventral mouthparts. *1-2-3-4-5,* see explanation of Fig. 16, Plate VIII.

Fig. 7. *Coccidotrophus socialis.* Head, Prothorax and Mesothorax from below. *a1-a2,* first and second antennal joints; *b,* bracon (= second hypopharyngeal rod); *bm,* basal membrane of antenna; *est,* eusternum; *eu,* eusternal plate of prothorax; *fur,* pit indicating attachment of furca; *gu,* gula; *leg,* basis of leg; *lig,* ligula; *m,* mentum and submentum fused; *prst, 1, 2* and *3,* presternum; *pstl 1* and *2,* poststernellum of first and second thoracic segments; *r, sp.,* rudimentary spiracle of metathorax; *sp,* spiracle of mesothorax, *stl,* sternellum; *taa,* anterior arm of tentorium; *tenb,* bridge of tentorium; *tla,* lateral arm of tentorium; *tp,* tentorial pit, longitudinal groove, indicating attachment of lateral arm of tentorium; *stl,* sternellum; *vc,* mandibular fossa of epicranium.

Fig. 8. *Coccidotrophus socialis.* Ventral surface of ventral mouthparts. *1-2-3-4-5,* five hypopharyngeal rods, see explanation of Fig. 16, Plate VIII.



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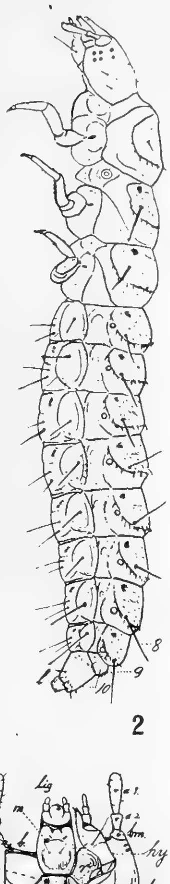

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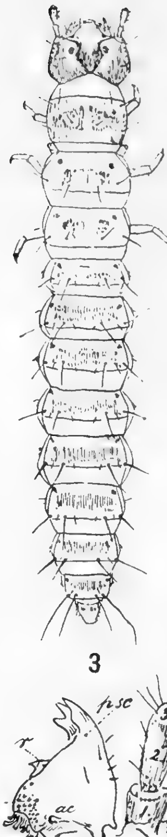

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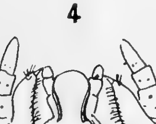

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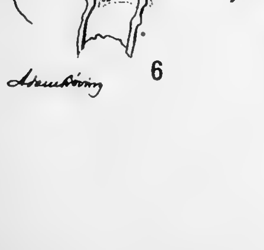

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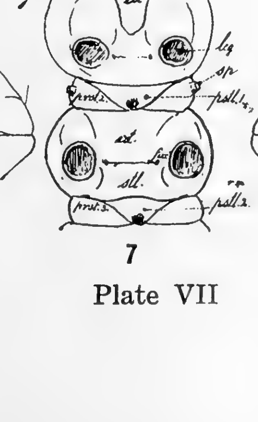

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Plate VII

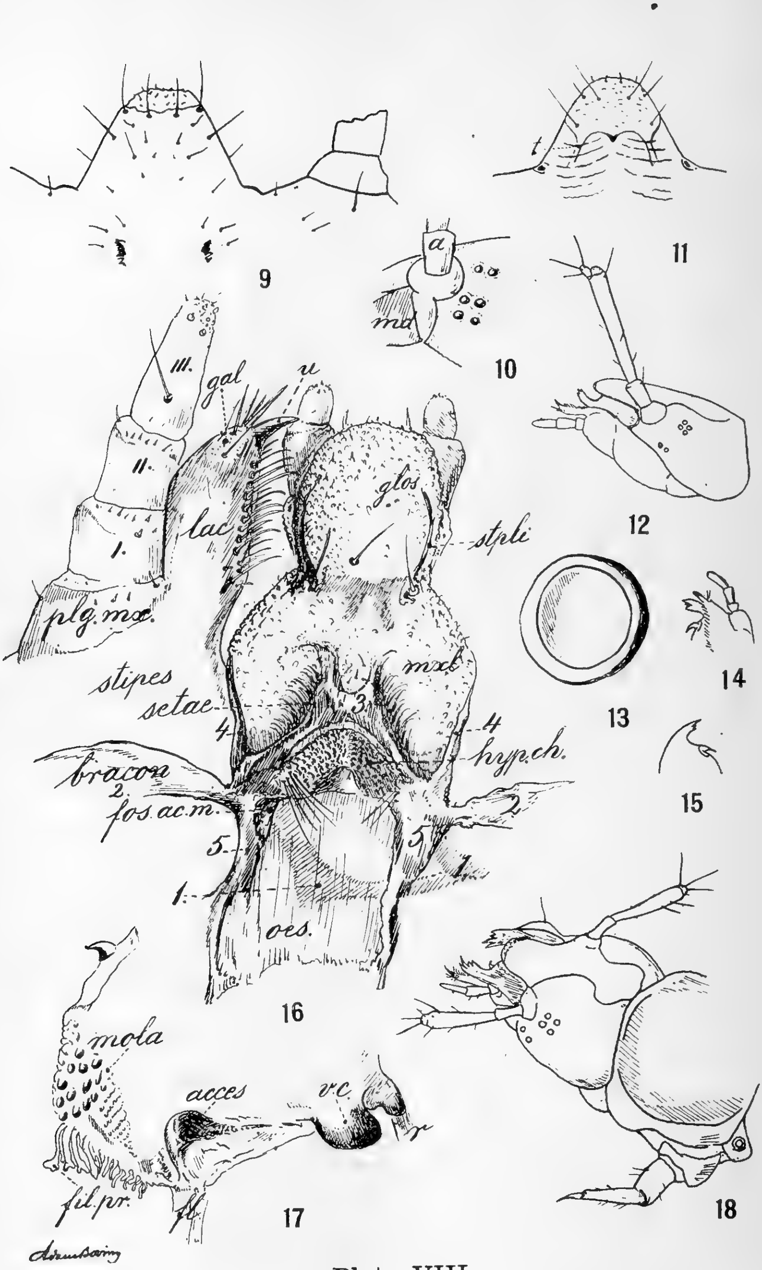
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Plate VIII

Plate VIII.

(Figures drawn by A. G. Böving).

Fig. 9. *Coccidotrophus socialis.* Anterior part of head from above, showing frons with chitinous spots, clypeus fused with front, membranous short labrum, basis of antenna.

Fig. 10. *Coccidotrophus socialis.* Anterior part of head from right side, showing basis of antenna basis of mandible, upper group of two ocelli, lower group of four ocelli.

Fig. 11. *Coccidotrophus socialis.* Epipharynx.

Fig. 12. *Cathartus advena.* Head from left side.

Fig. 13. *Coccidotrophus socialis.* Spiracle, highly magnified.

Fig. 14. *Cathartus advena.* Anterior part of left mandible and maxilla from below.

Fig. 15. *Cathartus advena.* Anterior part of left mandible from above.

Fig. 16. *Coccidotrophus socialis.* Maxilla, hypopharynx, maxillular area and glossa (= dorsal surface of ligula) facing buccal cavity; bracon, second chitinous rod from hypopharyngeal chitinization; *fos. ac. m,* fossa for the accessory mandibular condyle in base of hypopharyngeal chitinization (*acces,* fig. 17, Plate VIII); *gal,* possibly rudimentary galea; *glos,* glossa; *hyp. ch,* hypopharyngeal chitinization; *lac,* lacinia; *mxl,* maxillular area; *oes,* oesophagus; *plg. mx,* palpiger maxillæ; *u,* uncus; *setae,* setae along chitinous rod number three; *stipes,* dorsal surface of stipes maxillæ; *stpli,* chitinous rod between glossa and palpiger labii; *1-2-3-4-5,* chitinous rods from hypopharyngeal chitinization; *I-II-III,* basal, second, apical joints of palpus maxillaris.

Fig. 17. *Coccidotrophus socialis.* Posterior part of left mandible from below; *acces,* accessory condyle fitting into fossa in base of hypopharyngeal chitinization (*fos. ac. m,* fig. 16, Plate VIII); *fil, pr,* stiff chitinous filaments; *fl,* tendon of flexor mandibulæ; *mola,* granular ventral surface of the molar structure; *r,* tendon of retractor mandibulæ; *vc,* ventral condyle of mandible fitting into fossa of epicranium (*vc,* fig. 7, Plate VII).

Fig. 18. *Nausibius repanda.* Head and anterior part of thorax.

Plate IX.

(Figures drawn by A. G. Böving).

Fig. 19. *Coccidotrophus socialis.* Pupa; left side.
Fig. 20. *Coccidotrophus socialis.* Pupa; dorsal side.
Fig. 21. *Coccidotrophus socialis.* Pupa; ventral side.
Fig. 22. *Prostomis mandibularis.* (Denmark, Europe), Maxilla; *mx. art. a.*, maxillary articulating area.
Fig. 23. *Eunausibius wheeleri.* Pupa; left side. (Specimen slightly abnormal, having only four lateral projections on left side).
Fig. 24. *Prostomis mandibularis.* Larva from above.
Fig. 25. *Prostomis mandibularis.* Head from below.
Fig. 26. *Prostomis mandibularis.* Terminal part of abdomen from below.
Fig. 27. *Dryocora howitti* (New Zealand). Maxilla.
Fig. 28. *Dryocora howitti.* Mandible.
Fig. 29. *Dryocora howitti.* Ninth abdominal segment from above.
Fig. 30. *Dryocora howitti.* Ninth abdominal segment, left side
Fig. 31. *Dryocora howitti.* Head; dorsal side.
Fig. 32. *Dryocora howitti.* Larva from above.
Fig. 33. *Dryocora howitti.* Head; ventral side.

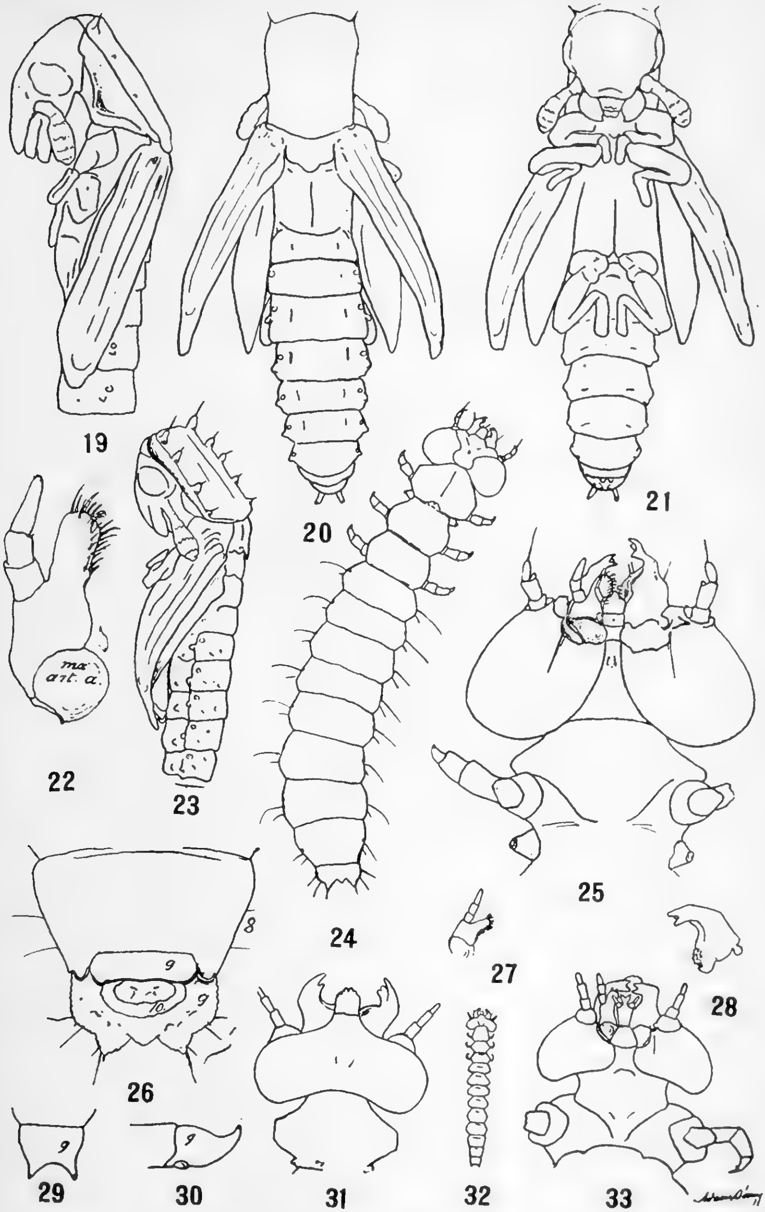
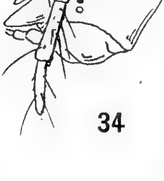


Plate IX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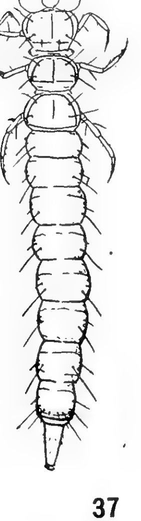
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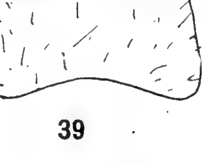
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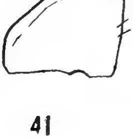
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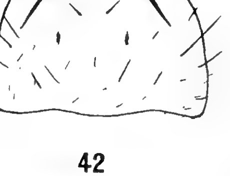
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Adam Boving

F. C. Craighead

Plate X

Plate X.

(Figures 34-38 drawn by A. G. Böving).
(Figures 39-44 drawn by F. C. Craighead).

Fig. 34. *Telephanus pallidulus* (Rio Piedras, Porto Rica). Head; left side.

Fig. 35. *Telephanus pallidulus.* End of abdomen; left side.

Fig. 36. *Telephonus pallidulus.* Left mandible; ventral surface.

Fig. 37. *Telephanus pallidulus.* Mature larva; dorsal side.

Fig. 38. *Telephanus pallidulus.* Maxillæ, glossa, maxillular area, hypopharyngeal chitinization, oesophagus; facing buccal cavity.

Fig. 39. *Scalidia linearis* Lec. Head; dorsal side. (Note: No distinct clypeus, large movable labrum).

Fig. 40. *Scalidia linearis.* Leg.

Fig. 41. *Scalidia linearis.* Right mandible; dorsal surface. (Note: No molar structure).

Fig. 42. *Scalidia linearis.* Head; ventral surface. (Note: Protracted mouthparts; large region formed by fusion of cardines, mentum and submentum; also large region formed by fusian of epicranial halves and gula).

Fig. 43. *Scalidia linearis.* Spiracle; annuliforme.

Fig. 44. *Scalidia linearis.* Left side of the mature, parasitic larva.

ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

FROM THE TROPICAL RESEARCH STATION IN BRITISH GUIANA

VOLUME III. NUMBER 8

(Tropical Research Station Contribution Number 102)

A NEW DIADIPLOSIS

By E. P. Felt

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December 24, 1921

A NEW DIADIPLOSIS

By E. P. Felt

The midge described below was received from Prof. Wheeler accompanied by the statement that the larvae were devouring mealy-bugs (*Pseudococcus bromeliae* Bouché) in a cavity of a peculiar myrmecophilous tree, *Tachigalia,* in British Guiana. The coccids and the fly larvæ live in a cavity of the leaf petiole.

This species approaches closely that West Indian *Diadiplosis cocci* Felt, which was reared from larvæ preying upon the eggs of *Saissetia nigra* Nietn., a scale insect frequently abundant upon the stems of Sea Island cotton. The female of the West Indian species has a distinct knob upon the terminal antennal segment and the lobes of the oviposter are somewhat narrower, two characters which serve to distinguish the species, though it is frequently very difficult to find characteristic structures in female gall midges.

Diadiplosis pseudococci sp. nov.

Female. Length 1.25 mm. Antennae extending to the base of the abdomen, sparsely haired, yellowish brown, of fourteen segments, the fifth with a stem about one-fourth the length of the cylindrical basal enlargement, which latter has a length about two and one-half times its diameter and is slightly constricted near the basal third; low, broad circumfila occur on the enlargement at the basal third and apically; basally there is a thick whorl of rather long, stout setae and on the ventral face near the distal third a rather thick group of long, rather strongly curved, slender setae; terminal segment somewhat produced, with a length nearly three times its diameter and tapering gradually to a sub-acute apex (no knob as in *D. cocci)* Palpi: the first segment short, the second with a length about twice its diameter, and the third a little longer than the second. Mesonotum dark reddish brown; scutellum and postscutellum yellowish orange; abdomen "orange red"; the sclerites yellowish brown; wings hyaline; halteres pale yellowish, fuscous subapically; coxae and femora basally pale yellowish, the remainder of the legs dark straw; claws moderately stout, strongly curved, unidentate; the pulvilli about one-half the length of the claws; ovipositor short, the lobes broadly oval and clothed sparsely with rather coarse hairs.

Pupa. Length 1.5 mm. Rather stout, yellowish orange, the antennal cases extending to the middle of the thorax; the wing cases to the third abdominal segment and the leg cases to the fourth and fifth abdominal segments; posterior extremely broadly rounded, with a median furrow, the abdominal segments dorsally each with a rather broad, transverse band of scattering weak spines.

Larva. Length 1.5 mm. Moderately stout, yellowish orange (probably reddish orange in life); head short, mostly retracted; the breastbone weakly developed, bilobed anteriorly, the lobes rather broad, broadly rounded and roundly excavated at the internal basal angles; the shaft weakly and irregularly developed; the posterior extremity obsolescent; near the middle of each segment there is a transverse row of moderately long, tapering, setose processes; skin rather finely shagreened, posterior extremely broadly rounded.

Type Cecid. A3176, New York State Museum.

The larvæ, as noted by Prof. Wheeler, live under a web in small groups. The pupae occur intermixed and can be distinguished from larvae only with difficulty. The midges doubtless emerge directly from these shelters.

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A NEW BLEPYRUS

By C. T. Brues

Blepyrus tachigaliæ sp. nov.

Female. Length 1.5 mm. Head metallic green, thorax black with an æneous cast, abdomen bronzed black; antennæ yellow and black, the scape and funicle yellow, darker on the scape basally, the pedicel and club black; coxæ black, femora black with brown tips, tibiæ brownish yellow with a black streak at base, tarsi pale, with the last joint dark. Wings deeply infuscated basally, hyaline on apical half. Front one-fourth the width of the head at middle, broader above and below, with large punctures forming about four vertical rows; malar furrow shallow and not very distinct; cheeks finely, vertically aciculated, eyes with short pubescence. Antennæ inserted close to the mouth, the scape reaching barely halfway to the vertex, excavated and distinctly, although not broadly, produced below; pedicel triangular, longer than thick and half as long as the funicle; funicle joints about equal in length, the apical joint more than twice as broad as the basal one; club enlarged, flattened and obliquely truncate at apex, as long as the pedicel and funicle together. Thorax, including scutellum, highly convex when seen in profile, the mesonotum nearly as long as the scutellum, the surface of both shining, minutely punctulate and finely hairy; axillary suture apparently obsolete; scutellum very long, the side margins straight till near the apex, which is therefore rather sharply rounded. Abdomen very short, concave above, with long, scattered hairs at the sides. Legs stout, the spur of middle tibia strong, as long as the first tarsal joint, the tarsal spinules strong on all four basal joints. Marginal vein short, not over twice as long as thick; stigmal vein long, postmarginal slightly shorter, their angle of separation about 100 deg.; wing cilia short, those on the costa longer.

Type and paratype bred from *Pseudococcus bromeliæ* Bouché, occurring in cavities in the petioles of *Tachigalia* sp. at Kartabo, British Guiana.

This species agrees well with Howard's original generic diagnosis[1] except that the antennal scape is slightly enlarged below as in certain species of *Bothriothorax* (e. g., *B. minor* Silvestri). The color of the body, appendages and wings will distinguish the present form.

---

[1] Proc. U. S. Nat. Mus., Vol. 21, p. 233 (1898).

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FROM THE TROPICAL RESEARCH
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TWO TACHIGALIA MEMBRACIDS

By HERBERT OSBORN

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TWO TACHIGALIA MEMBRACIDS

By Herbert Osborn

***Endoastus* (?) *productus* sp. nov.**

(Fig. 17.)

Head produced before the eyes, about as long as width between the eyes, distinctly furrowed above and below and bifid at tip, ocelli close to front margin of eye, antennæ below the eye in distinct sockets with raised margin; pronotum strongly convex, sloping to head, posterior angles subacute; scutellum triangular slightly longer than basal width; elytra narrow, scarcely reaching end of abdomen; legs short cylindric, all of nearly equal length.

The color is uniformly dark brown except tibiæ, which are lighter, the surface of body and elytra densely and minutely punctured.

Female genital segment three times as long as preceding; the ovipositor extruded; male subgenital plate narrow, upcurved.

Length of female 5.5 mm., of male 4 mm.

This species has a more produced head than *E. caviceps* Fowl., but there seems to be no good structural character to warrant the formation of a distinct genus for it, and at least until the study of related species shows such distinction it seems proper to place it here.

Superficially it has a strong resemblance to the Cicadellids but in structural characters is obviously Membracid.

Eight specimens, seven females, one male. Kartabo, Bartica District, British Guiana, 1920, feeding on the terminal shoots of young *Tachigalia* trees.

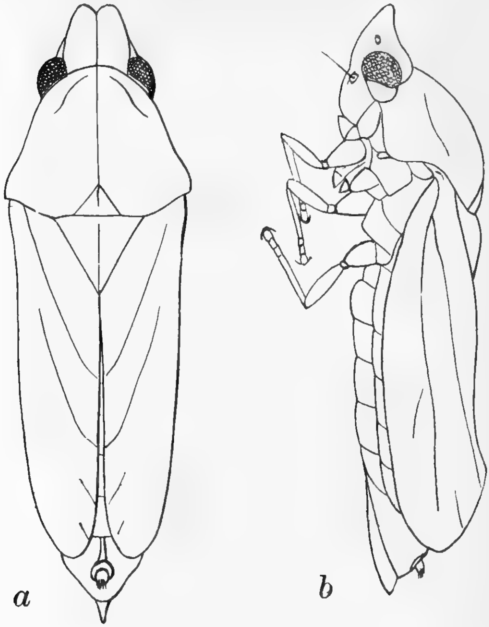

FIG. 17. *ENDOASTUS* (?) *PRODUCTUS* SP. NOV. FEMALE.
a, dorsal; *b*, lateral aspect.

Microcentrus (?) sp. Nymph.

A single nymph agreeing closely in structural characters with nymphs of *Microcentrus* sps. of Eastern U. S.

Body flattened, slightly convex above, head short, the anterior border with broad, fringed plates each side; abdominal segments 2-6 with flattened, fringed, plate-like expansions and the terminal segment broadly fringed. Length 6.5 mm., width of thorax 3 mm.

Feeding on the terminal shoots of young *Tachigalia* trees Kartabo, B. G., July, 1920.

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(Tropical Research Station Contribution Number 105)

A NEW ENTOMOBRYA

By J. W. FOLSOM

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DECEMBER 24, 1921

A NEW ENTOMOBRYA

By J. W. Folsom

Entomobrya wheeleri sp. nov.

(Fig. 18)

Head and body mottled with blue pigment, with no definite color pattern (Fig. 18*a*). Sternum white. Antennæ blue; first three segments darker apically. Coxæ slightly pigmented, also femora distally and tibiotarsi proximally. Furcula unpigmented. Eyes 8-8, on black patches, the two inner proximal eyes of each side being smaller than the others. Antennæ one and three-fifths times as long as the head, with segments in relative lengths about as 9:22:19:30; basal ring large, resembling a segment. Mesonotum not projecting anteriorly. Fourth abdominal segment almost five times as long as the third. Unguis (Fig. 18*b*) with a pair of lateral teeth and with two inner teeth, the proximal tooth being doubled. Unguiculus three-fifths as long as the unguis. Furcula attaining the ventral tube. Manubrium and dentes subequal in length. Dentes crenulate dorsally. Mucrones (Fig. 18*c*) subequally bidentate, the basal spine being absent; two fringed setæ projecting from each dens extend almost to the end of each mucro. Corpus of tenaculum with a single curving ventral seta. General clothing of dense short setæ. Clavate, ringed setæ occur on the anterior part of the head, on the last abdominal segment, and on the dorsal region of the manubrium. Pointed, fringed setæ are present on the last two abdominal segments and on the furcula dorsally and ventrally. A few long, stout, fringed setæ occur on the antennæ, two or three on each coxa, a few on femur and tibiotarsus, and several on the anterior surface of the ventral tube. Length 1 mm.

The preceding description applies only to the largest specimen as regards proportions and pigmentation, for these characters vary according to the age of the individual, as usual. Thus in a specimen 0.39 mm. in length, there is scarcely any blue pigment, the fourth antennal segment being, however,

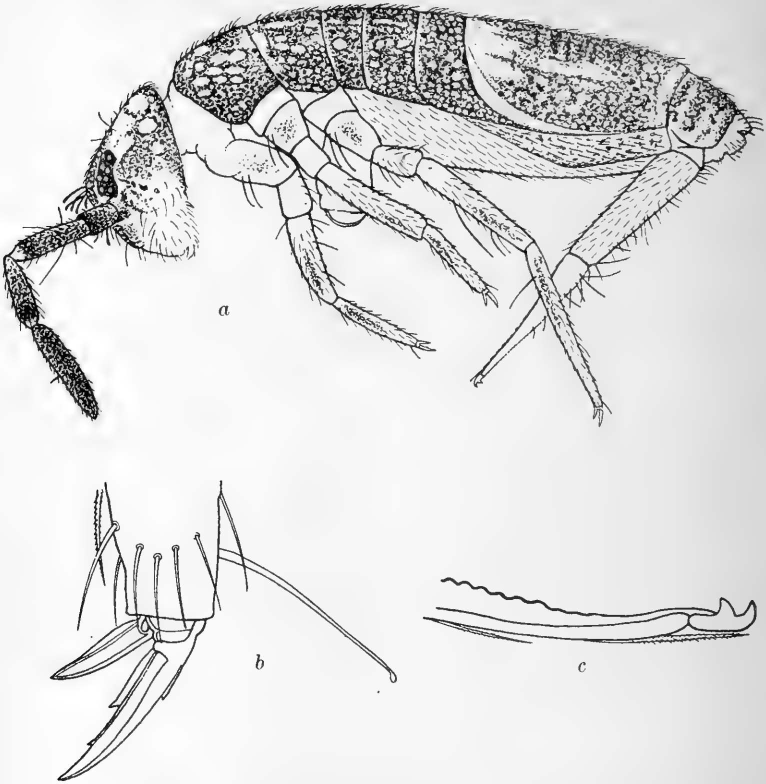

FIG. 18. *ENTOMOBRYA WHEELERI* SP. NOV.
a, lateral view, X 41.5; *b*, left hind foot, X 386; *c*, left mucro, X 386.

faintly tinged apically with blue; the eyes are pigmented separately instead of collectively; the antennæ are subequal to the head in length, with segments short and stout, in relative lengths as 4:5:5:11; while the fourth abdominal segment is only two and two-thirds times as long as the third. In an individual 0.6 mm. in length, the ratio between the third and fourth abdominal segments is as 1:4.

Described from four cotypes, which have been deposited in the Museum of Comparative Zoology, Cambridge, Mass.

I take pleasure in naming this new collembolan after Professor W. M. Wheeler, who found it living with colonies of a peculiar social beetle, *Coccidotrophus socialis* Schwarz and Barber, at Kartabo, in British Guiana.

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FROM THE TROPICAL RESEARCH STATION IN BRITISH GUIANA

Smithsonian Institution
JAN 21 1921
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VOLUME III. NUMBER 12

(Tropical Research Station Contribution Number 106)

FETUSES OF THE GUIANA HOWLING MONKEY

By Adolph H. Schultz

Research Associate, Department of Embryology, Carnegie Institution of Washington.

PUBLISHED BY THE SOCIETY
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December 24, 1921

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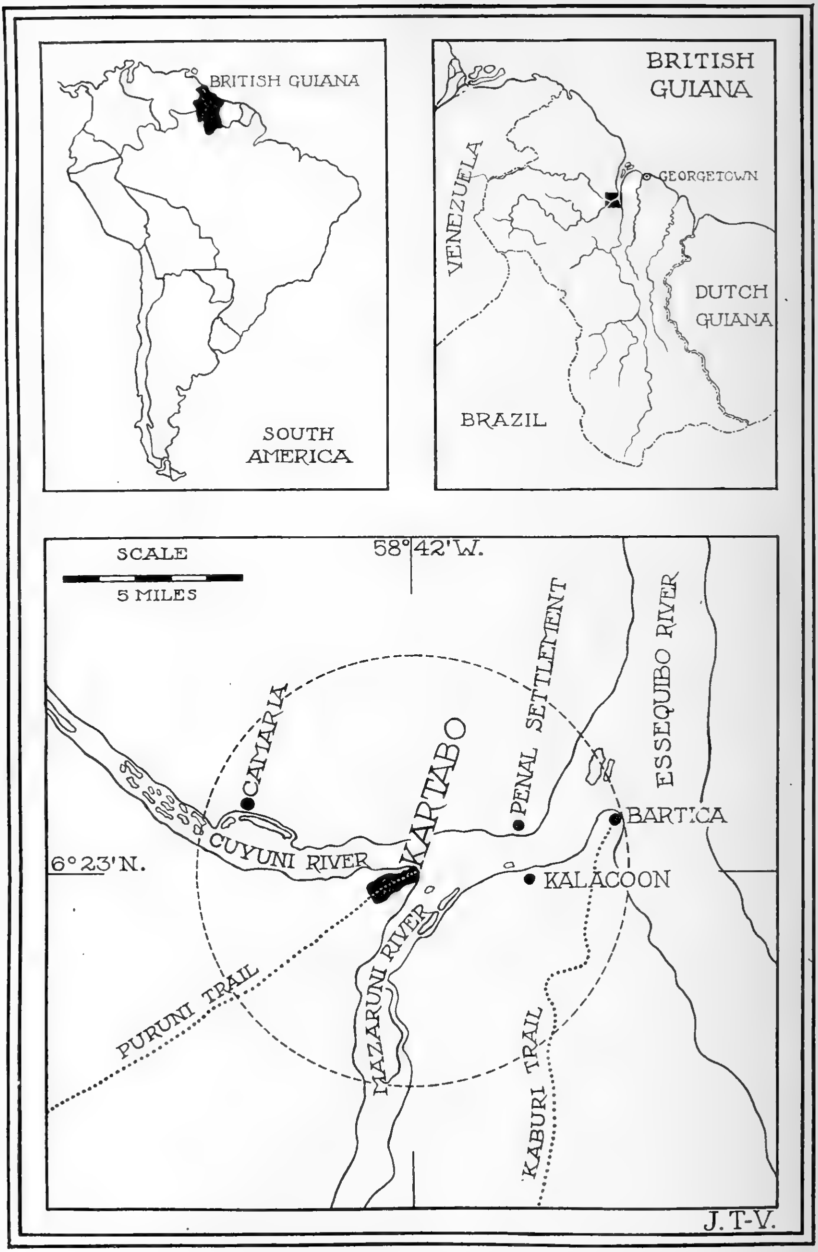

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FETUSES OF THE GUIANA HOWLING MONKEY

BY ADOLPH H. SCHULTZ

Research Associate, Department of Embryology, Carnegie Institution of Washington.

Our knowledge of the development of the monkey is still very limited. This is especially true in regard to platyrrhines, most of the scanty literature dealing with Old World monkeys. Just as in the case of human development, more work has been done on the early than on the later stages of fetal development. It is only through a complete knowledge of the entire intrauterine development of the different monkey genera, however, that we may hope to understand fully their position in the system of primates, their relation to each other, and their various specializations and differences, problems of equal importance to the zoologist, as well as to the comparative anatomist and scholar of evolution. Furthermore, such knowledge will prove of great interest to the embryologist and physical anthropologist, who may derive therefrom a clearer insight into the laws governing growth and the conditions of development of the various parts of the body.

The following notes form a small contribution in this direction; they comprise a description of two older fetuses of a howling monkey from South America. These specimens were given by Mr. William Beebe, Director of the Tropical Research Station of the New York Zoological Society, to the Carnegie Laboratory of Embryology. In addition to the fetuses, use has been made of observations on the skeleton of an adult male Alouatta, lent by Mr. Beebe, and another skeleton of an adult and two preserved bodies of juvenile male Alouattas from the anatomical collection of the University of Zürich. The author wishes to take this opportunity to express his sincerest thanks to Mr. Beebe for this valuable material, and to Prof. W. Felix for his kind permission to study the specimens of the Anatomy in Zürich.

The sub-species of monkey to which the fetuses and one of the skeletons (No. 4) belong is *Alouatta seniculus macconnelli* Elliot, the Guiana howling monkey (Beebe, '19). The other skeleton

(No. 3) and the two preserved bodies (Nos. 1 and 2) are of the species *Alouatta seniculus* L.[1] The rarity of the fetuses is increased by the fact that they are twins, twinning in monkeys being to all appearances not any more frequent than in man.[2] From an examination of the fetal membranes it is evident that the fetuses are monozygotic or single-ovum twins. Both are males and one of them is slightly larger than the other, their respective sitting-heights (crown-rump lengths) being 111 mm. (twin A) and 105 mm. (twin B). To what actual age this size corresponds it is impossible to tell. The duration of pregnancy in Alouatta is probably not more than five months,[3] and the fetuses in question had reached certainly the second half of their intrauterine development. Through a careful comparison with the human it is found that the development of these monkey fetuses corresponds most closely with that of a human fetus of twenty weeks, but no doubt they are actually younger. In respect to the state of development of the lanugo, the ears, genitals, hands and feet, and of ossification, the Alouatta fetuses are analogous to human fetuses of the twentieth week, but the latter are considerably larger, their sitting-height being on an average 154 to 164 mm.

[1] The sub-species of these cannot be determined.

[2] Selenka ('92) mentions one case of twins in a *Cercocebus cynomolgus* and Fitzsimons ('19) records two instances of twins in *Papio porcarius* and one in *Cercopithecus pygerythrus*.

[3] Bluntschli ('13) gives the duration of pregnancy for Cebus and Chrysothrix as 4½ to 5 months.

TABLE 1.

ABSOLUTE MEASUREMENTS OF THE ALOUATTA FETUSES

No.	Measurement (in millimeters):	twin A.	twin B.
1.	Sitting height: Top of head to lowest point on buttocks	111	105
2.	Thoraco-abdominal height: Symphysion (upper border of symphysis pubis) to suprasternal notch..........	52.5	47
3.	Symphysion to nipple (the latter projected on midsagittal plane)	47	40
4.	Symphysion to omphalion (center of attachment of umbilical cord)	18	14.8
5.	Biacromial diameter: Distance between the acromial processes	30	28.5
6.	Bimammillary diameter: Distance between nipples.....	21	18.8
7.	Bitrochanteric diameter: Distance between the great trochanters	21.7	21
8.	Transverse diameter of chest (at nipple height).......	27.7	26.4

9. Sagittal diameter of chest (at nipple height)	24	23.8
10. Circumference of chest (at nipple height)	87	84
11. Length of upper arm: Top of caput humeri to humero-radial joint (radiale)	32	31
12. Length of forearm: Radiale to tip of styloid process (stylion)	27.2	26.9
13. Length of hand: Middle of line combining styloid processes of radius and ulna to tip of middle finger	25.7	23.3
14. Length of thumb: Stylion to tip of thumb	15.2	14.8
15. Breadth of hand (across metacarpo-phalangeal joints (II to V)	12	11.3
16. Length of thigh: Top of great trochanter to lateral point of knee joint	30.6	29.6
17. Length of leg: Medial point of knee joint (tibiale) to tip of internal malleolus	25.5	25
18. Tibiale to sole of foot	31.3	29.9
19. Length of foot: Heel to tip of longest toe	33	32.1
20. Breadth of foot (across metatarso-phalangeal joints II to V + breadth of this joint on great toe)	13	12.8
21. Greatest length of head: Glabella to most distant point on head	39.4	38.1
22. Greatest breadth of head: (over temporal or parietal bones)	32	31
23. Auricular height of head: Tragion (upper border of tragus) projected on midsagittal plane to vertex (perpendicular to ear-eye horizon)	21.5	21.2
24. Nasion-inion diameter: Point over middle of naso-frontal suture (nasion) to occipital protuberance (inion)	39.2	38.1
25. Biauricular breadth: Width between the tragion points	31	29.6
26. Horizontal circumference of head (greatest circumference passing through glabella)	115	110
27. Sagittal arc: Nasion to inion	61	56.9
28. Transverse arc: Tragion to tragion (perpendicular to ear-eye horizon)	67.5	64.3
29. Total head height: Lowest point of chin (gnathion) to vertex (perpendicular to ear-eye horizon)	37	36.2
30. Total face height: Nasion to gnathion	17.2	17
31. Upper face height: Nasion to middle of mouth	12.3	12.4
32. Bizygomatic breadth: Greatest breadth between zygomatic arches	31	29.8
33. Nasal height: Nasion to subnasal point (where nasal septum and upper lip meet)	9.3	9.7
34. Nasal breadth: Greatest breadth between nasal wings	9.4	9.2
35. Breadth of nasal septum: Smallest distance between nostrils	3.8	3.6
36. Interocular breadth: Distance between medial angles of eyes	8	7.9
37. Breadth of mouth	15	13.5
38. Length of ear: Highest point on helix to lowest point on lobule	12.7	12.4
39. Breadth of ear: Greatest breadth between anterior and posterior border of helix	9	8.6

TABLE 2. INDICES OF FETAL, JUVENILE, AND ADULT ALOUATTA AND OF HUMAN FETUSES. THE NUMBERS IN PARENTHESIS IN THE FORMULAE REFER TO THE NUMBER OF THE MEASUREMENT IN TABLE 1.

No.	INDEX	Formula:	*Alouatta seniculus macconnelli. Fetuses*		*Alouatta seniculus*			*Alouatta senicul. maccon.*	Average of nine negro Fetuses 20th Week
					Bodies. Juveniles.		Skeletons. Adults.		
			Twin A	Twin B	1.	2.	3.	4.	
I.	Relative biacromial diameter	$\frac{(5)}{(2)} \times 100$	57.1	60.6	43.3	41.3	....	....	70.5
II.	Relative bitrochanteric diameter	$\frac{(7)}{(2)} \times 100$	41.7	44.7	45.0	45.2	....	....	54.3
III.	Relative circumference of chest	$\frac{(10)}{(2)} \times 100$	165.6	178.6	121.6	145.2	....	....	207.2
IV.	Thoracic index	$\frac{(8)}{(9)} \times 100$	115.4	110.9	102.3	98.0	....	....	119.1
V.	Relative bimammillary diameter	$\frac{(6)}{(8)} \times 100$	75.8	71.2	90.5	89.8	....	....	62.5
VI.	Relative position of nipple	$\frac{(3)}{(2)} \times 100$	89.6	85.1	100.0	101.6	....	....	77.1
VII.	Relative position of umbilicus	$\frac{(4)}{(2)} \times 100$	34.3	31.5	....	....	....	....	19.3
VIII.	Relative length of upper extremity	$\frac{(11)+(12)+(13)}{(2)} \times 100$	161.6	172.6	167.4	166.2	....	....	142.4
IX.	Humero-radial index	$\frac{(12)}{(11)} \times 100$	85.0	86.8	87.5	86.3	88.0	91.4	78.2
X.	Forearm-hand index	$\frac{(13)}{(12)} \times 100$	94.5	86.6	88.0	87.7	....	79.9	78.7
XI.	Relative length of thumb	$\frac{(14)}{(13)} \times 100$	59.2	63.6	62.1	59.5	....	57.5	69.5
XII.	Hand index	$\frac{(15)}{(13)} \times 100$	46.7	48.7	35.0	38.0	....	....	51.3
XIII.	Relative length of lower extremity	$\frac{(16)+(18)}{(2)} \times 100$	117.8	126.5	134.1	130.9	....	....	130.0
XIV.	Femoro-tibal index	$\frac{(17)}{(16)} \times 100$	83.4	84.5	87.3	87.6	88.8	92.8	82.1
XV.	Leg-Foot index	$\frac{(19)}{(17)} \times 100$	129.3	128.4	115.8	121.0	....	100.0	83.2

XVI.	Foot index	$\frac{(20)}{(19)} \times 100$	39.4	39.9	30.0	32.6	....	....	41.6
XVII.	Intermembral index	$\frac{(11)+(12)+(13)}{(16)+(18)} \times 100$	137.0	136.4	124.8	126.8	....	....	109.7
XVIII.	Femoro-humeral index	$\frac{(11)}{(16)} \times 100$	104.5	104.7	96.2	98.8	99.4	97.8	91.4
XIX.	Tibio-radial index	$\frac{(12)}{(17)} \times 100$	106.6	107.5	96.4	97.2	98.5	96.4	87.2
XX.	Foot-hand index	$\frac{(13)}{(19)} \times 100$	77.9	72.6	73.2	70.4	....	77.0	82.5
XXI.	Relative size of head	$\frac{(26)+(27)+(24)+(28)+(25)}{3 \times (1)} \times 100$	94.2	94.9	69.6	72.7	....	....	105.3
XXII.	Head-trunk index	$\frac{(21)+(22)+(23)}{3 \times (2)} \times 100$	59.0	64.0	39.0	40.7	....	....	71.2
XXIII.	Cephalic index	$\frac{(22)}{(21)} \times 100$	81.2	81.4	81.7	76.1	....	....	85.7
XXIV.	Length-height index of head	$\frac{(23)}{(21)} \times 100$	54.6	55.6	52.5	53.7	....	....	74.9
XXV.	Sagittal-vault index	$\frac{(24)}{(27)} \times 100$	64.3	67.0	77.9	72.8	....	....	49.9
XXVI.	Face-trunk index	$\frac{(30)}{(2)} \times 100$	32.8	36.2	33.3	33.3	....	....	35.6
XXVII.	Relative size of upper face	$\frac{(31) \times 3}{(26)+(27)+(24)+(28)+(25)} \times 100$	11.8	12.4	16.5	15.0	....	....	9.8
XXVIII.	Vertical cephalo-facial index	$\frac{(30)}{(23)} \times 100$	80.0	80.2	126.9	116.6	....	....	58.0
XXIX.	Upper-face index	$\frac{(31)}{(32)} \times 100$	39.7	41.6	55.6	53.1	....	....	37.8
XXX.	Relative nasal height	$\frac{(33)}{(31)} \times 100$	75.6	78.2	92.0	92.3	....	....	66.4
XXXI.	Relative nasal breadth	$\frac{(34)}{(32)} \times 100$	30.3	30.8	27.3	24.5	....	....	28.0
XXXII.	Nasal index	$\frac{(34)}{(33)} \times 100$	101.1	94.8	53.5	50.0	....	....	111.7
XXXIII.	Relative interocular breadth	$\frac{(36)}{(32)} \times 100$	25.8	26.5	22.2	19.4	....	....	28.5
XXXIV.	Ear index	$\frac{(39)}{(38)} \times 100$	70.9	69.4	67.8	66.7	....	....	63.7
XXXV.	Relative size of ear	$\frac{(38) \times (39)}{(21) \times (29)} \times 100$	7.8	7.7	14.5	12.1			3.3

For the purpose of comparing the outer form of the Alouatta fetuses with that of the human fetus and of older Alouattas, and in order to describe the proportions of the former fetuses in an exact, numerical way, a series of measurements has been taken and indices of these have been formed. The technique of meas-

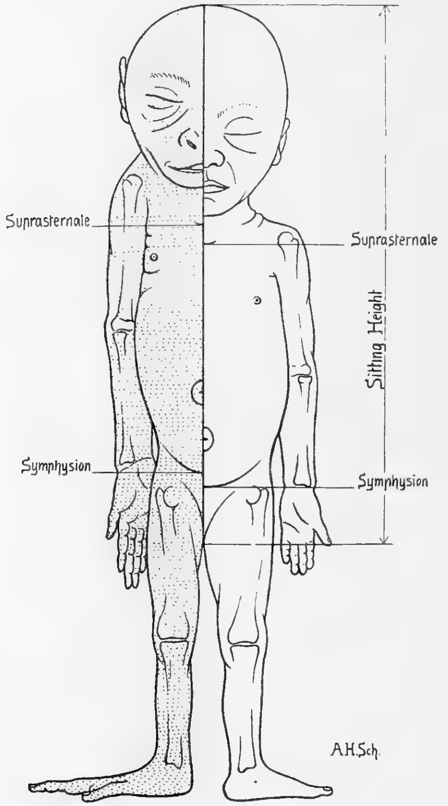

FIG. 19. SCHEMATIC DRAWING OF ALOUATTA FETUS (DOTTED HALF) AND NEGRO FETUS OF TWENTY WEEKS, REDUCED TO SAME SITTING-HEIGHT.

uring and the formulae for the indices, as well as the measurements and indices themselves, are compiled in tables 1 and 2. In drawing conclusions from these tables one has to be careful on account of the scarcity of the material and the considerable variability thereof. When more material is available, especially different genera and different stages of development, such conclusions will become safer and more extensive. In this paper I intend chiefly to place on record a detailed and accurate description of the two monkey fetuses and also to sketch in a preliminary way the changes during growth and some results of the comparison with human fetuses. The averages of the above tabulated measurements and of those of the human fetuses were used for the construction of a schematic drawing (Fig. 19) which may serve to illustrate the following remarks concerning the body proportions of the Alouatta fetuses.

The length of the trunk relative to the sitting-height is the same in the Alouatta fetus as in the human fetus; however, the different transverse diameters of the trunk, and the circumference of the chest are all relatively considerably smaller in Alouatta, which accounts for the slender appearance of the trunk in the latter. The adult condition is well expressed in the fetuses by the fact that, in relation to the length of the trunk, the width between the shoulders, as well as between the hips, is very much smaller in the Alouatta than in the human fetus. We know that, with the exception of the gorilla, man has the widest shoulders and hips of any of the adult primates. The shoulders of the Alouatta fetus are not only relatively closer together but they are also very much higher than in the human fetus, which fact constitutes a very marked difference between the two types. The thoracic index shows only a slight difference; in both types the transverse diameter of the chest surpasses the sagittal diameter. The somewhat larger average in human fetuses, however, points to a much more marked difference in later stages of growth, when the thorax is much broader in man than in any platyrrhine monkey, the latter having a deep and narrow chest. The nipples of the Alouatta fetus are considerably higher and more laterally situated than in the negro;[4] this close proximity of the mammae to the axillae is characteristic for most New World monkeys. The extreme in the very high and lateral position of the nipple in Alouatta is not reached until postnatal life, when the nipple may lie above the level of the suprasternal notch. The umbilicus of Alouatta lies relatively much higher than in the human fetus. From our findings on the trunk it is apparent that there exist

[4] The nipple of the Alouatta fetus lies over the third rib, in the human fetus between the fourth and fifth rib.

differences between the Alouatta and the human fetus in every point except in the relative length of the anterior wall of the trunk. The greatest differences consist in the shorter transverse diameters of the trunk, and the higher position of the shoulders, the nipples, and the umbilicus in the Alouatta.

The upper extremity is relatively considerably longer in the Alouatta than in the human fetuses; it reaches practically no farther down in Alouatta but is, as shown above, inserted higher than in human fetuses. In this difference in length the various parts composing the arm participate to a different degree. The relatively greatest difference exists in the length of the hand; somewhat less is the difference in the forearm, and least of all in the upper arm, but all three are relatively longer in the Alouatta. The relations of these parts to each other are expressed in the humero-radial and forearm-hand indices; according to the former, the radius, relative to the humerus, is longer in Alouatta, and according to the latter the hand, in relation to the forearm, is also very much longer in the monkey fetus. The humero-radial index in the adult Alouatta amounts to 91 according to Mollison ('10) and to 88 to 91.4 according to table 2. These figures are higher than the corresponding ones for the fetuses; therefore, the forearm in Alouatta has a greater rate of growth than the upper arm. According to the forearm-hand index, which in Alouatta decreases during growth, the hand has a slower rate of growth than the forearm. The human hand, in contrast to the hand of other primates, is characterized by its relatively greater breadth. This difference is already present in our fetuses, the hand index being larger in the human. During postnatal development the hand of Alouatta becomes still more slender. The length of the thumb in relation to the length of the hand is considerably less in the Alouatta than in the human fetuses, and this relation does not seem to change markedly during growth. The reduction of the thumb, typical for most monkeys, is, therefore, recognizable in fetal life. In the Alouatta fetuses fingers II to V are, in relation to the metacarpus, very much longer than the human fingers. Finger III is the longest but IV is almost as long, and finger II reaches about as far as finger V.

The lower extremity is relatively little shorter in the Alouatta, both femur and tibia being slightly shorter than in the negro fetuses. This minute difference is at first rather surprising, in consideration of the fact that man's lower extremity is relatively by far the longest of all primates. However, this distinction does not fully appear until some time during postnatal growth. The relation of the tibia to the femur is also only slightly different, the relative length of the tibia of the Alouatta being somewhat greater than of the negro fetus. During postnatal development the femoro-tibial index in Alouatta increases steadily. Martin ('14) states that this index increases during growth in all human races; it may, therefore, be concluded that the lower leg has a more intense rate of growth than the thigh, not only in man but also in Alouatta. The foot of the Alouatta is very much longer than that of the human fetus, and this, indeed, is one of the most marked differences between the body proportions in the two types. This difference is very pronounced in the relation of the foot length to the length of the tibia. The human foot is relatively the shortest of all the primates and this most probably holds true in fetal stages also. In both Alouatta and man the leg-foot index decreases markedly during growth. The fetal Alouatta foot is narrower and more slender than the foot of the human fetus. In the former the great toe is very much shortened, the second and third toes are of equal length, and the heel is not prominent.

In summarizing the results of this comparison of the extremities in Alouatta and human fetuses the greater length of the upper extremity in the Alouatta fetus and the approximately equal length of the lower one are points especially noteworthy. This different behavior in the relation of the upper to the lower extremity is precisely expressed in the intermembral index, which amounts to 136.7 in the Alouatta and to only 109.7 in negro fetuses. This index decreases during postnatal development in Alouatta as well as in man. The most distal portions of the extremities, the hand and the foot, in the Alouatta surpass in length the corresponding members of the human fetus to a greater extent than the more proximal parts. The thumb and the great toe especially is less developed in the Alouatta than in the human fetus.

It remains to consider briefly the proportions of the head. Here the most striking feature consists in the smaller size of the brain part of the head of the Alouatta as compared with the human fetus, a difference which is especially manifest in the height. There is a greater difference in the breadth than in the length of the head, as shown by the smaller cephalic index of the Alouatta, and a very much greater difference in height than in either of the other diameters, as shown in the length-height index, which is very much smaller in the Alouatta; the length, therefore, shows the least difference of any of the head diameters. The height of the face, from nasion to chin, is equal in the two types; the upper-face height is somewhat greater in the monkey, and the anterior part of the mandible is therefore less developed in height than it is in the human fetus. The breadth of the face shows but little difference, but the mouth is very much broader in Alouatta. The external nose is higher as well as broader in the monkey fetuses, the greater difference existing in height, so that the nasal index becomes considerably larger in the human fetuses. The low nasal index of our monkey fetuses is not restricted to platyrrhines, but is also found in fetuses of catarrhines and apes (Schultz, '20), in which also the nose is high relative to its width. In regard to the fetal nasal index, therefore, man seems to occupy an exceptional position among the primates. The relative interocular breadth is greater in adult man than in any adult monkeys or apes; it is therefore not surprising that the human fetus surpasses in this respect the Alouatta fetus, although not to such a degree as it would in the adult stage. The relative interocular breadth decreases in both Alouatta and man during growth. The nasal septum is very much broader in the Alouatta fetuses, which already show the typical features of the platyrrhine nose with laterally pointing nostrils. The ear of the Alouatta is considerably larger than that of the human fetus, a difference which becomes very evident when the size of the ear is expressed in percentage of the size of the head. The ear of the juvenile Alouatta is relatively almost twice as large as that of the fetus. In relation to its length, it is somewhat broader in the latter than in the average human fetus of that stage. The external meatus is situated farther back on the head in the monkey fetus. A further point of interest

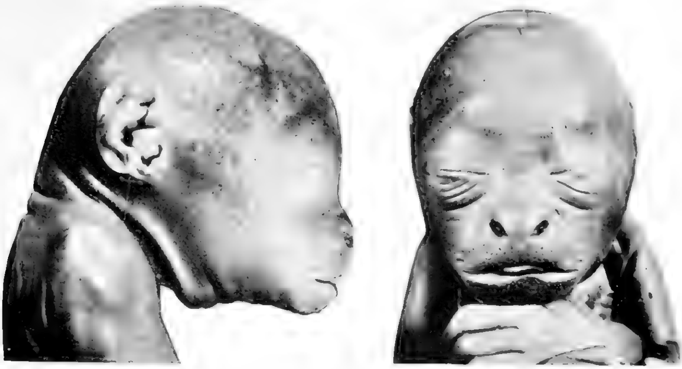

FIG. 20. FRONT AND RIGHT SIDE VIEW OF HEAD OF ALOUATTA FETUS (TWIN A). APPROX. NATURAL SIZE

in the latter is the finding, on the lateral surface of the auricular fold, immediately behind the anthelix, of two low and not very distinct longitudinal folds, which without doubt, correspond to the (five) folds found by Schwalbe ('97) in human fetuses of four months. Figure 20 illustrates the typical features of the head of the Alouatta fetuses.

Following is a condensed description of points of interest on the integument of the Alouatta fetuses. In the latter, in contrast to human fetuses, there is no philtrum nor labial tubercle and the visible part of the mucous lips is extremely narrow. The lanugo of the Alouatta fetuses at this stage of development is restricted to the head. Very fine and short sparse hair is found on the forehead and over each zygoma in front of the ears. Longer, and somewhat more strongly developed hair occurs in the region of the chin and on the upper lip. These, with the exception of a few black ones on the upper lip, are very light. The eyebrows are formed by long, almost bristle-like sinus hairs, which are entirely black on the medial portions of the brows; the lateral parts consist of hairs black in their lower part and light at the end. A few of the outermost hairs in the brows are entirely light. There are no anlagen for sinus hairs on the cheeks of these twin fetuses, but such were found by Frédéric ('06) in three out of five Alouatta fetuses. No papillary ridges can be made out on the palms, soles, or ventral side of the tail; these apparently do not occur until later in fetal development.

The arrangement of pads (touch balls) and epidermal folds on the palm and sole is shown in figure 21. The finger nails, as well as the toe nails, are well developed and curved, in both longitudinal and transverse directions, especially in the latter, and resemble claws.

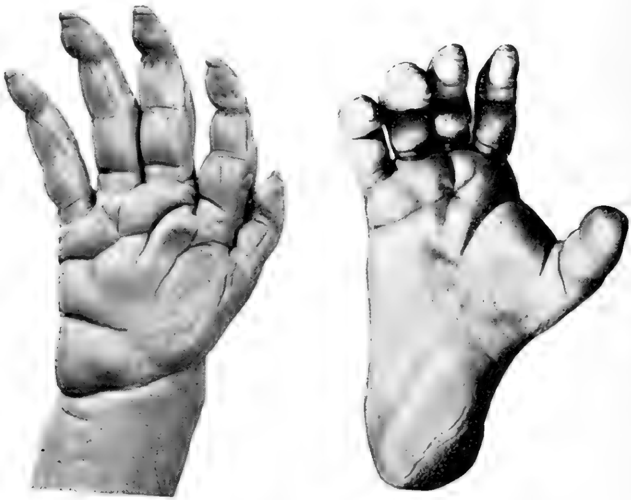

FIG. 21. RIGHT HAND AND FOOT OF ALOUATTA FETUS (TWIN A), TWICE NATURAL SIZE

A few remarks concerning the degree of resemblance between these twin fetuses of Alouatta may be of interest. One frequently finds the assumption that monozygotic twins are "identical", and this is especially expected in fetuses in which environmental conditions have not exerted an influence, as they do in postnatal life. Newman ('17) has collected sufficient proofs to show that absolute identity is never found, even in single-ovum twins. In comparing the columns for twin A with those for twin B in tables 1 and 2, it is at once apparent that there is no identity in the proportions of their bodies. All of the absolute measurements of A are larger than the corresponding ones of B with two exceptions—the upper-face height and the nasal height, which are slightly greater in twin B. The degree of resemblance between twins is most accurately obtained by figuring out the average percentage difference for all the absolute measurements taken. This is done according to the following formula:

$$\left\{ \sum \frac{\text{m A} - \text{m B}}{\tfrac{1}{2}\,(\text{m A} + \text{m B})} \times 100 \right\} \div \text{n}$$

A stands for twin A, B for twin B, m for measurement, and n for the number of measurements used—in our case 39. The result thus obtained is 4.81, i. e., a measurement of twin B differs on an average from the corresponding measurement of twin A 4.81 percent. This rather high percentage is naturally affected by the difference in absolute size in general between the twins, but even if this were equalized, considerable difference would remain, as shown by the fact that the indices, likewise differ. The author's experience with human monozygotic twins, especially those of fetal stages, is analogous to that gained on these monkey twins, inasmuch as human twins also show upon closer examination a great number of more or less marked deviations. Finally, I may state that so far, I have never found human single-ovum twins, of any state of development, with exactly the same general size. This is also the case in the Alouatta twins, one being larger than the other.

For a study of the ossification and of the cartilaginous parts of the skeleton, X-ray photographs were taken of one of the Alouatta fetuses and the other one (twin A) was stained with toluidin blue and cleared in a three percent solution of potassium hydroxide and afterward placed in glycerine, a process which, in addition to the ossified parts, shows the cartilage in a dark blue color. For some points it became necessary also to partly dissect one of the fetuses in order to observe in detail certain conditions of the skeleton. Figure 22 is an exact drawing of the cleared specimen and may serve to illustrate the following description.

The spinal column consists of 57 vertebrae; 7 cervical, 14 thoracic, 5 lumbar, 3 sacral, and 28 caudal. These numbers occurred also in all the other Alouattas examined, with the exception of skeleton 3, which has only 27 caudal vertebrae. In table 3 the lengths of the different spinal regions are expressed in percentages of the praecaudal length of the spine. From the

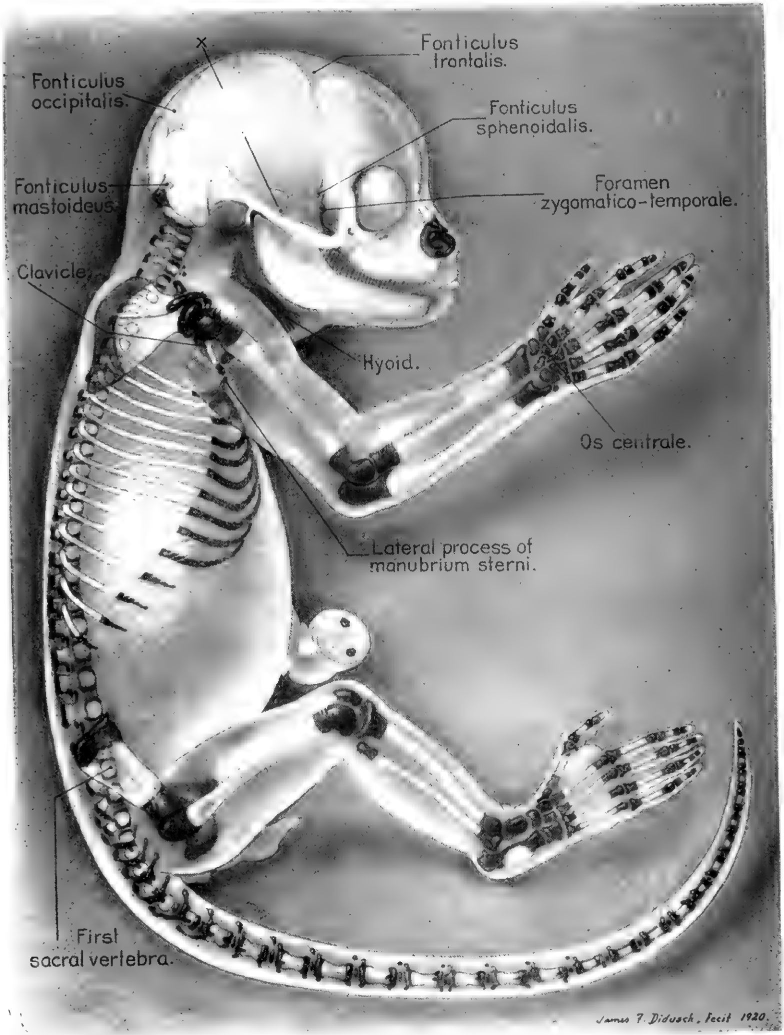

FIG. 22. SIDE VIEW OF CLEARED ALOUATTA FETUS, SHOWING THE SKELETON. NATURAL SIZE

figures in this table it can be concluded that the cervical and the sacral regions of the Alouatta fetus are shorter than in human fetuses, whereas the thoracic region is considerably longer in the former than in the latter. It is furthermore of interest to note that in both Alouatta and man during growth the relative length of the thoracic region decreases, while the lumbar and sacral regions increase. In Alouatta the length of the caudal region is relatively greater in adults than in fetuses. This relatively greater rate of growth of the tail is also well expressed in the following percentage relations of the length of the latter to the sitting-height: Fetus A 109.0, fetus B 113.3, juvenile Alouatta (No. 1) 165.0, and juvenile Alouatta (No. 2) 165.7. Toldt ('03) found that the relative length of the tail changed very little during growth in case of *Macacus cynomolgus* L. This suggests the possibility that, whereas the tail of Alouatta is in a state of progressive evolution, that of Macacus is stationary, if not regressive, a suggestion which may be supported by the fact

TABLE 3. LENGTHS OF THE DIFFERENT SPINAL REGIONS IN PERCENTAGES OF THE PRAECAUDAL LENGTH OF THE SPINE IN ALOUATTA AND MAN.

	Region of spine: cervical	thoracic	lumbar	sacral	caudal
Alouatta seniculus macconnelli.... fetus (twin B)	17.0	49.3	22.7	11.0	133.5
Alouatta seniculus juv. (No. 1)...	13.4	47.5	26.0	13.1	186.7
Alouatta seniculus ad. (No. 3)....	14.8	45.1	27.3	12.8	160.0
Alouatta seniculus macconnelli.... adult (No. 4)	17.4	43.2	26.6	12.8	161.3
Human fetuses of 20 weeks.......	21.0	41.5	22.0	15.5	....
Human adults (Martin, '14)......	16.0	39.0	25.0	19.0	....

that in the genus *Macacus* there are several species with an almost rudimentary tail. In the spine of the Alouatta fetus each vertebra contains one ossification center for the body and, down to the fifth caudal vertebra one for each hemiarch. There are 14 ribs on each side, which are well ossified, their osseous shafts having about the same proportional length in regard to the costal cartilages as they have in the adult stage. The first eight pairs of ribs reach the sternum; the next two pairs are asternal ribs, and the remaining four pairs are floating ribs; even the last pair is still fairly long. This arrangement of ribs is the rule in the juvenile and the adult Alouatta also, with the exception of skeleton 3, in which only seven pairs of ribs reach the sternum and five pairs are floating ribs, the last pair being very short. The

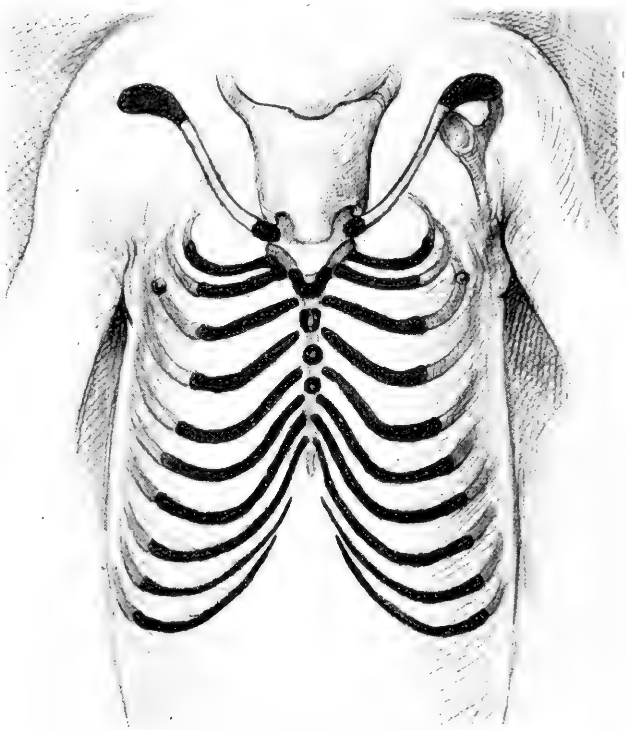

FIG. 23. SKETCH OF STERNUM OF ALOUATTA FETUS

sternum as yet shows no ossification centers. It is a slender cartilaginous structure in which only three ring-shaped zones and one uppermost, V-shaped zone are stained. The sternum of the adult Alouatta is distinguished by a unique condition—a splitting of the manubrium, due to the enormous development of the hyoid and larynx. It is extremely interesting to find this condition already present in the fetus. The cranial end of the fetal sternum forks into two diverging processes to which the two uppermost pairs of ribs and the clavicles are attached. Between these halves of the manubrium emerges the trachea from the thorax, and immediately above and almost in front of them lies the large hyoid (see figure 23). In the adult the second rib inserts somewhat lower on the sternum, not, as in the fetus, on the lateral process itself, but on the base of the latter, or even slightly below the forking of the two processes. The clavicles are well ossified and are curved S-shaped, very similar to that in the human fetus. The scapula has a greatest length equal to its greatest breadth, whereas in the adult state the breadth surpasses the length (from the glenoid cavity to the vertebral margin). The vertebral margin above the dorsal end of the spina scapulae is approximately one-half the length of the portion of this margin below the spine of the scapula. The latter portion of the vertebral margin has a concave contour, thus forming a scaphoid scapula. The acromial and coracoid processes are cartilaginous without ossification centers, as are also the dorsal edge and glenoid cavity of the scapula. The pelvis contains two pairs of ossification centers, one in the ilia and the other in the ischia; the pubic portion of the pelvis as yet shows no sign of ossification. The blades of the ilia are long and slender.

All the shafts of the long bones of the extremities are well ossified; there are no ossification centers in any of their epiphyseal ends. The humerus has no foramen entepicondyloideum, which is found in *Cebus* and other platyrrhines. On the humeri of the skeleton No. 3 there is a foramen supratrochleare on each side, but this is missing in the other specimens of *Alouatta* examined. The torsion of the fetal humerus, i. e., the angle between the axes of the caput and of the trochlea, amounts to 90 degrees, which is less than the torsion in human fetuses of corresponding development, in which I found this angle to vary from 98 to 130 degrees. The proximal end of the olecranon projects considerably beyond the incisura semilunaris, whereas the olecranon in the human fetus ends abruptly at the proximal end of the latter incisura. An analogous difference in the olecranon is found between modern adult man and adult monkeys, and it is interesting to see this distinction already clearly defined in fetal stages. The tibia in its upper portion shows a rather marked backward bend (proximal retroflexion). The carpus consists entirely of cartilage and contains a well-developed centrale, which at this stage of human development has disappeared from the wrist. Among the tarsial cartilages the calcaneus possesses a rather extensive ossified zone. In the human fetus this ossification center normally does not occur until the sixth month; this seems to be the only point in which the state of ossification of the Alouatta fetuses does not coincide with that of the human

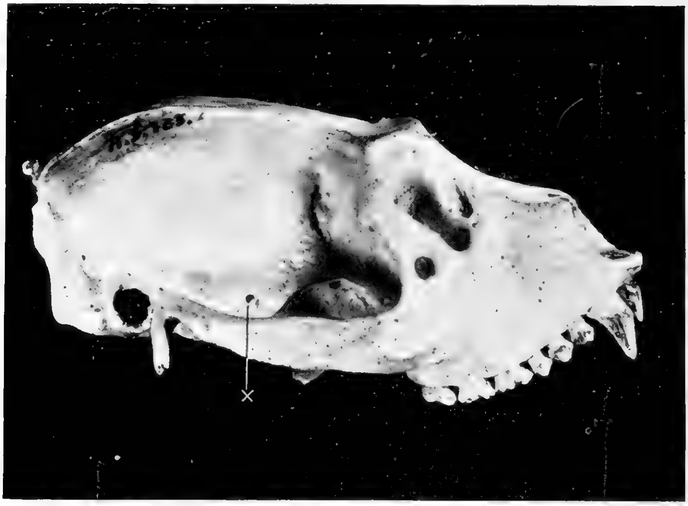

FIG. 24. SKULL OF AN OLD ALOUATTA SENICULUS WITH FORAMEN TEMPORALE AT X

fetuses of twenty weeks. At the distal end of each metacarpus and of the first metatarsus sesamoid cartilages are to be found.

Most of the elements of the skull of the Alouatta fetuses are already ossified to a considerable extent; apparently only the petrosum forms an exception in this respect. The great fontanelle sends a gradually narrowing arm almost as far as the naso-frontal suture and posteriorly communicates by a fairly broad arm with the occipital fontanelle; both are rather large. The two pairs of lateral fontanelles are small. From the frontal bone a process reaches toward the alisphenoid separating the parietal from the malar bone, a condition usually found in Alouatta, but contrary to the rule in other platyrrhines. The lacrimal fossa is situated almost outside of the orbit and is in full view when looking at the skull from in front. The foramen zygomatico-faciale is very wide. Where the orbital plate of the zygomaticum and the alisphenoid meet there is a foramen zygomatico-temporale of considerable size. This foramen has been described by Joseph ('76), who found it in all adult New World monkeys. It represents a vestige of the complete communication between temporal and orbital fossae found in Lemuroidea. The foramen is closed by a true membrana obturatoria orbitae. In our fetuses this foramen communicates by a narrow arm with the fissura orbitalis inferior, thus actually forming a continuation of the latter, which constitutes a more conspicuous remnant of the former full communication between the two fossæ. In the squama temporalis of the Alouatta fetus, over the root of the zygomatic arch, a fine foramen is to be found (x in figure 22). This foramen may correspond to that noted by v. d. Broek ('08) in the squama temporalis of *Ateleus.* I observed that the presence of this foramen is not restricted to the genus *Ateleus* but occurs also in many other platyrrhines.[5] Among the skulls of New World monkeys of my collection I found the foramen at a corresponding place and of relatively large size in eight *Alouatta seniculus* L. (see figure 24), including both juvenile and very old animals, in two species of *Ateleus,* and in one *Aotus boliviensis* Elliot. It was missing in all skulls of *Cebus* and of *Hapale* which I examined. This foramen is formed by an emissary vein; it may be called *foramen temporale.* In the skull of the very old *Alouatta seniculus macconnelli* (No. 4) no trace of it could be seen. This, and the fact that in the fetus of the same sub-species there is only an extremely fine foramen in the squama temporalis, which may be merely a foramen nutritium, makes it possible that this sub-species of *Alouatta seniculus* has no true foramen temporale. The ramus mandibulæ is broad and rather high; in later stages of growth this portion of the mandible of Alouatta increases enormously in size, enclosing the greatly enlarged hyoid. The hyoid capsule in the fetus is still cartilaginous, but already of a quite extraordinary size. The nasal cartilages are well developed and differentiated. The lateral nasal cartilage is of triangular shape and the greater alar cartilage encircles the nostril almost entirely, whereby its greatest surface is directed forward instead of sidewise, as in catarrhines.

The most interesting conclusion of this study is the fact that most of the typical differences existing between adult man and adult Alouatta—be it those of outer form or those of the skeleton—are already well defined in fetal stages, although not yet as pronounced as in the adult.

[5] A rather large foramen on the corresponding place was found by the author in two human adult skulls of his collection (Nos. 266, white, and 216, negro).

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FROM THE TROPICAL RESEARCH STATION IN BRITISH GUIANA

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VOLUME III, NUMBER 13

(Tropical Research Station Contribution Number 108)

MAMMALS COLLECTED BY WILLIAM BEEBE AT THE BRITISH GUIANA TROPICAL RESEARCH STATION

By H. E. ANTHONY.

Associate Curator of Mammals of the Western Hemisphere
American Museum of Natural History

PUBLISHED BY THE SOCIETY
THE ZOOLOGICAL PARK, NEW YORK

DECEMBER 24, 1921

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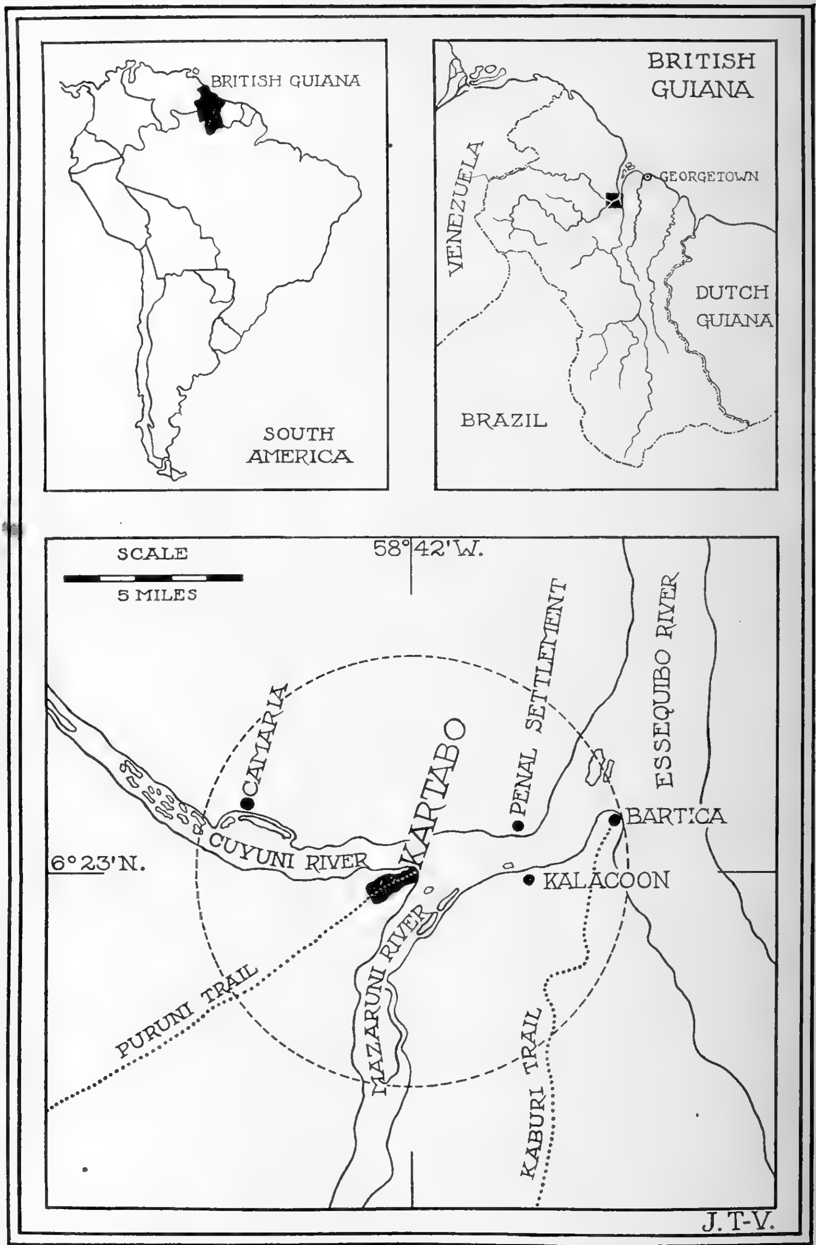
When the New York Zoological Society established a Tropical Research Station in British Guiana, with Mr. William Beebe as Director, an arrangement was made whereby the Department of Mammals of the American Museum was to receive such specimens of mammals as might be collected from time to time.

The first work of the Station was done in 1916, and has been carried on at intervals ever since, resulting in the accession of some five hundred and twenty-one specimens of mammals. The collecting has been done, for the most part, at three points, Kartabo, Kalacoon and the Penal Settlement, all, as shown on the accompanying map, lying within a small area forty-five miles inland from the coast. This region is included in the humid, tropical, rain forest zone[1] and is a most important locality, not alone for the richness of the mammalian fauna but because of the great historical value which attaches to specimens secured from northeastern South America. Many of the classical species, many of the forms described by Linnæus, have their habitat somewhere within this general region, so that a series from the Guianas may be considered as typical.

The work of the Station staff was so occupied by their own particular problems that the collecting of mammals was an incidental feature and, in consequence, the list of species secured there is far from complete. On the other hand, the aggregate amount of time spent at the Station has resulted in the accumulation of large series of some species, and a very gratifying

[1]For photographs and details of this region see, "Tropical Wild Life in British Guiana", William Beebe, N. Y. Zool. Soc., 1917, and Zoologica, III, 1921, No. 1, by Henry Fairfield Osborn.



LOCATION OF THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY

The circle represents a radius of six miles.

number of rarities. Four forms new to science were taken and in addition there are ten species new to the museum collections. In all fifty-six species and subspecies are represented. No small part of the value to be attached to this collection lies in the number of skeletons preserved, since there are skeletons for nearly all of the species represented by a series of any size.

In the identification of this collection, I have received valuable assistance from Mr. Gerrit S. Miller of the United States National Museum, through the loan of comparative material, while I am indebted to Dr. Wilfred H. Osgood of the Field Museum, for opinions on some nomenclatural points.

1. *Didelphis marsupialis marsupialis* Linnæus.

1758. *Didelphis marsupialis* Linnæus, Syst. Nat., I, p. 54, (part).
1902. *Didelphis marsupialis* Allen. Bull. Amer. Mus. Nat. Hist., XVI, p. 257.

Six specimens: Kartabo, 5 skins, 4 skulls, 1 skeleton.

2. *Marmosa chloe* Thomas.

1907. *Marmosa chloe* Thomas. Ann. and Mag. Nat. Hist., (7) XX, p. 167.

Seven specimens: Kartabo, 7 skins, 6 skulls, 4 skeletons.

These animals are practically topotypes of *chloe,* since this species was described from the Demerara river, 29 miles above Georgetown.

3. *Marmosa cinerea demerarae* Thomas.

1905. *Marmosa cinerea demerarae* Thomas. Ann. and Mag. Nat. Hist., (7), XVI, p. 313.

Eight specimens: Kartabo, 7 skins, 4 skulls, 5 skeletons.

The series, which includes both adults and half grown young, agrees quite closely with the type description of *demerarae,* type locality, Comackka, eighty miles up the Demerara River.

4. *Metachirus nudicaudatus nudicaudatus* (Geoffroy).

1803. *Didelphys nudicaudata* E. Geoffroy. Cat. Mus., p. 142.

Immature specimen: Kartabo, skin with skeleton.

5. *Monodelphis brevicaudata brevicaudata* (Schreber).

1778. *Didelphys brachyuros* Schreber. Säug. III, 549 pl. cli (plate published in 1777).
Peramys brevicaudata auctorum.

One specimen: Kartabo, skin with skeleton.

The material for comparison with this specimen of *Peramys* is too inadequate to enable me to do more than assign it provisionally to *brevicaudata,* on the assumption that the animal of the Guiana lowlands is Schreber's species. Judging from the limited series of red *Peramys* in the collection from Venezuela and British Guiana, there exists either a very great degree of individual variation or else a need for additional new species.

6. *Bradypus cuculliger* Wagler.

1831. *Bradypus cuculliger* Wagler, Isis, p. 605.
1871. *Arctopithecus cuculliger* Gray, Proc. Zool. Soc. London, p. 440.

Eight specimens: Kartabo, 5 skins, 5 skulls, 2 skeletons; Kalacoon, 1 skin; Kyk-over-al, 1 skin, 1 skull.

This series is referred to *cuculliger* upon the basis of the descriptions given in the two references cited above, and with regard to the fact that Gray had a specimen from Demerara which he called *cuculliger.* The agreement with the descriptions is fairly close and the series averages darker in color than a series of *tridactylus flaccidus* from Venezuela; but the color pattern is rather similar to that of *flaccidus,* in fact so similar that, should my identification of *cuculliger* be correct, I believe that *flaccidus* should stand as a subspecies of *cuculliger* and not of *tridactylus.* Compared with specimens of *tridactylus* from Santarem, Brazil, the Guiana specimens are radically different in the coloring of the head, throat and neck.

7. *Choloepus didactylus* Linnæus.

1766. *Bradypus didactylus* Linnæus. Syst. Nat., I, p. 51.

Two specimens: Kalacoon, 1 skin, 1 odd skull.

8. *Myrmecophaga tridactyla* Linnæus.

1758. *Myrmecophaga tridactyla* Linnæus, Syst. Nat., p. 35.

One of these anteaters was brought back alive and placed in the New York Zoological Park. It has since died and is now in the Museum collection. It was taken at Kartabo and was only about half grown.

9. *Tamandua tetradactyla tetradactyla* (Linnæus).

1766. *Myrmecophaga tetradactyla* Linnæus, Syst. Nat. I, p. 52.

Twelve specimens: Kartabo, 9 skins, 10 skulls, 2 skeletons; Kalacoon, 1 skin, 2 skulls.

The color of the pelage of these anteaters varies so considerably that, were the two extreme examples to be considered alone, they might well be thought to be distinct from one another. The dark dorsal area is almost completely absent from one specimen which in consequence greatly resembles the yellow *longicaudata*. However, the apparent gap between this yellow specimen and the darkest of the series, is well bridged over by the specimens of intermediate coloration. The shape of the nasals, used as a character of separation between *longicaudata* and *tetradactyla,* varies almost as much as does the color of the pelage, the narrowest examples being no wider than the nasals of *longicaudata* from Maripa, Venezuela.

10. *Cyclopes didactylus didactylus* (Linnæus).

1766. *Myrmecophaga didactyla* Linnæus, Syst. Nat. I, p. 51.

One specimen: Penal Settlement, skin and skeleton.

11. *Dasypus novemcinctus novemcinctus* Linnæus.

1766. *Dasypus novemcinctus* Linnæus, Syst. Nat. I, p. 54.

Four specimens: Kartabo, 4 skins, 4 skulls, 2 skeletons.

These are all half grown young.

12. *Tatu kappleri* (Krauss).

1862. *Dasypus kappleri* Krauss, Archiv. Naturg., Vol. I, p. 24.

Three specimens: Kartabo, 2 skins, 1 skull; Kalacoon, 1 skin with skeleton.

These are the first specimens of *kappleri* to be received in the Museum's collection. This species is widely different from *Dasypus novemcinctus,* which it resembles somewhat superficially. Aside from a slight difference in size, *kappleri* being the larger, it has only eight movable bands instead of nine, it has two rows of spur-like scales on the hind legs which are entirely wanting on *novemcinctus,* a rudimentary fifth toe on the fore foot, longer ears and noticeably different skull characters, the most important of which is the peculiar flange-like margins of the posterior palate.

13. *Tayassu pecari beebei* Anthony.

1921. *Tayassu pecari beebei* Anthony, Amer. Mus. Novitates, No. 19, p. 1.

Eight specimens: Kartabo, 7 skins, 7 skulls, 2 skeletons.

General Characters.[2]—Closely related to *pecari pecari,* but differing in the extent of white on the snout and lower jaw.

Description.—Coloration about as in *p. pecari* but white of face and throat markings more yellowish; long hairs of upper parts brownish black; snout, above, only slighter lighter in color than rest of upper parts and not with strongly contrasting whitish of *p. pecari;* chin and throat patch restricted and not in such marked contrast to the surrounding areas; feet dark to hoofs. Skull as in *p. pecari.*

Measurements.—Taken from animal in flesh: total length, 1090 mm.; tail vertebrae, 60; hind foot, 224; weight 80 pounds.

This subspecies was described upon the basis of the restricted white areas upon the nose and throat. It is closely related to true *pecari* of Brazil, and was named in honor of Mr. William Beebe, the Director of the Tropical Research Station.

14. *Pecari tajacu macrocephalus* Anthony.

1921. *Pecari tajacu macrocephalus* Anthony, Amer. Mus. Novitates. No. 19, p. 3.

Eight specimens: Kartabo, 5 skins, 6 skulls.

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[2]This description, together with those of the other three new species, appeared first in American Museum Novitates, No. 19, by H. E. Anthony.

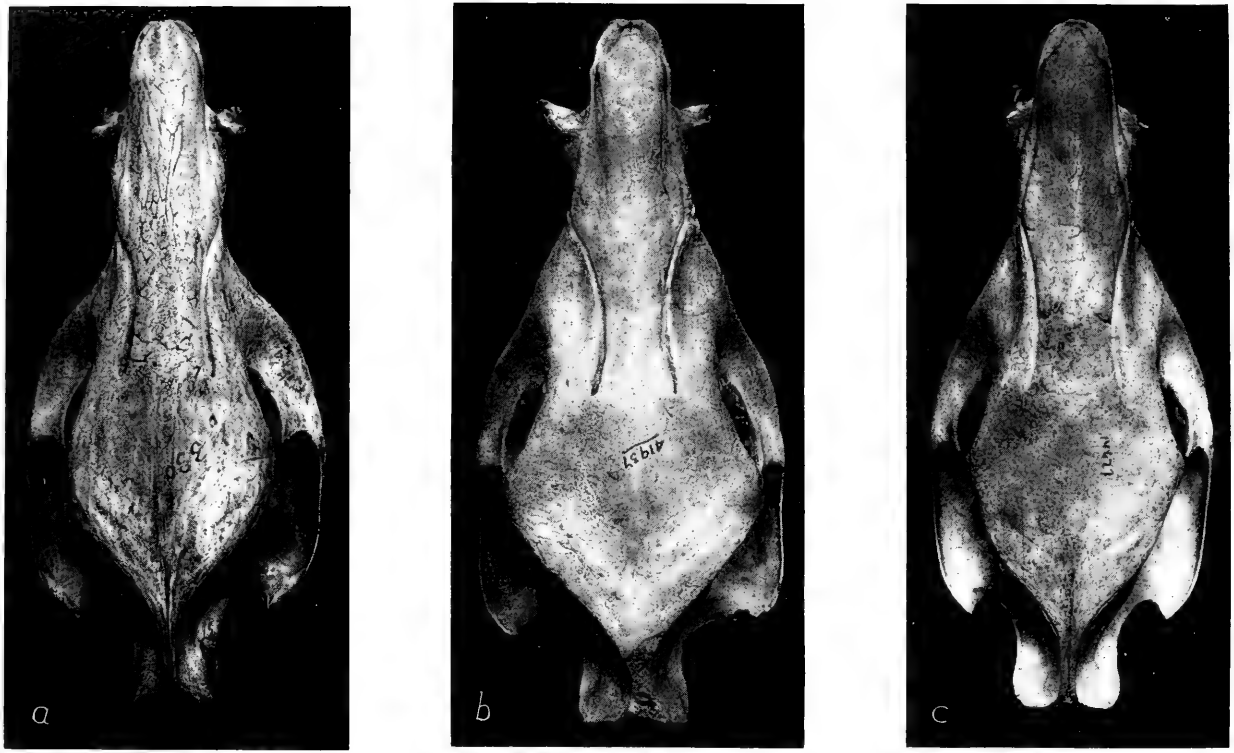

FIGURE 25

(a), *Pecari tajacu tajacu* (b), *Pecari tajacu macrocephalus* (c) *Pecari torvus*

All figures three eighths natural size.

General Characters.—Similar to *tajacu* but with skull larger and markedly different in structure.

Description.—Pelage about as in *tajacu*, grizzled yellowish and black, with black dorsal area; collar fairly well outlined.

Skull larger than that of *tajacu*, with more massive build, the forward extension of the zygomatic flange continued to canine alveolus and forming a heavy rostrum; outline of entire skull noticeably subtriangular viewed either from above or below, due to extended zygomatic flange; palate throughout anterior portion wider than distance across the molar series of that portion.

Measurements.—Taken in the flesh: total length 948 mm.; length of hind foot, 195.

Macrocephalus has been set off from typical *tajacu* because of important cranial differences. The Kartabo skulls have wide zygomatic flanges, which extend well out on the rostrum and give to the skull a subtriangular outline, when viewed from above or below. The skulls of true *tajacu* from Brazil have much slenderer rostra and the outline is flask-like.

15. *Mazama americana tumatumari* Allen.

1915. *Mazama americana tumatumari* Allen, Bull. Amer. Mus. Nat. Hist., XXXIV, p. 536.

Two specimens: Kartabo, 1 skin with skull; Kalacoon, 1 skin, spotted.

The specimen in the adult pelage appears to agree with the type, from Tumatumari, which is at no great distance from Kartabo and Kalacoon.

The very young specimen, which is only a flat skin without skull, is very brightly colored with numerous and conspicuous buffy spots.

16. *Mazama nemorivaga* (F. Cuvier).

1817. *Cervus nemorivagus* F. Cuvier, Diction. Sci. Nat. VII, p. 485 (part, the Cayenne specimens only).
1915. *Mazama nemorivagus* Allen, Bull. Amer. Mus. Nat. Hist. XXXIV, p. 548.

Nineteen specimens: Bartica, 1 skin; Kartabo, 11 skins, 9 skulls, 1 skeleton; Kalacoon, 4 skins, 2 skulls, 2 skeletons.

There is considerable variation in color shown by this large series, although all are some shade of light brown. The variation consists chiefly in a more or less extensive darkening of the dorsal area and, to a lesser degree, in the intensity of the dark coloring on the legs. Four young, in the spotted coat, are included in the series, the youngest of which is very conspicuously spotted but the oldest is only very faintly marked and about to assume a pelage like that of the adult.

17. *Hydrochærus hydrochærus* (Linnæus).

1776. *Sus hydrochærus* Linnæus, Syst. Nat., I p. 103.

Two immature specimens: Kartabo, skins with skeletons.

These specimens are too young, being about the size of *Sylvilagus*, to give any characters.

18. *Dasyprocta aguti flavescens* (Thomas)

1898. *Dasyprocta rubrata flavescens* Thomas, Ann. and Mag. Nat. Hist., (7), II, p. 274.

Thirty-four specimens: Kartabo, 20 skins, 33 skulls, 1 skeleton; Kalacoon, 1 skull.

This large series exemplifies the degree of variation found in the genus. The intensity of coloration on the rump varies from ochraceous—orange to Sanford's brown (Ridgway, Color Standards and Nomenclature); the extent of the bright area is often considerably reduced by the encroachment of the darker colored hairs of the upper dorsal region; the nape and shoulders, while normally quite dark, are sometimes much lighter and the degree of punctulation is far from constant.

Mr. Oldfield Thomas has referred[3] the northern Guiana agoutis to the above species, mentioning among his specimens a large series from Demerara. Specimens in our collection from Tumatumari, British Guiana, are indistinguishable from the Kartabo series, although they had previously been identified as *lucifer cayennae.* I agree with Mr. Thomas that the Guiana specimens have nothing to do with Wagler's *prymnolopha,* since none of the large series of *flavescens* before me

[3]1917, Ann. and Mag. Nat. Hist., (8), XX, p. 259.

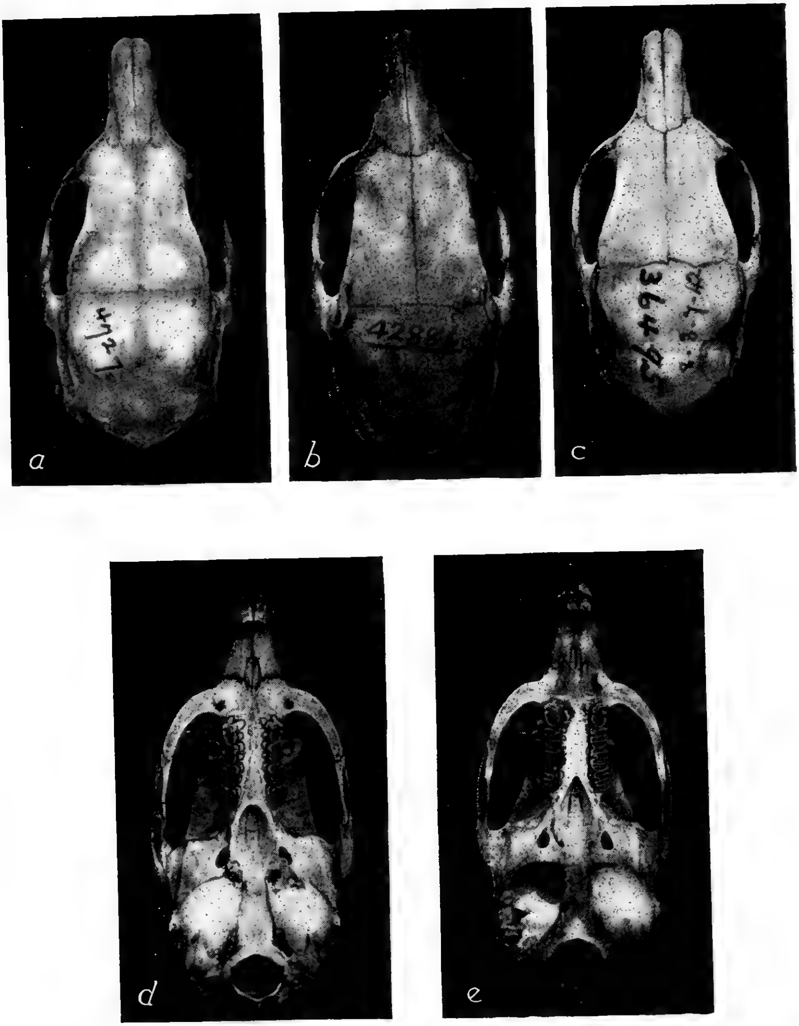

FIGURE 26

(*a*), Dorsal aspect of skull of *Echimys armatus*, Trinidad.
(*b*), Dorsal aspect of skull of *Echimys longirostris*, Kartabo.
(*c*), Dorsal aspect of skull of *Echimys armatus*, Demerara.
(*d*), Ventral aspect of skull of *Echimys longirostris*, same skull as shown in *b*.
(*e*), Ventral aspect of skull of *Echimys armatus*, same skull as shown in *c*.

All figures natural size.

shows any tendency toward the development of a black rump patch, which is a very conspicuous feature of *prymnolopha*.

19. *Agouti paca paca* (Linnæus).

1766. *Mus paca* Linnæus, Syst. Nat., I, p. 81.

Two specimens: Kartabo, skins with skulls.

These specimens are provisionally identified as *paca* but it is possible that they represent *fulvus* of Cuvier. Owing to a scarcity of suitable material from northeastern South America, and to the rather confusing status of the group as set forth in literature, the wide range of individual variation making identification from written descriptions most difficult, I have thought it best to assign the Guiana material to *paca*.

20. *Proechimys cayennensis* (Desmarest).

1817. *Echimys cayennensis* Desmarest, Nouv. Dict., X, p. 59.

Eleven specimens: Kartabo, 4 skins, 3 skulls, 4 skeletons; Kalacoon, 1 skin; Samiri Island, Mazaruni River, 6 skins.

The relationships of *cayennensis*, as given by Thomas[4], are with *trinitatis*, and this series of spiny rats from Guiana bear considerable resemblance to the rats from Trinidad, both superficially and in cranial characters.

21. *Echimys longirostris* Anthony.

1921. *Echimys longirostris* Anthony, American Museum Novitates, No. 19, p. 5.

One specimen: Kartabo, skin and skeleton.

General Characters.—Most like *armatus*, but differing in characters of pelage and in significant details of cranial structure, having much longer nasals and shallow postpalatal notch.

Description.—Pelage spiny, but with many unmodified hairs which partially mask the spines; hairs on crown only slightly spinous; color above, a mixture of black, ochraceous and buff, the ochraceous strongest on nose and face and posterior to shoulders along dorsal area; black strongest on neck and shoulders; flanks lighter than dorsal area and merging insensibly into the grayish under parts; hairs of underparts subspinous, gray at base and tipped with buff; pectoral area more brightly colored than posterior

[4] 1903, Ann. and Mag. Nat. Hist., (7), XI, p. 491.

under parts; hands and feet grizzled gray, buff and ochraceous, dirty white distally; tail haired at base for about 50 mm., colored same as rump, scaly for rest of its length, sparsely haired, practically unicolor, ashy in color.

Skull elongate with convex superior outline; nasals long, slender, subcylindrical; lateral margins of temporals forming straight lines, not concave; postpalatal notch U-shaped, reaching scarcely beyond the posterior margin of last molar; molar pattern typical of the genus.

Measurements.—Taken from dried skin; total length 466 mm., tail vertebræ 225; hind foot 38.

Although no less than three different names have been employed for the *Echimys* of British Guiana, the types have been determined to be specifically identical so that *guianae* and *castaneus* stand as synonyms of *armatus*. The Kartabo *Echimys* could be identified under none of these names and it was necessary to make it a new species. A fair amount of comparative material representing all three of these names has been available but no specimen was found which had such long nasals nor such a great interorbital breadth.

22. *Mus musculus musculus* Linnæus.

1758. *Mus musculus* Linnæus, Syst. Nat., I, p. 62.

Twelve specimens: Kartabo, 1 skin; Georgetown, 11 skins, 5 skulls.

23. *Rattus rattus alexandrinus* (Geoffroy).

1818. *Mus alexandrinus* Geoffroy, Descr. Egypt, II, 733.

Twenty-three specimens: Georgetown, 17 skins, 9 skulls, 3 skeletons; Penal Settlement, 6 skins, 3 skulls, 1 skeleton.

24. *Œcomys guianæ* Thomas.

1910. *Œcomys guianæ* Thos. Ann. and Mag. Nat. Hist., (8) VI, p. 187.

Two specimens: Kartabo, 2 skins, 1 skeleton.

These specimens agree with the description of *guianæ* closely enough to be so identified and they were taken sufficiently near to the type locality of *guianæ*, River Supinaam, to be considered topotypical.

25. *Œcomys nitedulus* Thomas.

1910. *Œcomys nitedulus* Thos. Ann. and Mag. Nat. Hist., (8) VI, p. 505.

Three specimens: Kartabo, 3 skins, 1 skull, 1 skeleton.

The type locality of *nitedulus* is the lower Essequibo River, thirteen miles from mouth, which is not very distant from Kartabo. The specimens from Kartabo are none of them old adults and consequently appear to be a trifle smaller than the measurements given by Thomas.

26. *Œcomys rutilus* Anthony.

1921. *Œcomys rutilus* Anthony, Amer. Mus. Novitates, No. 19, p. 4.

One specimen: Kartabo, skin with skeleton.

General Characters.—A small, brightly colored species, with very short tail and clear white under parts.

Description.—Color above, between amber brown and hazel (Ridgway), darkest along dorsal area and on crown, the hairs slaty black for basal two-thirds; below, clear white, the hairs white to the base; hands and feet dirty white, almost dusky; dark orbital ring with small dark area at posterior corner of the eye; tail brownish, unicolor. Skull small and broad, rostrum very short, zygomata flaring, a low supra-orbital beading.

Measurements.—Taken in the flesh: total length, 171 mm.; tail vertebrae, 94; hind foot, 20. Greatest length of skull, 24.2; zygomatic breadth, 13.5; length of nasals, 7.7; interorbital breadth, 4.4; breadth of brain case, 11; palate, to incisors, 10; palatal foramina, 3.7x2.2; length of upper molar series, 3.4.

This is a small, brightly colored mouse, of the genus *Œcomys*, quite distinct from the other *Œcomys* collected there, *nitedulus,* and possibly a relative of *rosilla* Thomas, from which it differs however in clear white underparts.

27. *Neacomys guianæ* Thomas.

1905. *Neacomys guianæ* Thomas, Ann. and Mag. Nat. Hist., (7) XVI, p. 310.

Two specimens: Kartabo, 2 skins, 1 skull, 2 skeletons.

These specimens are essentially topotypes since Thomas gives the type locality as the Demerara River, altitude 120 feet.

28. *Nectomys squamipes melanius* Thomas.

1910. *Nectomys squamipes melanius* Thomas, Ann. and Mag. Nat. Hist., (8) VI, p. 185.

Twenty-three specimens: Kartabo, 7 skins, 6 skulls, 6 skeletons; Kalacoon, 1 skin; Kyk-over-al, 11 skins, 8 skulls, 4 skeletons; Samiri Island, Mazaruni River, 4 skins.

The series agrees quite closely with the description of the type, and as the type locality is given as the lower Essequibo River, twelve miles from mouth, the Beebe specimens are practically topotypes.

29. *Oryzomys velutinus?*

1893. *Oryzomys velutinus* Allen, Bull. Amer. Mus. Nat. Hist., V, p. 214.

Ten specimens: Kartabo, 10 skins, 3 skulls, 3 skeletons.

The short-haired *Oryzomys* of the Beebe collection are provisionally referred to *velutinus,* although it may be questioned whether *velutinus* is not truly insular and the name not to be used for mainland forms. Without specimens of Lund's *laticeps* for comparison, and because of the confusing status of the *Oryzomys* of northeastern South America, these specimens are so named now, merely for the sake of convenience, but it is quite possible that more material will show them to be a subspecies of *laticeps.* These specimens agree quite closely with *velutinus* from Trinidad.

30. *Oryzomys* sp.?

One specimen: Bartica, skin, without skull.

This is a large species, strongly ochraceous above and buffy white below. It is not unlike *trinitatis* in general appearance, and on the other hand it agrees fairly well with the type description of *macconnelli*[5] but appears to be rather too small in size.

31. *Oryzomys* sp.?

Two specimens: Kartabo, 2 skins, 1 skull.

[5] 1910. Thomas, Ann. and Mag. Nat. Hist., (8) VI, p. 186.

These two specimens are of the *meridensis* group and possibly are closely related to *caracolus* Thomas[6] described from near Caracas, Venezuela.

32. *Guerlinguetus æstuans æstuans* (Linnæus).

1766. *Sciurus æstuans* Linnæus, Syst. Nat., I, p. 88, (Surinam).
1915. *Guerlinguetus æstuans æstuans* Allen, Bull. Amer. Mus. Nat Hist., XXXIV, p. 256.

Five specimens: Kartabo, 5 skins, 3 skulls, 2 skeletons.

This series is especially acceptable since this species of the Guiana lowlands has hitherto been very poorly represented in the Museum collection.

33. *Procyon cancrivorus cancrivorus* (Cuvier).

1798. *Ursus cancrivorus* Cuvier, Tabl. Elem. Hist. Nat., p. 113.

Two specimens: Penal Settlement, 2 skins, 2 skulls, 1 skeleton.

34. *Potos flavus flavus* (Schreber).

1775. *Lemur flavus* Schreber, Säug. I., p. 145, pl. 42.

Two specimens: Kalacoon, 1 skin, 1 odd skull.

35. *Lutra mitis* Thomas.

1908. *Lutra mitis* Thomas, Ann. and Mag. Nat. Hist., (8), I, p. 393.

Three specimens: Kartabo, 1 skin, 1 skull, 1 skeleton; Kalacoon, 1 skull.

The skin and the skulls seem to agree fairly well with Thomas's description of the type.

36. *Tayra barbara barbara* (Linnæus).

1766. *Mustela barbara* Linnæus, Syst. Nat., I, p. 67.

Four specimens: Kartabo, 2 skins, 2 skulls, 2 skeletons; Kalacoon, 1 skull.

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[6] 1914. Ann. and Mag. Nat. Hist., (8) XIV, p. 242.

One specimen has the head and neck above grizzled gray and the chest area dirty whitish; the other has the corresponding areas yellowish above and pale ochraceous below.

The odd skull is unusually large, with a very high sagittal crest, and measures, greatest length, 130 mm.; zygomatic breadth, 78.5 against 107 and 65, the dimensions of an adult female from Kartabo.

37. *Nasua phæocephala* Allen.

1904. *Nasua phæocephala* Allen, Bull. Amer. Mus. Nat. Hist., XX, p. 334.

Four specimens: Kartabo, 3 skins, 3 skulls, 1 skeleton; Kalacoon, 1 skeleton.

These specimens agree well in coloration with the type of *phæocephala*, from Suapure, Venezuela.

38. *Panthera onca* (Linnæus).

1766. *Felis onca* Linnæus, Syst. Nat., I, p. 61.

One specimen: Kartabo, skin and skull, adult male.

Skull measurements: Greatest length, 238 mm.; length of nasals, 57; zygomatic breadth, 160; mastoid breadth, 99; breadth of rostrum, 67; length of upper tooth row to incisors, 95.

39. *Margay tigrina vigens* (Thomas).

1904. *Felis weidii vigens* Thos., Ann. and Mag. Nat. Hist., (7) XIV, p. 192.

1919. *Margay tigrina vigens* Allen, Bull. Amer. Mus. Nat. Hist., XLI, p. 357.

One specimen: Kartabo, skin with skeleton.

This specimen agrees, in most essential characters, with the type description of *vigens* (*loc. cit.*). The skull measurements are a trifle larger for the Kartabo animal and the color pattern varies slightly from that given by Thomas, in the lesser number of dark rings on the tail and the whiter underparts.

40. *Herpailurus yaguarondi unicolor* (Traill).

1819. *Felis unicolor* Traill, Mem. Wernerian Soc., III, p. 170.
1919. *Herpailurus yaguarondi unicolor* Allen, Bull. Amer. Mus. Nat. Hist., XLI, p. 383.

One specimen: Kartabo, skin and skeleton, adult male.

This rare cat is in the black phase and is a glistening black all over, except about the head and neck which is grizzled with gray.

Measurements, taken in the flesh; total length, 1150 mm.; tail vertebræ, 470; hind foot, 155; weight, 19 pounds.

Skull, greatest length, 112 mm.; basal length, 99; zygomatic breadth, 71; breadth of braincase, 43.5; length entire upper tooth row, 42.7.

41. *Saccopteryx bilineata* (Temminck).

1839. *Urocryptus bilineatus* Temminck, Van der Hoeven, Tijdsch. Natur., p. 33.

Three specimens in alcohol: Kalacoon.

42. *Rhynchiscus naso* (Wied).

1821. *Vespertilio naso* Wied, Schinz's Thierreich, Vol. I, p. 179.

Thirteen specimens in alcohol: Kaow Island, Essequibo River, 12; Kartabo, 1.

The collector's notes state that these bats were found "on bark of tree."

43. *Glossophaga soricina soricina* (Pallas).

1766. *Vespertilio soricinus* Pallas, Miscell. Zool., p. 48.

Sixty specimens: Creeklands, Berbice, 28 skins, 20 skulls, 20 skeletons; Georgetown, 6 skins, 16 alcoholics; Kartabo, 10 alcoholics.

This large series of *Glossophaga* presents but little variation in color and appears to be typical *soricina* in every character.

44. *Hemiderma perspicillatum perspicillatum* (Linnæus).

1758. *[Vespertilio] perspicillatus* Linnæus, Syst. Nat., I, p. 31.

Fifty-seven specimens: Georgetown, 10 skins; 29 alcoholics; Kalacoon, 4 alcoholics: Kartabo, 14 alcoholics.

This series is quite uniform in character and presents no points worthy of comment.

45. *Mesophylla macconnelli* Thomas.

1901. *Mesophylla macconnelli* Thomas, Ann. and Mag. Nat. Hist., (7), VIII, p. 145.

Seven specimens in alcohol: Kartabo, July 22, 1920.

This genus has hitherto been unrepresented in the Museum collection, but there is little difficulty in identifying it from the description given by Miller in "The Families and Genera of Bats," p. 158. The most conspicuous features of the skull are the swollen maxillaries and depressed nasal region, while the pelage of *macconnelli* is very light colored.

These specimens were taken at no very great distance from the type locality of the species which is Kanuku Mountains, British Guiana.

46. *Phyllostomus hastatus hastatus* (Pallas).

1767. *Vespertilio hastatum* Pallas, Spici. Zool., III, p. 7.

Three specimens in alcohol: Kartabo, 2; Kalacoon, 1.

47. *Vampyrus spectrum spectrum* (Linnæus).

1766. *Vespertilio spectrum* Linnæus, Syst. Nat., I, p. 46.

One specimen: Kartabo, skin and skeleton.

This very large species is represented by only one specimen which appears to be typical in all respects. The forearm is 104 mm. long.

48. *Furipterus horrens* (F. Cuvier).

1828. *Furia horrens* Cuvier, Mem. Mus., XVI, p. 150.

Six specimens: Kartabo, April 26 to August 25.

This series is a valuable addition to the Museum collection since *Furipterus* is exceedingly rare. The series is uniform in coloration and the average measurement of the forearm is 34.9 mm.

49. *Eumops milleri* (Allen).

1900. *Promops milleri* Allen, Bull. Amer. Mus. Nat. Hist., XIII, p. 91

Two specimens (1 imm.) in alcohol: Kartabo.

The adult specimen agrees fairly well in all characters but size with the type of *milleri*. In cranial characters the two are identical with the following exceptions, the Kartabo specimen has slightly smaller upper incisors and less extensive basicranial pits. The following measurements are of the Kartabo bat, contrasted with the type of *milleri* in parentheses; forearm, 55 mm. (58.7); greatest length of skull, 24.7 (25.2); zygomatic breadth, 14.2 (14.2): length of upper tooth row, C-M^3, 9.3, (9.8).

This specimen is not unlike the type of *Eumops barbatus* (Allen) which differs from *milleri* mainly in size only. Additional material may show that *barbatus* should stand either as a subspecies of *milleri* or as its synonym, and the older name of *milleri* is followed, because of the inadequate material representing *barbatus*, the type being unique.

50. *Molossus obscurus* Geoffroy.

1805. *Molossus obscurus* Geoffroy, Ann. du Mus., VI, p. 154.

Twenty-two specimens: Georgetown, 9 alcoholics; Kalacoon, 1 skin, 9 alcoholics; Kartabo, 3 alcoholics.

Only one specimen of the entire series is in the red phase.

51. *Molossus rufus* Geoffroy.

1805. *Molossus rufus* Geoffroy, Ann. du Mus., VI, p. 154.

Six specimens: Georgetown, 3 skins; Kartabo, 1 alcoholic; Penal Settlement, 2 alcoholics.

These specimens are in the dark phase, and the Kartabo example has a forearm 48 mm. in length.

52. *Saimiri sciureus* (Linnæus).

1758. *Simia sciurea* Linnæus, Syst. Nat. I, p. 19.
1913. *Saimiri sciureus* Elliot, Review of the Primates, I, p. 310.

Five specimens: Kartabo, 3 skins, 2 skulls, 1 skeleton; Kalacoon, 1 skin, 1 skull.

Of the *Saimiri* taken in British Guiana, all but one appear to be typical *sciureus*, the series being fairly uniform in coloration. The exception, a skin without skull, differs in having black lateral stripes on the head and behind the eye, while the dorsal region is a much brighter color than in the other specimens, being quite yellow. This specimen, from Kartabo, I have provisionally identified as *cassaquiarensis*, a considerable extension of range, if the identification proves to be correct, since the range of this species is to the west of British Guiana.

53. *Saimiri cassaquiarensis* (Humboldt).

1811. *Chrysothrix sciureus cassaquiarensis* Humboldt, Rec. Obs. Zool. I, p. 334, (1815)
1913. *Saimiri cassaquiarensis* Elliot, Review of the Primates, I, p. 311.

One specimen: Kartabo, skin without skull.

54. *Alouatta seniculus macconnelli* (Elliot).

1910. *Alouatta macconnelli* Elliot, Ann. and Mag. Nat. Hist., (8), V. p. 80.
1916. *Alouatta seniculus macconnelli* Allen, Bull. Amer. Mus. Nat. Hist., XXXV, p. 233.

Thirty-three specimens: Kartabo, 22 skins, 23 skulls, 8 skeletons; Kalacoon, 3 skins, 7 skulls.

This large series displays a very considerable range of individual variation in color. The general tone of the upper parts varies from yellow to bright orange red, with a corresponding lack of uniformity in the coloration of the limbs and tail, which in some specimens are much darker than the upper parts, although this condition is not as conspicuous as in true *seniculus.*

A group of eight individuals, six adults and two young, has been mounted and placed on exhibition in the American Museum of Natural History.

55. *Pithecia pithecia* (Linnæus).

1766. *Simia pithecia* Linnæus, Syst. Nat., I, p. 40.
1913. *Pithecia pithecia* Elliot, Review of the Primates, I, p. 293.

Twenty-seven specimens: Kartabo, 17 skins, 19 skulls, 5 skeletons; Kalacoon, 4 skins.

The status of the species of the genus *Pithecia* is far from satisfactory, to judge by the literature and the specimens in the Museum collection, and the present series focuses attention upon this fact. The specimens all were taken in a small area and exhibit considerable variation in coloration. In the males, the color of the head varies in the amount of ochraceous; in one specimen this color extends from the under side to the median line of the upperparts, but the normal color above is a dirty white.

56. *Cebus apella apella* (Linnæus).

1758. *Simia apella* Linnæus, Syst. Nat. I, p. 28.
1913. *Cebus apella* Elliot, Review of the Primates, II, p. 78.

Twenty-five specimens: Kartabo, 15 skins, 23 skulls, 2 skeletons.

Although the range of color variation shown by this series is considerable, the average is darker than that of a series of *apiculatus* from Venezuela. The series shows but little of the fulvous which characterises *apiculatus* and is much darker than *apella brunneus.*

APPENDIX A

By H. E. Anthony

The following four species of mammals, a rat, a mongoose and two bats, were collected at Georgetown, sixty miles away on the coast, and have not as yet been taken at the Station.

Rattus norvegicus (Erxleben).

1777. [*Mus*] *norvegicus* Erxlebon, Syst. Regni Anim., Vol. I, p. 381.

Four specimens: Georgetown, 4 skins, 4 skulls, 2 skeletons.

Mungos birmanicus (Thomas).

1886. *Herpestes auropunctatus birmanicus* Thomas, Proc. Zool. Soc., London, p. 58.
1911. *Mungos birmanicus* G. M. Allen, Bull. Mus. Comp. Zool., LIV, p. 217.

One specimen: Georgetown, skin and skeleton.

It is to be hoped that the mongoose will find enough enemies upon the continental mainland to prevent the widespread distribution and destruction which have followed its introduction into the West Indies.

Artibeus planirostris planirostris (Spix).

1823. *Phyllostoma planirostre* Spix, Sim. et Vesp. Bros., p. 66.
1908. *Artibeus planirostris planirostris* Andersen, Proc. Zool. Soc., London, p. 237.

One specimen: Georgetown, skin and skeleton.

This specimen is best considered as *p. planirostris* on the basis of measurements, although on geographical grounds it should be *p. fallax*. The following measurements, total length of skull, 28.5 mm.; mastoid width, 15.5; width of braincase, 12; maxillary width across m^1, 17.5; upper tooth row, c-m^2, 10; forearm, 61; all come closer to those of the former subspecies than they do to those of the latter, as set forth by Andersen in his monograph of the genus op. cit. page 246.

The skull lacks the m^3 on both sides and it is interesting in this connection to note that three out of four of Andersen's only specimens of the *planirostris* group which lacked m^3 came from British Guiana, page 234, *op. cit.* as did also an "unusually small specimen" of *p. fallax,* page 243.

Macrophyllum macrophyllum (Wied).

1825. *Phyllostoma macrophyllum* Wied, Beitr. zur Naturgesch. Brasilien, Vol. II, p. 188.

One specimen (male): Georgetown, April.

This specimen is in alcohol and is in excellent condition. The skull has been removed and cleaned for examination. This rare species is well characterized externally by the very high and broad noseleaf, long, slender tragus and very extensive interfemoral membrane, which has a series of longitudinal rows of minute dermal papillæ along the proximal half of the under surface. The most striking cranial characters are the shelf-like surface just anterior to the external nares, the enlarged median incisors above and the greatly reduced second lower premolar, which is scarcely visible to the naked eye.

Length of forearm, 34.5 mm.

APPENDIX B

By WILLIAM BEEBE

The following unmistakable mammals have been observed by me at the Station, or in some cases collected alive or dead, and not preserved. I add them to complete the tentative list of mammals of the Station.

57 *Chironectes* sp. .... (Water Opossum)
58 *Desmodus* sp. .... (Vampire Bat)
59 *Icticyon* sp. .... (Crab-dog)
60 *Felis* sp. .... (Puma)
61 *Leopardus* sp. .... (Ocelot)
62 *Myoprocta* sp. .... (Short-tailed Agouti)
63 *Coendu* sp. .... (Tree Porcupine)
64 *Sciurillus* sp. .... (Dwarf Squirrel)
65 *Priodontes* sp. .... (Giant Armadillo)
66 *Tapirus* sp. .... (Tapir)
67 *Trichechus* sp. .... (Manatee)
68 *Inia* sp. .... (Fresh-water Dolphin)
69 *Leontocebus?* sp. .... (Marmoset)
70 *Ateles* sp. .... (Spider Monkey)

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ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE NEW YORK ZOOLOGICAL SOCIETY

FROM THE TROPICAL RESEARCH
STATION IN BRITISH GUIANA

VOLUME III, NUMBERS 14 AND 15

Tropical Research Station Contributions Numbers 134 and 135

14. NEW BATRACHIANS
15. NEW LIZARDS

FROM THE TROPICAL RESEARCH STATION
BRITISH GUIANA

By G. KINGSLEY NOBLE

Associate Curator of Herpetology, in Charge,
American Museum of Natural History

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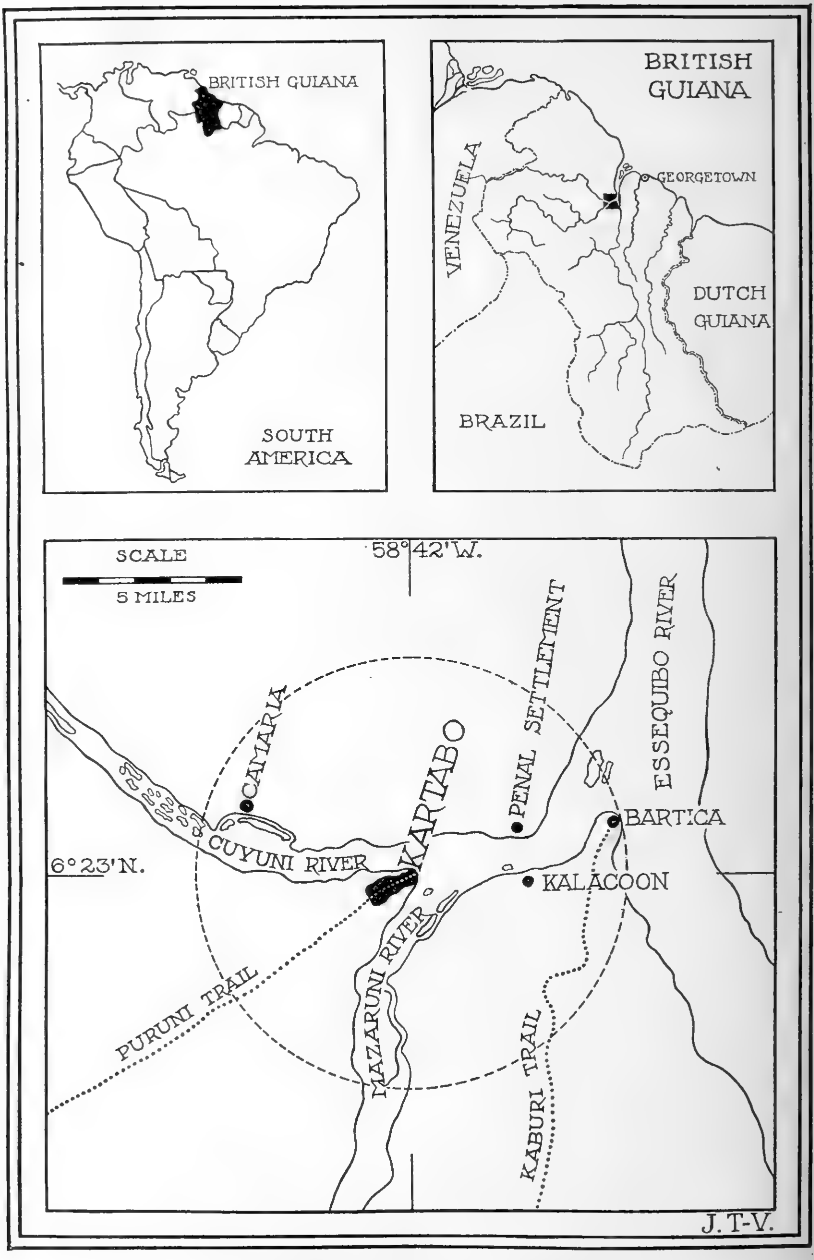

LOCATION OF THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY

The circle represents a radius of six miles.

First form on press September 10, 1923

NEW BATRACHIANS
FROM THE TROPICAL RESEARCH STATION BRITISH GUIANA

By G. Kingsley Noble
Associate Curator of Herpetology, in Charge, American Museum of Natural History

Among the Amphibia secured by Mr. William Beebe or by members of his staff while at the Tropical Research Station and substations maintained by the New York Zoological Society in British Guiana, there are included a number of new forms. The reptiles and amphibians collected by Mr. Beebe have already been reported upon in part (Beebe, 1919, Zoologica II, No. 7). Mr. Beebe has been kind enough to place in my hands his new species for description. The present paper deals with only the Amphibia collected. A second paper will consider the new reptiles obtained by Mr. Beebe. It is Mr. Beebe's intention to publish later a full account of the reptiles and amphibians found near the Tropical Research Station, together with a series of colored plates illustrating most of the forms described below. I have added to the following descriptions a diagnosis of one species found at the Zoological Society's Research Substation near the Kaieteur Falls, but represented in the collections at my disposal only by specimens secured by a former expedition.

Hyloxalus beebei sp. nov.

DIAGNOSIS

Readily distinguished from all other species of the genus by its small size, rudimentary webs and brilliant coloration in life. Preserved specimens are straw-color above with a dark stripe on either side of the head and body, and with an irregular stippling of dark brown on the back. From the species of *Phyllobates,* which it closely resembles, this species may be distinguished by the short but well-defined webs between the toes, and by its distinctive coloration.

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* Tropical Research Station, Contribution Number 134.

TYPE

A.M.N.H. No. A-18683; adult ♀; near Kaieteur Falls, British Guiana; February 18, 1921; William Beebe.

DESCRIPTION OF TYPE

Size very small; snout rounded, a trifle longer than the greatest diameter of the eye; distance between nostril and tip of snout a trifle less than the distance between nostril and eye; interorbital space one and one-half times as broad as the upper eye-lid; tympanum nearly two-thirds the diameter of the eye, rather indistinct, less than its own diameter from the eye. Tibiotarsal articulations of either side in contact when the legs are placed at right angles to the body; tibiotarsal articulation reaching the posterior border of the eye. Digital dilations very small, the discs less than one-half the diameter of the tympanum; fingers free, the first finger not as long as the second; toes with a short but very distinct rudiment of a web; no fringe extending the length of the toes as in most species of *Hyloxalus*. Two metatarsal tubercles, the outer pointed and one-third the diameter of the inner which is not very distinct; a well-defined tarsal fold. Tongue ovate, slightly nicked behind. Skin smooth above, slightly granular on the sides; no well-defined folds on the back.

Ground tone in alcohol a pale straw-color; streak of dark brown from tip of the snout through the eye to the groin, this stripe very narrow on the head, broadening out behind the tympanum until it equals the greatest diameter of the latter, narrowing again on the sides of the body to disappear in the lumbar region; dorsal surface slightly stippled with the same brown tone; two pale streaks on either side of the back, extending from the eye to the pelvic region, free of this dark stippling; jaws and ventral surface immaculate; hinder and upper portion of the thigh indistinctly stippled with dark brown; upper surfaces of the lower limbs stippled with the same dark tone, the stippling tending to form three or more dark cross-bands. In life, the ground tone was a bright yellow and the pattern was much more distinct.

MEASUREMENTS

Tip of Snout to Vent	16.5 mm.
Tip of Snout to Posterior Border of Tympanum	5.8 "
Greatest Breadth of the Head	5.5 "
Distance from Axilla to Tip of Longest Finger	11.0 "
Distance from Vent to Tip of Longest Toe	26.0 "
Tibia	7.5 "

REMARKS

This distinctive species of *Hyloxalus* is of special interest because it seems to bridge the gap supposed to exist between *Hyloxalus* and *Phyllobates.* The species agrees entirely with *Phyllobates* in regard to its skeletal characters, and in most external features is similar to that genus, but the presence of the short web, much shorter than in any hitherto described species of *Hyloxalus,* prevents our referring it to *Phyllobates.* Undoubtedly, *Hyloxalus* is the more primitive genus, and it would be interesting to find the stock from which it arose. As I have pointed out elsewhere (Noble, 1922, Bull. A.M.N.H., Vol. XLVI, pp. 1-87), the brachycephalids have been derived from bufonid ancestors. It is highly probable that the stock from which *Hyloxalus* has been derived will be found in the *Bufonidae.*

The type specimen described above, although only 16.5 mm. in total length, possessed seven eggs within the ovaries, averaging 2 mm. in diameter. These eggs were heavily pigmented. All Salientia which lay eggs of such enormous size deposit them on land. It is therefore very probable that *Hyloxalus,* in spite of the web between its toes, is purely terrestrial and lays its eggs in moist situations similar to those utilized by *Eleutherodactylus.*

Hyla ornatissima sp. nov.

DIAGNOSIS

A medium sized *Hyla* possessing arched vomerine teeth which form a shallow ∩; fingers two-thirds webbed, toes nearly entire webbed. Tibiotarsal articulation extending beyond the snout. Gaudy coloration of pinks and browns; two dark, pink-edged spots on the snout; a dark interorbital bar and a diamond shaped spot just anterior to the pelvis, similarly edged with pink.

TYPE

A.M.N.H. No. A-13491; adult ♀; Meamu, Mazaruni R., British Guiana; June 10, 1920; William Beebe.

DESCRIPTION OF TYPE

Tongue as long as broad, unemarginate behind; vomerine teeth in two slightly arched series nearly in contact with each other and directed slightly forward; the anterior margin of the arch on a level with the posterior border of the choanae. Head exactly as long as broad; nostrils near the end of the snout; interorbital space slightly more than half as great as the distance between nostril and eye; head greatly flattened with concave loreal region and prominent snout; interorbital space twice the diameter of the upper eye-lid, slightly greater than the greatest diameter of the eye; no ossification in the derm of the head; tympanum distinct, its greatest diameter less than half the greatest diameter of the eye. Tibiotarsal articulation extending beyond the tip of the snout. Digits with well-defined discs, these a trifle less than the greatest diameter of the tympanum; fingers two-thirds webbed; toes fully webbed, except that the web hardly extends beyond the base of the penultimate phalanx of the fourth toe; no external evidence of a rudiment of the prepollex. Skin smooth above, slightly granular on the belly; no folds on the back or sides of the body.

Ground color, in preserved specimens, pale straw-color or yellowish; dorsal surface finely sprinkled with small pink spots; a dark brown spot on either side of the snout edged with pink; a dark spot on each upper eye-lid and an interorbital bar of the same color, these outlined by the same pinkish tone; a dark diamond-shaped figure just anterior to the pelvis, continued posteriorly in a narrow coccygeal stripe; two small spots anterior to the diamond-shaped figure of the same tone, this figure broadly edged with pink, a few irregular pink blotches along the coccygeal stripe and near the anterior spots; tips of the toes brownish; two dark spots on the forearm; a few small pinkish spots on the upper surface of the limbs; a few small pinkish spots and three or four dark ones on the upper surface of the hind limbs; ventral surface immaculate except for the tips of the fingers and toes which are brownish.

MEASUREMENTS

Tip of Snout to Vent	40.0	mm.
Tip of Snout to Posterior Border of Tympanum	12.5	"
Greatest Breadth of the Head	14.0	"
Distance from Axilla to Tip of Longest Finger	22.5	"
Distance from Vent to Tip of Longest toe	70.0	"
Tibia	23.0	"

REMARKS

The species is represented in the collection by only a single specimen which was captured by an Indian and brought to the Zoological Station. Its gaudy coloration in life readily distinguishes it from the other Guianan hylas.

Leptodactylus stictigularis sp. nov.

DIAGNOSIS

A medium sized *Leptodactylus,* having a broad head; chestnut or reddish brown dorsal coloration; conspicuous whitish or pink upper lip and a dark throat studded with white spots. Tibiotarsal articulation extending to the middle of the eye; toes bearing narrow dermal fringes; skin smooth or granular; two well-defined dorso-lateral folds extending from eye to groin.

TYPE

A.M.N.H. No. A-10398; adult ♂; Kartabo, British Guiana; 1919; William Beebe.

DESCRIPTION OF TYPE

Size moderate; head flattened, a little broader than long; snout distinctly longer than the greatest diameter of the eye; distance between tip of snout and nostril contained twice in the distance between nostril and eye; interorbital space one and one-third times as broad as the upper eye-lid, about equal to the greatest diameter of the eye; canthus rostralis rounded but rather distinct; the loreal region concave; tympanum two-thirds the greatest diameter of the eye, separated from the eye by a space equal to half its own diameter. Tibiotarsal joints of either side overlap when the legs are placed at right angles to the body; tibiotarsal articulation, when extended forward, marks the middle of the eye. Digits slender, terminating in very small discs; first finger very long; second finger only two-thirds as long as the first; toes slender, bordered with a narrow fringe; sub-articular tubercles pronounced; two metatarsal tubercles, the outer two-thirds the length of the inner; a well-defined tarsal fold. Tongue large, slightly nicked behind; vomerine teeth in two arched groups nearly in contact with each other and touching the posterior border of the choanae; the most anterior part of each arch anterior to the posterior edge of the choanae. Skin smooth or slightly granular; a well-defined dorso-lateral fold extending from the eye to groin; ventral surfaces smooth, no abdominal disc.

Ground tone chestnut brown; upper lips broadly edged with gray; a grayish interorbital bar; the canthus and the dorso-lateral fold edged with dark brown; the supra-tympanic fold of the same color; posterior surfaces of thighs very dark brown; three or four rows of irregular whitish spots studding this dark area; three ill-defined dark bars on the dorsal surface of the thighs, three or four on the lower limbs; soles of feet very dark brown, parts of the lower leg suffused with the same color; sides of the body milky, stippled with the chestnut ground tone; ground tone of ventral surface white; throat a dark brown studded with numerous white spots; periphery of abdomen densely stippled with brown; middle of abdomen and distal portions of the thighs lightly stippled with the same color.

MEASUREMENTS

Tip of Snout to Vent	56.0	mm.
Tip of Snout to Posterior Border of Tympanum	20.5	"

Greatest Breadth of Head	23.0	"
Distance from Axilla to Tip of Longest Finger	34.0	"
Distance from Vent to Tip of Longest Toe	84.0	"
Tibia	27.0	"

REMARKS

The species is represented in our collections by a single paratype. It differs but little from the type in color. The dark throat color is indistinctly continued on the anterior part of the abdomen, but here the white spots have given place to white blotches. The pale stripe on the upper lip is pink in this specimen, and the interorbital bar is of the same color.

L. stictigularis seems to be most closely allied to *L. rhodomystax* Boulenger, from which it differs in its longer leg, somewhat differently arranged vomerine teeth and different coloration. *L. rhodomystax* has been recorded from British Guiana by Ruthven (1919 Occ. Papers Mus. Zool., Univ. of Mich., No. 69, p. 4.) I have recently had the opportunity of examining Ruthven's specimens and find them to be unquestionably the young of *L. pentadactylus.* This leaves the question open as to whether or not *L. rhodomystax* might not have been based upon a juvenile specimen of that species. This question can only be answered by examination of the types.

Leptodactylus minutus sp. nov.

DIAGNOSIS

A minute *Leptodactylus* lacking fringes to the toes and without dorsal folds; skin glandular, but never warty; an irregular series of dark spots above, these sometimes forming an interorbital bar and a symmetrical pattern on the shoulders. Apparently closely allied to *L. pulcher* Boulenger, from which it is distinguished by its different color pattern and shorter leg; somewhat similar to the immature *L. caliginosus* and *L. typhonius,* distinguished from these by the characters already mentioned.

TYPE

A.M.N.H. No. A-13495; adult ♀; Bartica District, British Guiana; January 8, 1916; William Beebe.

DESCRIPTION OF TYPE

Size very small; head distinctly longer than broad; distance between tip of snout and nostril contained twice in distance between nostril and eye; interorbital width one and one-half times as broad as the upper eye-lid, equal to the greatest diameter of the eye; canthus rostralis rounded, the loreal region sloping gradually; tympanum very distinct, one-half the greatest diameter of the eye, separated from the eye by a trifle less than half its own diameter. Tibiotarsal joints of each side strongly overlap when the legs are placed at right angles to the body; tibiotarsal articulations mark the anterior corner of the eye when the legs are extended forward. Tips of digits not swollen into discs, only slightly larger than the diameter of the penultimate phalanges; first finger a trifle shorter than the second; toes slender, not fringed; subarticular tubercles pronounced; two well-defined metatarsal tubercles; a tarsal fold. Tongue ovoid, slightly nicked behind; vomerine teeth in two slightly arched series well behind the choanae, separated from each other by a space equal to their distance from the choanae. Skin slightly glandular but not warty above, a few feeble warts on the sides of the body tending to form an ill-defined dorso-lateral fold; ventral surface smooth, a very pronounced abdominal disc.

Ground tone of dorsal surface dull olive-gray; three pale stripes running the length of the back, the two outer pale stripes irregularly suffused with pink; the whole dorsal surface, excepting the pale bands, irregularly spotted with dark brown; about twelve spots on the back and four on each side of the body ventral to the pale streak; two or three dark spots on each upper jaw; a series of dark spots forming cross bars on the limbs; hinder surface of thighs suffused with brownish; ventral surfaces immaculate excepting for a delicate suffusion of brown on the throat and hind limbs.

MEASUREMENTS

Tip of Snout to Vent	22.0 mm.
Tip of Snout to Posterior Border of Tympanum	8.0 "
Greatest Breadth of Head	7.5 "
Distance from Axilla to Tip of Longest Finger	12.5 "
Distance from Vent to Tip of Longest Toe	37.0 "
Tibia	11.0 "

REMARKS

The six paratypes show a considerable range of variation in color; the ground tone may be very pale or somewhat darker than in the type; a well-defined interorbital bar may be present forming a regular cross with a scapular marking; the other spots on the back may have a very symmetrical or irregular arrangement; the dark spots on the upper jaw usually form a very well-defined series; the three dorsal stripes are not as well-defined in the paratypes as in the type; in three of the specimens there is no indication of these light streaks.

Leptodactylus rugosus sp. nov.

DIAGNOSIS

A small species, very similar to *L. caliginosus,* but with a broader head, shorter leg and very rugose dorsum. It is further distinguished from that species by its large tympanum, different coloration, and absence of nuptial spines in the breeding male.

TYPE

A.M.N.H. No. A-1169; adult ♂; near Kaieteur Falls, British Guiana; August 13, 1911; F. E. Lutz.

DESCRIPTION OF TYPE

Size small; head flattened, as long as broad; snout longer than the greatest diameter of the orbit; interorbital space narrower than the breadth of the upper eye-lid, much less than the greatest diameter of the eye; canthus rostralis rounded; loreal region slightly concave; tympanum two-thirds the greatest diameter of the eye, separated from the latter by a space less than half its own diameter. Tibiotarsal joints of either side barely overlap when the legs are placed at right angles to the body; tibiotarsal articulation when extended forward reaches the anterior border of the tympanum. Digits slender, without terminal dilations; first finger longer than the second; toes slender, without fringes; subarticular tubercles pronounced; two metatarsal tubercles, the outer two-thirds the length of the inner; a well-defined tarsal fold. Tongue large, slightly nicked behind; vomerine teeth in two arched series on a level with the posterior border of the choanae, and nearly in contact with each other in the mid-line; anterior edge of each arch not extending forward beyond the choanae. Skin very rugose above, some of the tubercles forming short folds which run cephalo-caudad on the back; upper eye-lids covered with numerous warts; a few warts on the snout and dorsal surface of the limbs.

Ground tone above reddish brown, a few indistinct paler marks on the upper lip, and numerous pale mottlings on the posterior surfaces of the thighs; some indication of dark cross-bands on the upper and lower legs; ventral surfaces straw-colored, heavily blotched with brown, the spotting darkest on the throat and palest on the ventral surfaces of the thighs.

MEASUREMENTS

Tip of Snout to Vent	38.0	mm.
Tip of Snout to Postrior Border of Tympanum	15.5	"
Greatest Breadth of Head	16.0	"
Distance from Axilla to Tip of Longest Finger	21.5	"
Distance from Vent to Tip of Longest Toe	55.0	"
Tibia	17.5	"

REMARKS

The four paratypes in our collection range from 16.5 to 41.0 mm. head and body length. They show very little variation in either coloration or structural characters. The pale bars on the upper lip are very distinct in the largest specimen and some indication of an interorbital bar is present. The venter of all four paratypes is either immaculate or lightly spotted with brown.

NEW LIZARDS
FROM THE TROPICAL RESEARCH STATION BRITISH GUIANA

By G. Kingsley Noble
Associate Curator of Herpetology, in Charge, American Museum of Natural History

Among the reptiles secured by Mr. William Beebe or by his staff at the New York Zoological Society's Tropical Research Station in British Guiana, there are included a number of rare and interesting forms. Two lizards in the collection are found to be undescribed, while two others are reported from British Guiana for the first time. The latter are *Neusticurus bicarinatus* (Linné), from Kartabo, and *Cercosaura ocellata* Wagler from both Kartabo and the Bartica District. Many of the species secured by Mr. Beebe, such as *Sphaerodactylus molei* Boettger, were very imperfectly known. These Mr. Beebe is planning to discuss in a later paper. The present paper is limited to merely a description of the new forms in the collection. It may be added that the species described below will be figured in Mr. Beebe's general account of the reptiles of the Research Station.

Gonatodes beebei sp. nov.

DIAGNOSIS

A large *Gonatodes* of uniform reddish brown color above and without spots on the throat or venter; a species having not one but a series of spines over the eye, and having the nostril not indenting the rostral.

TYPE

A.M.N.H. No. R-21251; adult ♂; Kartabo, British Guiana; 1921; William Beebe.

DESCRIPTION OF TYPE

Size large; distance from tip of snout to ear contained exactly four times in the distance from snout to vent; greatest diameter of the eye contained one and one-half times in the

* Tropical Research Station, Contribution Number 135.

distance from tip of snout to eye; distance from tip of snout to nostril contained twice in the distance between nostril and eye; distance from snout to middle of eye decidedly greater than the distance from ear to latter point; ear opening oval in outline, about one-third the greatest diameter of the eye. Digits cylindrical, proximal scales of their ventral surfaces very much larger than distal ones, grading rather abruptly into the latter; dorsal surfaces of head and body covered with coarse granules, those of the head not larger than those of the body; granules of the occiput slightly smaller than those of the snout; posterior superciliaries slightly more pointed but not distinctly larger than the supraorbitals; anterior superciliaries very much larger than the supraorbital granules, three or four of these enlarged superciliaries sharply pointed and forming a series of low spines which project from the upper eye-lid just anterior to the mid point of the eye; a large cleft rostral bordered posteriorly by three small median granules, two large lateral scales and the nostrils; nostrils in contact with the rostral but not indenting it; five upper and four lower labials; mental large, pointed behind, followed by two small scales larger than the smallest labial, gular region with coarse granules of the same size as those of the snout; ventral surfaces of the body and posterior appendages covered with large cycloid, overlapping scales, these of about three times the diameter of the dorsal granules; under surface of the tail covered proximally with scales similar to those of the abdomen, covered distally by one or two series of very broad scales,—these scales three to five times as broad as the abdominal scales.

Uniform reddish brown above, whitish immaculate below, except for a slight suffusion of brown on the abdomen and appendages, this suffusion tending to form dark edges to the scales of the ventral surface of the thigh.

MEASUREMENTS

Tip of Snout to Vent	47.0	mm.
Tip of Snout to Ear	11.5	"
Tip of Snout to Orbit	5.5	"
Greatest Width of Head	7.0	"
Vent to Tip of Tail	47.0	"

REMARKS

The species is represented in our collections by only a single specimen. The species may be readily distinguished from other forms of *Gonatodes* by its large size, narrow head and uniform coloration. It is perhaps allied to *G. ferrugineus* described by Cope from Trinidad.

Leposoma taeniata sp. nov.

DIAGNOSIS

Very closely related to *L. scincoides* and *L. dispar;* intermediate between these two forms in scutation, very different from either in coloration; fronto-nasal obtusely angular posteriorly; one anterior and three pairs of chin shields, the posterior pair separated from each other by a single scale; scales of the body strongly keeled, mucronate; dorsal scales forming transverse and oblique rows; ventral scales forming transverse and longitudinal rows on the abdomen. Reddish brown above, whitish below, a broad band of dark brown extending along either side of the head and body.

TYPE

A.M.N.H. No. R-21266; adult ♀; Kartabo, British Guiana; June 19, 1919; William Beebe.

DESCRIPTION OF TYPE

Head narrow; fronto-nasal obliquely angular behind; a pair of small prefrontals, not half as long as the frontal, slightly larger than the fronto-parietals; two lateral parietals and an enormous inter-parietal, the former about one-third as wide as the latter; four supraoculars; all dorsal head shields roughened, as in the other species of *Leposoma;* no loreal but two freno-orbitals, the dorsal having twice the diameter of the ventral; six upper and five lower labials; chin shields large, one anterior and three pairs, the two anterior pairs in contact, the posterior pair separated by a single scale; a few enlarged scales posterior to the chin shields; separated from the gulars by a single row of small scales which extends across the throat from ear to ear; chin shields similar to the ventrals, but narrower and more pointed. Body covered with uniform scales which form transverse and oblique rows on the back; transverse and longitudinal rows on the ventral surface; the scales about as broad as they are long; strongly keeled, mucronate; 27 scales around the middle of the body, 38 scales from the occiput to the base of the tail and 40 from the third pair of chin shields to the vent; 4 pre-anals, three of these slightly larger than the ventral scales; caudal scales like those of the body but the scales tending to form regular longitudinal and transverse rows as on the venter; the keels of the caudal scales forming a series of ridges; 14 of these ridges around the tail, fifteen scales from the base.

Ground tone above, reddish brown, two broad stripes of dark brown extending from the tip of the snout along the entire length of head and body and about one-third the length of the tail; no spotting on dorsal surface; a few dark spots on the labials and sides of the head; sides of the body below dark stripe, brownish, somewhat spotted; ventral surface white, immaculate except for four small spots on the chin shields and a suffusion of brown on the ventral surface of the tail.

MEASUREMENTS

Tip of Snout to Vent	34.0 mm.
Tip of Snout to Ear	7.5 "
Tip of Snout to Orbit	3.0 "
Greatest Width of Head	4.5 "

REMARKS.

The eight paratypes of this species in the collection differ only slightly in color. They all exhibit the dark band on either side of the head and body. In a few specimens there is some indication of a pale, narrow band dorsal to this dark stripe. In a few of the specimens there are a few flecks of dark brown on the dorsal surface, but these never form the dark spots found in the other species of the genus. This flecking is perhaps most distinct at the base of the tail.

There is very little variation in scutation. The scale counts of six of the paratypes (two others are badly damaged) is as follows:

Scales around the middle of the body average............27.0
(Max. 29. Min. 26.)
Scales from occiput to base of tail average............38.2
(Max. 39. Min. 37.)
Scales from 3d pair of chin shield to vent average 39.6
(Max. 40. Min. 39.)

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sonian Institution
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VOLUME III, NUMBERS 16-21
(Tropical Research Station Contributions 136-141)

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OCTOBER 1, 1923

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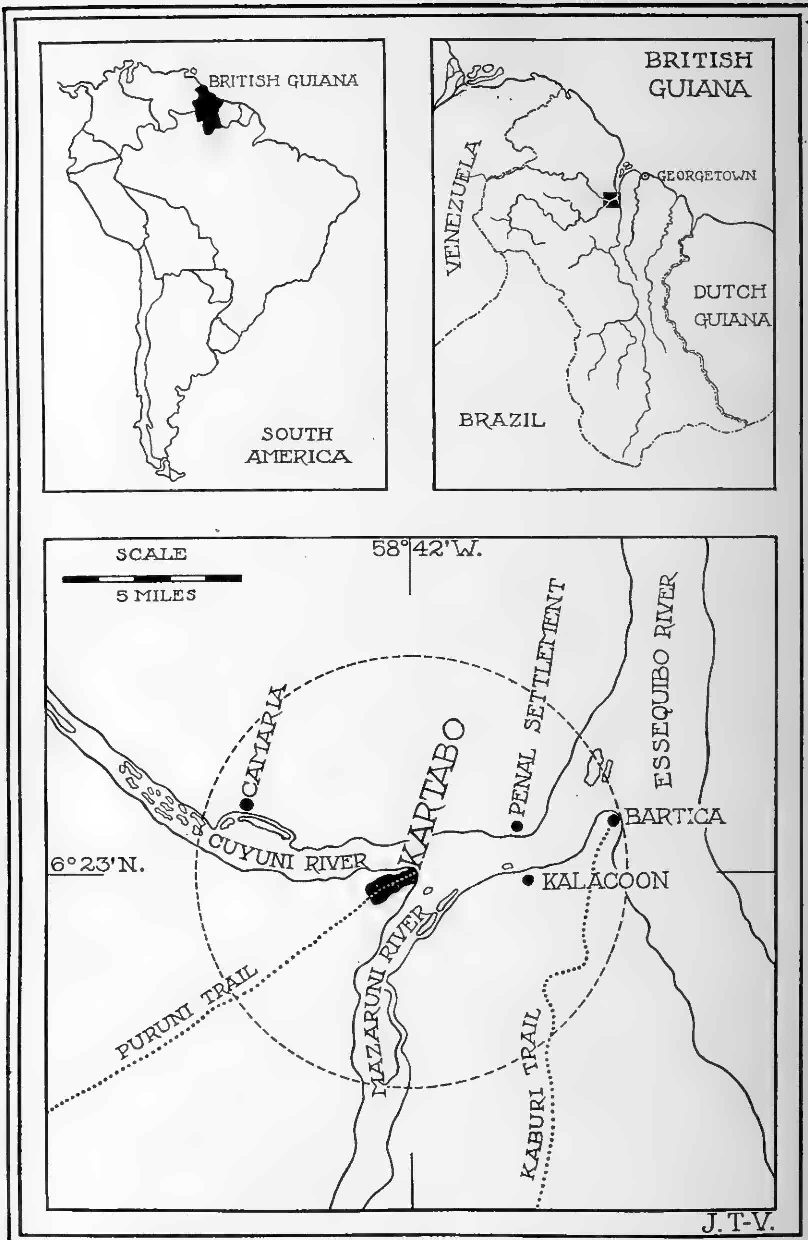

Fig. 27. LOCATION OF THE TROPICAL RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY

The circle represents a radius of six miles.

First form on press October 16, 1923

DESCRIPTIONES TERMITUM IN ANGLORUM GUIANA REPERTORUM*

By F. Silvestri.

(Plates XI-XV).

Eutermes parvellus

(Plate XI).

Femina alata.—Corpus castaneum clypeo isabellino, pronoto macula isabellina T-formi signato, mesonoti et metanoti parte antica isabellina, sternorum 1-6 parte mediana isabellina, pedibus rufescentibus, alis rufo-brunis.

Caput fere 1/4 longius quam inter oculos latius, supra setis sat numerosis brevibus et brevioribus instructum, fenestra perparva angustiore cum linea antica, clypeo bene inflato sat setoso, ejusdem dimidia parte c. 1/5 latiore quam longiore; oculis sat magnis, bene convexis, prominulis, ocellis parvis, ab oculis aliquantum minus quam ocelli diametros longitudinalis remotis, antennis 14-articulatis, articulo tertio quam secundus fere dimidio breviore et quam quartus parum longiore.

Pronotum subsemiellipticum, quam caput cum oculis 1/3 minus latum, medium antice haud sinuatum, spatio brevissimo sursum vergente, lateribus gradatim convergentibus, margine postico rotundato; meso- et metanotum lateribus gradatim aliquantum convergentibus, angulis posticis rotundatis, margine postico medio parum late et parum profunde inciso. Alae in superficie tuberculis percrebris 5-6 radiatis et setis brevibus sparsis instructa; venas vide Plate XI, 4, 5.

Pedes bene setosi; tibiae secundi paris setas vide Plate XI, 7.

Abdominis tergita et sternita setis numerosis brevibus et brevioribus, pleuris setis brevioribus sat numerosis instructis. Cerci breviores setas vide Plate XI, 8.

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* Tropical Research Station, Contribution No. 136.

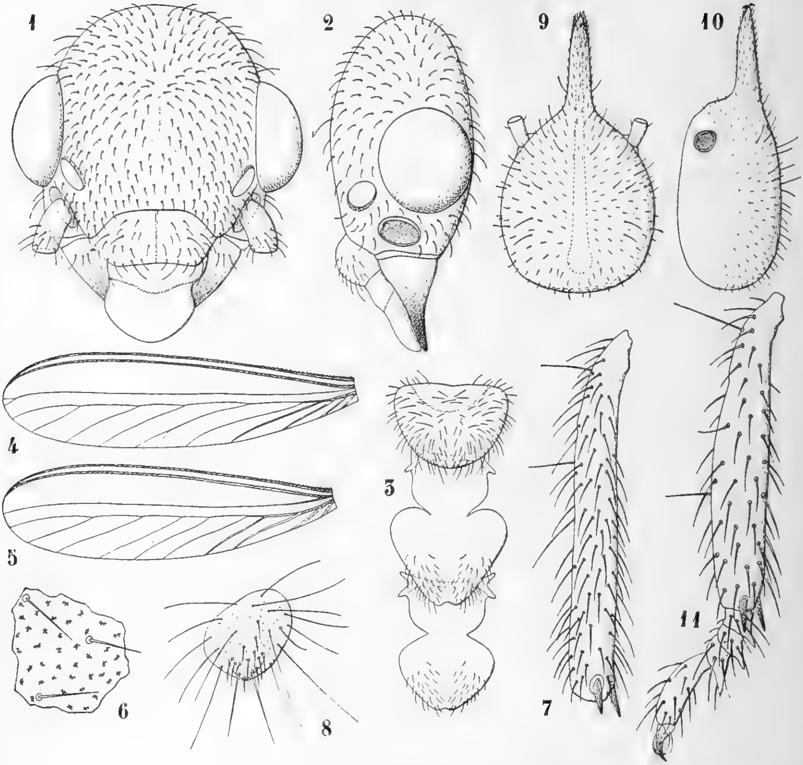

Plate XI. *EUTERMES PARVELLUS.*

1, feminae caput pronum; 2, idem lateraliter inspectum; 3, scuta thoracalia; 4, 5, alae; 6, alae particula multo ampliata; 7, tibia pedum paris secundi; 8, cercus; 9, 10, militis caput pronum et lateraliter inspectum; 11, militis pes paris secundi a tibia.

Long. corp. cum alis mm 8, sine alis 5, long. capitis 0,65, ejusdem lat. inter oculos 0,52, diametros longitud. oculi 0,28, long. antennarum 1,20, alae anticae 6,7, ejusdem lat. 1,7, long. tibiae III, 0, 78.

Mas. Feminae similis.

Miles. Corpus stramineum abdomine cibi contenti causa maxima pro parte cinereo.

Caput (Plate XI, 9-10) parum minus quam duplo longius quam latius, subovale, naso sat longo et sat attenuato, superficie setis brevioribus sat numerosis et setis nonnullis brevibus instructa, antennis 12-articulatis, articulo tertio quam secundus multo angustiore et c. 1/3 breviore, a quarto haud bene separato et quam idem aliquantum angustiore et eidem longitudine subaequali.

Pronoti lobus anticus parvus, margine medio paullum profunde sinuato, antice setis nonnullis spiniformibus instructus, postice setis 3+3 sat longis et nonnullis brevioribus; meso- et metanotum parce setosa lateribus rotundatis.

Pedes sat setosi; secundi paris vide Plate XI, 11, tarsorum articulis 1-3 apice infero elongato, acuto.

Abdominis tergita et sternita setis sat numeroris brevioribus et brevibus instructa. Cerci apice acuto instructi.

Long. corporis mm. 2,5, long. capitis 0,98-1,04, ejusdem lat. 0,56, long. nasi ab antennarum foveae margine antico mensi 0,39, antennarum 0,90, tibiae III, 0,52.

Operarius militi similis capite aeque longo atque lato, antennis 13-articulatis, articulo tertio a quarto vix distincto et quam secundus angustiore et c. dimidio breviore.

Long. corp. mm. 2,8-3, lat. capitis 0,58, long. antennarum 0,78, tibiae III, 0,38.

Observatio. Species haec ad *Eutermes microsoma* Silv. perproximum sed imaginis oculis parum majoribus et magis prominentibus, militum capite, praesertim naso, breviore facile distinguenda est; ab *Eutermes holmgreni* Banks militis capitis latitudine etiam distincta.

Habitat. Anglorum Guiana: Exempla vidi alata, nec non milites et operarios apud Kartabo cl. A. Emerson collecta, et milites et operarios cl. G. E. Bodkin lecta.

Hamitermes excellens sp. nov.

(Plate XII).

Femina alata. Corpus supra brunum clypeo latericio, ore et abdominis tergito ultimo rufescentibus, urosternitis lateraliter brunis, cetera superficie pallide isabellina, pedibus rufescentibus, alis brunis.

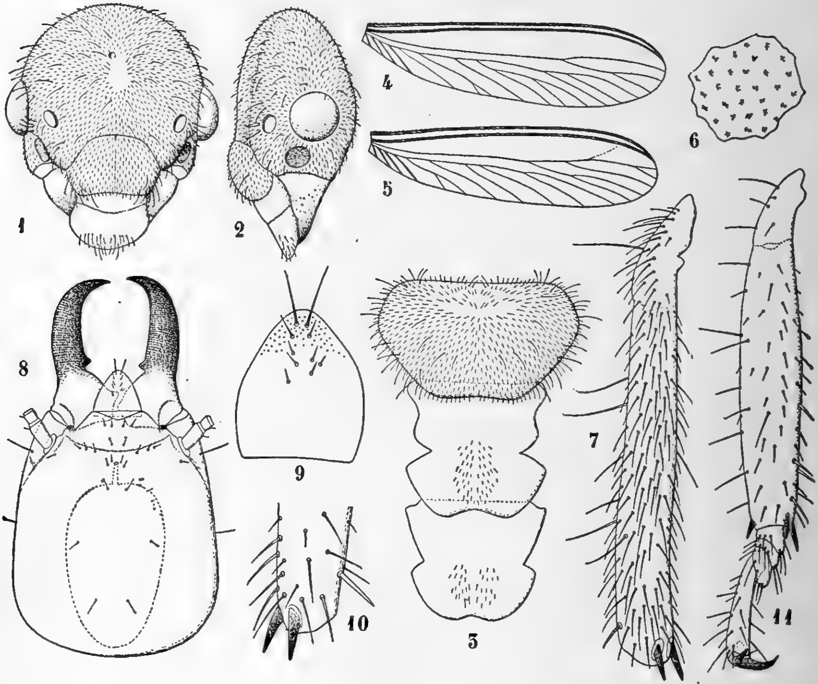

Plate XII. *HAMITERMES EXCELLENS* SP. NOV.

1, feminae caput pronum; 2, idem lateraliter inspectum; 3, scuta thoracalia; 4, 5, alae; 6, alae particula; 7, tibia paris secundi; 8, militis caput pronum; 9, ejusdem labrum; 10, militis tibia secundi paris postice inspecta; 11, militis pes primi paris a tibia.

Caput paullum longius atque inter oculos latius, supra setis brevibus et brevioribus numerosis instructum, fenestra magna subovali, parum longiore quam latiore, clypeo bene inflato et bene setoso, ejusdem dimidia parte c. 1/4 longiore quam latiore; oculis sat magnis, convexis, prominulis, ocellis parvis, ab oculis quam ocelli diametros longitudinalis parum minus remotis, antennis 15-articulatis, articulo tertio quam secundus c. dimidio et quam quartus c. 1/3 breviore, articulo quarto quam quintus parum longiore.

Pronotum quam caput cum oculis parum minus latum, medium antice haud sinuatum, brevi spatio sursum vergens lateribus parum longe ab angulo antico multo convergentibus margine postico subrecto, meso- et metanotum lateribus aliquantum convergentibus, margine postico medio late et parum profunde sinuato, angulis posticis rotundatis.

Alae superficie setis brevioribus sparsis et aliis per venas dispositis et tuberculis percrebis 5-6 radiatis instructa; venas vide Plate XII, 4, 5.

Pedes bene setosi, secundi paris tibiis, praeter calcaria duo interna, seta spiniformi parum robusta praeapicali externe aucta.

Abdominis tergita et sternita setis pernumerosis brevioribus et setis brevibus instructa. Cerci breviores, bene setosi.

Long. corp. cum alis mm 12, sine alis 6,8, long. capitis 1,23, ejusdem lat. inter oculos 1,17, diametros long. oculi 0,39, long. antennarum 1,68, alae anticae 10,2, ejusdem lat. 2,7, long. tibiae III, 1,38.

Mas feminae similis.

Miles. Corpus cremeum vel ochroleucum capite ferrugineo, mandibulis parte distali nigrescente, abdomine cibi contenti causa cinereo.

Caput parum longius quam latius, late convexum, lateribus partem anticam versus parum convergentibus, angulis posticis rotundatis, superficie supera setis paucis instructa, fontanella labro subsemielliptico, paullum longiore quam ante basim latiore, basi ipsa parum angustiore, setas vide Plate XII, 8, mandibulis quam capitis latitudo aliquantum brevioribus, dente sat magno ad basim partis distalis instructis, parte apicali bene arcuata, attenuata, antennis 15-articulatis, articulo tertio quam secundus et quam quartus 1/3 breviore, articulo quarto quam quintus parum breviore, in antenna nonnulla a tertio haud bene separato.

Pronotum quam capitis latitudo c. dimidio minus latum, lobo antico sursum vergente, medio parum sinuato, margine postico subrecto, lateribus rotundatis, superficie supera setis nonnullis sat longis et brevibus instructa, lobi antici superficie antica setis nonnullis brevissimis sat robusti instructa; meso- et metanotum lateribus rotundatis, supra setis nonnullis sat longis et brevibus praesertim posticis instructa.

Pedes sparse setosi, primi paris tibiis setis nonnullis internis robustis, secundi paris tibiis etiam seta spiniformi attenuata externa instructa.

Abdominis tergita et sternita setis sat longis sat numerosis et setis nonnullis brevibus et brevioribus instructa. Cerci articulo secundo quam primus c. 1/3 longiore, conico, acuto, setis consuetis.

Long. corp. (cum mandibulis) mm 6, long. capitis (sine mandibulis) 2,10, ejusdem lat. 1,76, long. antennarum 2, mandibularum 1,28, tibiae III, 1, 32.

Operarius. Corpus cremeum capite ochroleuco, abdomine cibi contenti causa cinereo.

Caput fere 1/9 latius quam longius, supra setis sat longis et brevibus instructum, clypeo sat inflato ejusdem dimidia parte paullum longiore quam latiore, antennis 15-articulatis, articulo tertio quam secundus c. dimidio et quam quartus parum breviore.

Thorax et abdomen eisdem militis similia.

Long. corp. mm 5, long. capitis 1,10, ejusdem lat. 1,8, long. antennarum 1,30, tibiae III, 1,10.

Habitat. Anglorum Guiana: exempla alata et militem et operarium ad Kartabo (ab A. Emerson) lecta et exempla alia ad Potaro a Bodkin vidi.

Observatio. Species haec magnitudine et militis forma ab *Ham. hamifer* Silv. distinctissima est.

Capritermes bodkini sp. nov.

(Plate XIII.)

Nympha feminilis. Corpus stramineum.

Caput aliquantum longius quam inter oculos latius, supra setis paucis brevibus instructum, oculis parvis, fuscis, parum prominentibus, antennis 16-articulatis, articulo tertio divisionem proximalem vix distinctam monstrante, secundum longitudine aequante et quam quartus vix longiore.

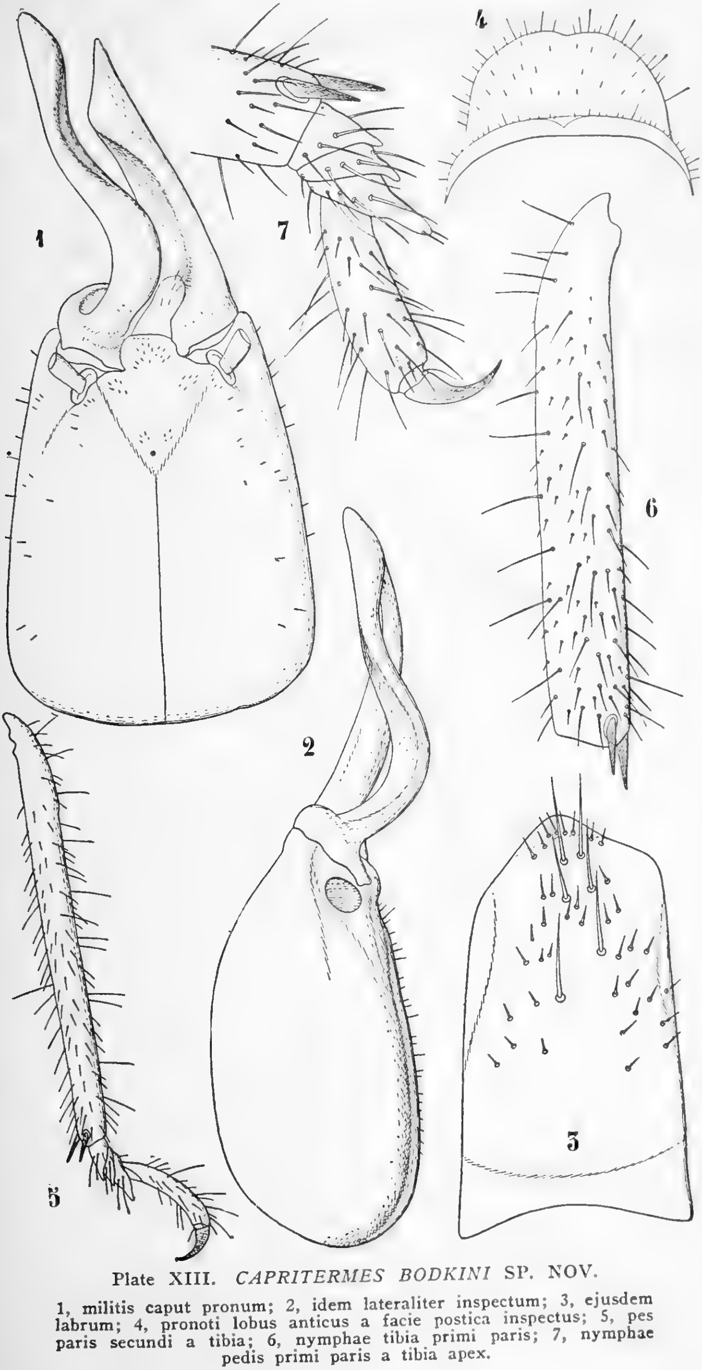

Plate XIII. *CAPRITERMES BODKINI* SP. NOV.

1, militis caput pronum; 2, idem lateraliter inspectum; 3, ejusdem labrum; 4, pronoti lobus anticus a facie postica inspectus; 5, pes paris secundi a tibia; 6, nymphae tibia primi paris; 7, nymphae pedis primi paris a tibia apex.

Pronotum quam caput cum oculis c. 1/5 minus latum, postice aliquantum late et parum profunde sinuatum. Appendices alares long. mm 2,4.

Pedes primi paris (Plate XIII, 7) ut ceteri calcaribus duobus instructi, parce setosi.

Long. corp. mm 8, long. capitis 1,62, ejusdem lat. inter oculos 1,35, long. antennarum 3, tibiae III, 2,2.
Miles. Corpus ochroleucum capite ochroleuco vel ochraceo mandibulis nigris. Caput fere 1/4 longius quam postice latius supra parce convexum lateribus partem posticam versus gradatim parum divergentibus, labro (Plate XIII, 3) subrectangulari apice subtriangulari, parum minus quam duplo longiore quam latiore, setis paucis brevibus distalibus et setis sat numerosis brevissimis instructo, mandibula laeva quam caput parum breviore, forma vide (Plate XIII, 1-2), mandibula dextera quam laeva aliquantum breviore, apice triangulari acuto, antennis 16-articulatis, articulo tertio secundum longitudine aequante et quam quartus paullum breviore.

Pronotum quam caput c. dimidio minus latum, lobo antico magno, margine supero medio parum inciso, facie antica setis brevissimis conicis sat numerosis, margine supero setis nonnullis brevibus et brevioribus, facie postica setis nonnullis brevioribus instructa; mesonotum postice subrotundatum, metanotum margine postico late et sat profunde sinuato.

Pedes longi, parce setosi, primi paris ut ceteri calcaribus duobus armati.

Abdominis tergita setis sat numerosis brevibus et sternita etiam setis sat numerosis brevioribus instructa. Cerci bene setosi, parte apicali longiuscula attenuata.

Long. corp. mm 11, long. capitis 3,8, ejusdem lat. 3, long. mandibulae laevae 3, antennarum 4,2, tibiae III, 3.
Operarius. Corpus ochroleucum, abdomine cibi contenti causa cinereo.

Caput subaeque longum atque latum, fenestra magna, setis nonnullis brevioribus instructum, clypeo bene inflato, antennis

16-articulatis articulo tertio nudo a quarto haud bene separato, quam secundus 1/3 breviore et quartum longitudine subaequante.

Thorax et abdomen eisdem militis similia.

Long. corp. mm 5,5, long. capitis 1,35, long. antennarum 2,20, tibiae III, 2.

Habitat. Anglorum Guiana: Potaro River (Bodkin legit. Dec., 1915).

Observatio. Species haec pedibus primi paris calcaribus duobus tantum instructis, militis capitis et labri forma, pedum longitudine distinctissima est.

***Capritermes bodkini* Silv. *modestior* var. nov.**

(Plate XIV.)

Femina alata. Caput et thoracis tergita luride testacea, clypeo aliquantum pallidiore, abdominis tergita rufescentia, sternita ochraceo-ferruginea, pedibus testaceo rufescentibus, alis? (in exemplo typico abruptis).

Caput parum longius (c. 1/11) quam inter oculos latius, supra setis sat numerosis minimis et nonnullis brevibus, fenestra magna, obcordiformi, bruna, prominula, clypeo parum inflato transverse subrectangulari ejusdem dimidia parte aliquantum latiore quam longiore; oculis sat magnis, bene convexis, ocellis sat parvis ab oculis ocelli dimidia longitudine distantibus, antennis?-articulatis (in exemplo typico haud integris, articulis 12-sistentibus), articulo tertio secundo subaequali et quam quartus paullum longiore.

Pronotum quam caput cum oculis aliquantum minus latum, parum magis quam duplo latius quam longius, medium antice vix sinuatum, brevi spatio sursum vergente, angulis anticis late rotundatis, lateribus aliquantum convergentibus, angulis posticis late rotundatis, margine postico late et parum profunde sinuato; meso- et metanotum lateribus postice aliquantum convergentibus, margine postico parum late et aliquantum profunde sinuato, angulis posticis obtusis.

Alae? (abruptae).

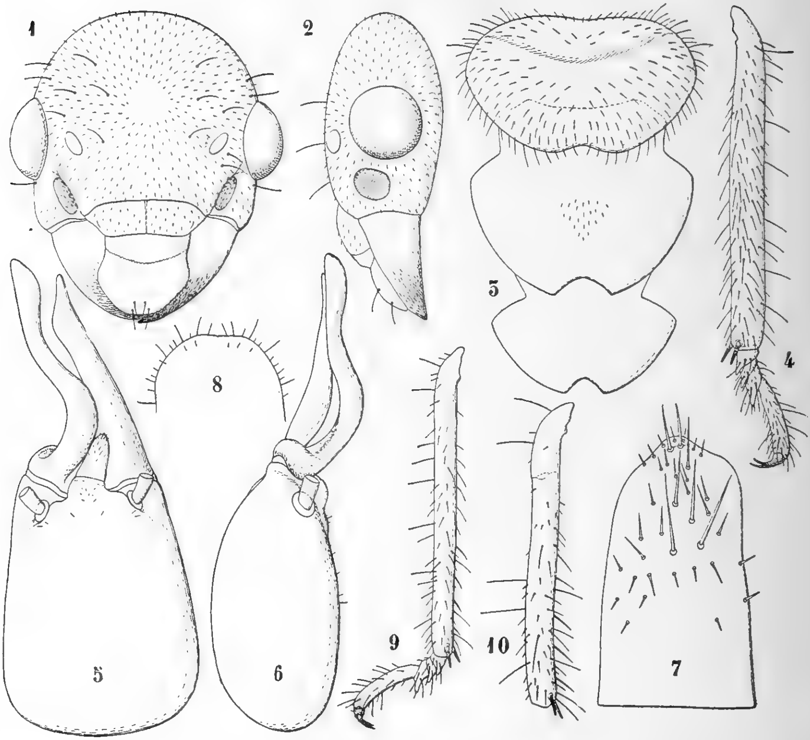

Plate XIV. *CAPRITERMES BODKINI* SILV. *MODESTIOR* VAR. NOV.

1, feminae caput pronum; 2, idem lateraliter inspectum; 3, scuta thoracalia; 4, pes paris secundi a tibia; 5, militis caput pronum; 6, idem lateraliter inspectum; 7, ejusdem labrum; 8, militis pronoti lobus anticus postice inspectus; 9, militis pes secundi paris a tibia; 10, operarii tibia primi paris.

Pedes bene setosi, tibiae setis internis sat robustis.

Abdominis tergita et sternita setis pernumerosis brevioribus et setis brevibus nonnullis instructa. Cerci breviores, bene setosi.

Long. corp. cum alis ?, sine alis 9, long. capitis 1,70, ejusdem lat. inter oculos 1,56, diametros long. oculi 0,59, long. antennarum ? , alae anticae ? , ejusdem lat. ? , long. tibiae III, 2.

Miles. Corpus stramineum, capite cremeo, mandibulis nigris.

Caput 1/6 longius quam postice latius, supra parce convexum, lateribus a parte antica ad posticam aliquantum divergentibus, labro subrectangulari, apice tantum subtriangulari parum minus quam duplo longiore quam postice latiore, parte distali supra setis nonnullis brevioribus et aliis brevissimis instructa, mandibula laeva capitis longitudinem aequante, forma vide (Plate XIV, 5-6), mandibula dextera quam laeva aliquantum breviore apice triangulari, antennis 16-articulatis, articulo tertio quam secundus c. 1/4 breviore et quam quartus parum longiore.

Pronotum quam capite c. dimidio minus latum, lobo antico magno, margine supero late rotundato medio vix inciso, facie antica setis brevissimis conicis sat numerosis, margine supero setis nonnullis brevibus et brevioribus, facie postica setis nonnullis brevioribus instructa, mesonotum postice vix sinuatum, metanotum late et sat profunde sinuatum.

Pedes longi, parce setosi, secundi paris vide (Plate XIV, 9).

Abdominis tergita et sternita setis nonnullis brevibus et aliis parce numerosis brevioribus vel (in dorso) brevissimis instructa. Cerci apice subconico longiusculo.

Long. corp. mm 10, long. capitis (sine mandibulis) 3, ejusdem lat. 2,5, long. antennarum 3, 6, mandibulae laevae 3, tibiae III, 2,5.

Operarius. Corpus stramineum, abdomine cibi contenti causa cinereo.

Caput c. 1/6 longius quam latius, ad antennas latius, supra seta nonulla breviore instructo, clypeo bene inflato, ejusdem dimidia parte parum latiore quam longiore, antennis 15-articulatis, articulo tertio quam secundus aliquantum angustiore et parum breviore, quam articulus quartus haud longiore et parum angustiore.

Thorax et abdomen ejusdem militis similia.

Long. corp. mm 4, long. capitis 1, ejusdem lat. 1,24, long. antennarum 1,85, tibiae III, 2,4.

Habitat. Anglorum Guiana: exempla typica ex Kartabo ab A. Emerson lecta.

Syntermes parallelus sp. nov.

(Plate XV).

Femina alata. Corpus castaneum, capitis parte antica testacea, mandibulis praeter apicem nigrum testaceis, thoracis pleuris et sternitis testaceo-latericiis areis avellaneis interruptis, antennis pedibusque testaceis, alis fuligineis, abdominis ventre ochraceo.

Caput subaeque longum atque inter oculos latum, supra setis paucioribus sparsis instructum, fenestra magna, circulari, clypeo convexiusculo, ejusdem dimidia parte fere 1/5 latiore quam longiore, oculis sat parvis valde convexis, ocellis (capite prono) ab oculis quam oculi diametros longitudinalis parum minus distantibus, antennis 19-articulatis, articulo secundo quam tertius haud vel paullum breviore et quam quartus aliquantum longiore.

Pronotum quam caput cum oculis vix minus latum, medium antice paullum, postice aliquantum sinuatum, angulis anticis acutis haud productis, angulis posticis late rotundatis, meso- et metanotum postice lateribus parum convergentibus, mesonoti margine postico latissime, metanoti vix sinuato.

Alae superficie setis brevioribus numerosis vestita; venas vide Plate XV, 4-5.

Pedes setuloli, tibiae latere interno setis brevibus sat robustis numerosis instructo, calcaribus apicalibus elongatis.

Abdominis tergita setis nonnullis praesertim posticis, sternita setis numerosis brevioribus instructa.

Long. corp. cum alis mm 29, sine alis 17, long. capitis cum mandibulis 3,7, sine mandibulis (labro excluso) 2,8, ejusdem lat. inter oculos 2,6, diametros longitudinalis oculi 0,59, long. antennarum 5, alae anticae 24,5, ejusdem lat. 5,8, long. tibiae III, 4.

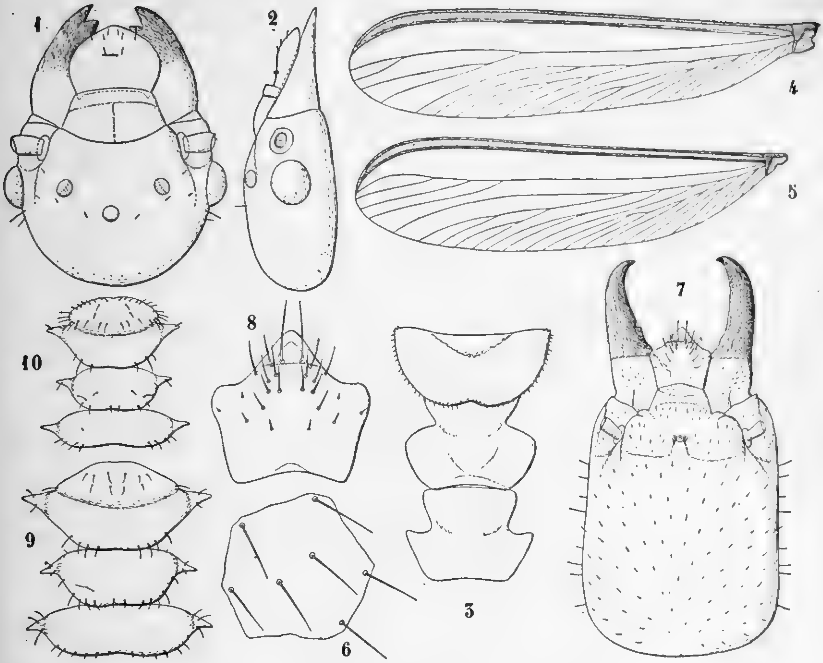

Plate XV. *SYNTERMES PARALLELUS* SP. NOV.

1, feminae caput pronum; 2, idem lateraliter inspectum; 3, scuta thoracalia; 4, 5, alae; 6, alae particula multo ampliata; 7, militis caput pronum; 8, ejusdem labrum; 9, militis scuta thoracalia; 10, operarii scuta thoracalia.

Mas ignotus.

Miles. Corpus fulvo-testaceum capite ochraceo-ferrugineo, mandibulis parte distali nigra.

Caput c. 1/3 longius quam latius lateribus parallelis, angulis posticis late rotundatis, setis brevioribus paucis sparsis instructum, supra pone fontanellam bene convexum, antice a fontanella ad labrum discendens et utrimque ad antennas aliquantum inflatum, fontanella supra tuberculum minimum tubiformem sita. Labrum (deplanatum) parum latius quam longius, antice angustatum, subtriangulare, utrimque ad partis triangularis basim excisum, lateribus ceteris postice parum convergentibus, setis vide (Plate XV). Mandibulae sat robustae, quam capitis latitudo c. 2/9 breviores, dextera dente minimo ad partis distalis basim, laeva a dente sat magno et dentibus duobus minimis, praeter basalem, armata, parte distali attenuata, apice breviter arcuato, acuto. Antennae 19-articulatae, articulo secundo quam tertius vix et quam quartus aliquantum longiore, articulo decimo duplo latiore quam longiore.

Scuta thoracalia in processum lateralem brevem (metanoti mm 0,48) acutum, spiniformem, extrorsum et aliquantum sursum vergentem producta; pronoti lobus anticus margine medio vix sinuato.

Pedes longi, breviter setosi.

Abdomen tergitis setis paucis praesertim posticis, sternitis setis sat numerosis intructis.

Long. corp. mm 12, long. capitis cum mandibulis 6,8, sine mandibulis 4,5, antennarum 4,6, tibiae tertii paris 3, lat. metanoti cum spinis 2,5.

Operarius major. Corpus fulvo-testaceum antennis latericiis, abdomine cibi contenti causa fusco-cinereo. Caput subaeque longum (mandibulis exclusis) atque latum lateribus postice parum convergentibus, fenestra circulari manifesta, supra setis paucioribus sparsis instructum, clypeo subplano setis 3-4 instructo; antennis 19-articulatis, articulo secundo quam tertium haud vel vix breviore et quam quartus aliquantum longiore, articulo decimo magis quam duplo longiore quam latiore.

Scuta thoracalia in processum lateralem brevem (metanoti mm 0,20) acutum, spiniformem producta; lobus anticus margine medio vix sinuato.

Abdomen tergitis setis paucis praesertim posticis, sternitis setis sat numerosis intructis.

Long. corp. mm 8, lat. capitis 2,6, long. antennarum 6, tibiae paris tertii 2,6, metanoti lat. 2.

Operarius minor. Corpus ochroleucum, abdomine cibi contenti causa cinereo.

Caput parum latius quam (mandibulis exclusis) longius fenestra magna, antennis 18-articulatis, articulo secundo quam tertius haud vel parum breviore et quam quartus paullum longiore.

Scuta thoracalia in processum lateralem perbrevem (metanoti mm 0,12) acutum producta.

Long. corp. mm 7, lat. capitis 1,9, long. antennarum 3,5, tibiae paris tertii 2, metanoti lat 1,56.

Habitat. Anglorum Guiana: Cattle Trail Survey, Canister Falls VI. 1920. A. A. Abraham legit.

Observatio. Species haec ad *S. molestus* Burm. proxima est, sed magnitudine majore, corporis et alarum colore, militis capitis forma et spinis thoracalibus bene distincta est.

NEW GENERA AND SPECIES OF TERMITOPHILOUS COLEOPTERA FROM NORTHERN SOUTH AMERICA*

By WILLIAM M. MANN.
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(Figs. 28-40)

Mr. Alfred Emerson has had the kindness to loan me for study a most remarkable series of beetles that he collected in termite nests, chiefly at the Tropical Research Station at the New York Zoological Society at Kartabo, British Guiana, but containing also several species from Trinidad.

The present paper includes merely descriptions of some of the forms It is intended at a later date, to publish a more extended account of these, together with descriptions and notes of others.

Holotypes of the new species have been deposited in the U. S. National Museum collection.

The accompanying habitus drawings have been made by Mr. Robert E. Snodgrass, Mr. Harry B. Bradford and Miss Julia Ellen Edmonson.

Family—STAPHYLINIDAE
Subfamily—ALEOCHARINAE
Tribe—COROTOCINI

Spirachtha mirabilis sp. nov.

(Fig. 28)

Female.—Length 2-2.50 mm. Membranous portions white, in some of the larger specimens irregularly infuscated; chitin on abdomen and tarsi pale brown, on head and thorax darker brown, antennae and legs black. Feebly shining.

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* Tropical Research Station, Contribution Number 137.

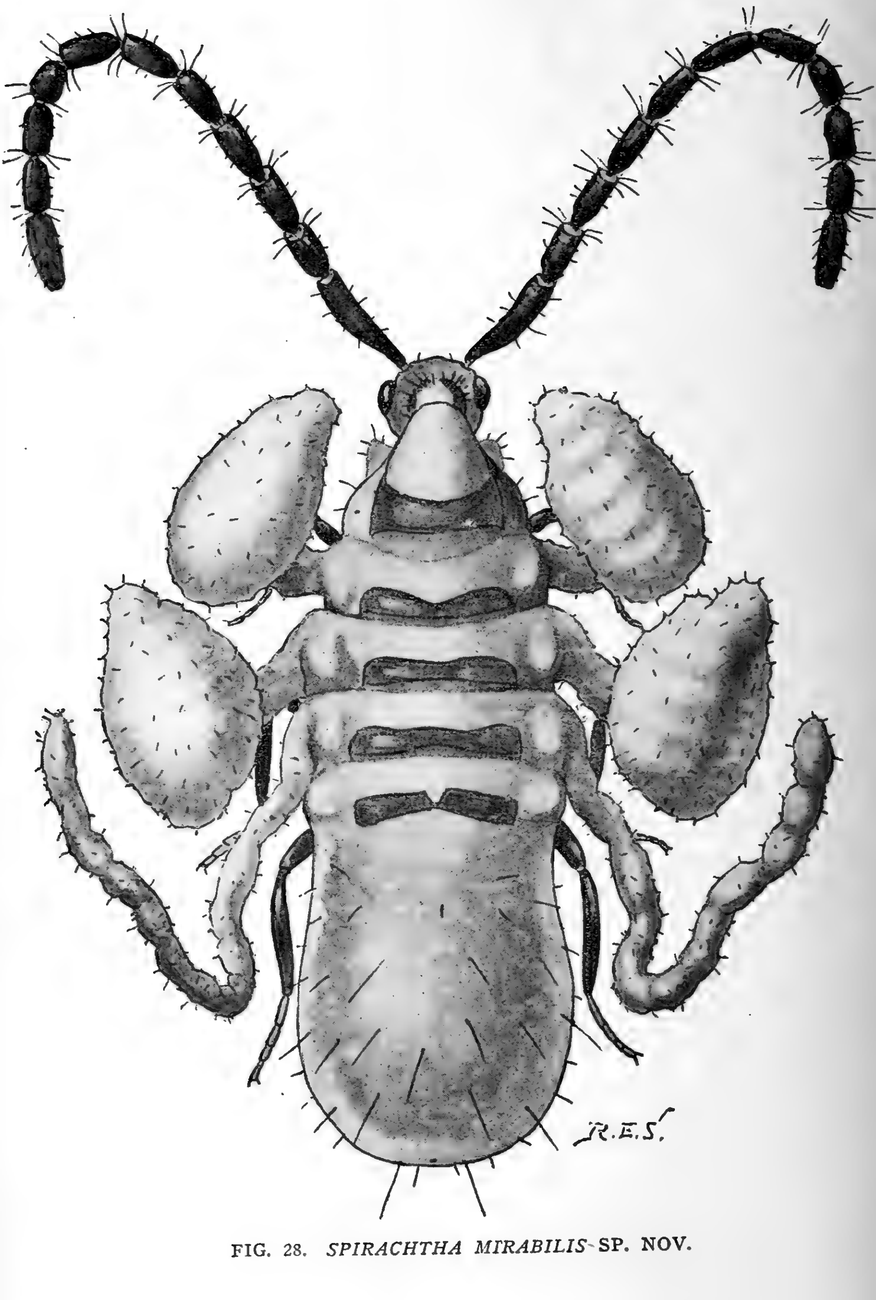

FIG. 28. *SPIRACHTHA MIRABILIS* SP. NOV.

Basal abdominal segment, the central surface of thorax and the appendages with erect hairs, which are pale yellow in color and longer on the abdomen and more sparse and black elsewhere.

Head about as long as broad, barely broader in front than behind, with a narrow median impressed submembranous area for nearly the length of front; sides posterior to eyes moderately convex; anterior border of front truncate; clypeus transverse, broadly concave at anterior border. Eyes one-third as long as sides of head, situated at front of sides. First antennal joint nearly as long as head, slender at base then gradually thickened and feebly sinuate to apex; second joint longer than broad and distinctly longer than the third; third joint twice as long as broad, joints 4-10 elongate, each a little shorter than the one preceding; terminal joint a little thicker than the others, and one and two-thirds times as long as the penultimate. Pronotum transverse, surface evenly and feebly convex, sides rounded, anterior and posterior borders broadly arcuate; separated from head by a membranous collar and with a smaller membranous pad visible at each side of the posterior border. Scutellum large, broadly triangular. Elytra together broader than long, separated for their entire length, posterior angles narrowly rounded, posterior borders nearly straight and strongly oblique. Abdomen nearly covering the remainder of body, second and third segments strongly inflated, rounded at apex; segments 3-7 with narrow transverse bands of chitin above; segments 4, 5, 6 with massive, constricted exudatorial developments, those on segments 5-6 terminating as large irregular masses, tuberculate and each tubercle bearing a stiff hair; on the fourth segment long, irregularly cylindrical, sharply bent at middle and with numerous constrictions, not as distinctly tuberculate as the other two pair Legs short and rather stout

Host.—Nasutitermes (*Constrictotermes*) *cavifrons* (Holmgren).

Type-locality.—Kartabo, British Guiana.

Differs from *S. eurymedusa* Schiödte in its longer head, the first antennal joint is less thickened and less arcuate, the pronotum lacks the broad, posterior membranous band, the elytra are separated for their entire length and their posterior borders are much more strongly oblique. The large masses at the ends of the two posterior pairs of exudatoria are characteristic. In *eurymedusa* they are slender and similar in form to the other pair and the posterior pair has one strong constriction instead of many feeble ones. The amount of membranous structure on the pronotum is variable in *mirabilis* and probably also in *eurymedusa.*

Spirachtha schiödtei sp. nov.

Female.—Length 1.50 mm.—Membranous portions white; chitin on abdomen pale brown, on head, thorax and appendages darker. Moderately shining, finely coriaceous.

Erect, stiff yellowish hairs scatered on abdomen (except on chitinous plates). Fine, black, semi-recumbent hairs on head, thorax and appendages.

Head a little broader than long; median membranous area broader than in *mirabilis;* front broadly impressed. Antennae stout, first joint nearly as long as the head, suddenly thickened near base and only slightly and very gradually enlarged toward tip, two and one-half times as long as the second joint; second joint as long as the third, less than twice as long as broad, narrow at base; joints 4-10 subequal, a little longer than broad; terminal joint one and two-thirds times as long as the penultimate. Pronotum broader than long, widest in front of middle. Elytra together broader than long, posterior corners projecting and narrowly rounded. Abdomen recurved as in *eurymedusa* and *mirabilis* but (in the majority of the specimens) extending only to anterior third of pronotum; exudatoria well developed, the anterior two pair constricted at middle into two portions; subequal in length, the apical part somewhat pear-shaped, not tuberculate but beset with bristles similar to those on second and third abdominal segments; posterior pair of exudatoria similar but with three "joints," the middle of which is small and the terminal a little larger than on the others. Legs a little more slender than in *mirabilis.*

Host.—*Nasutitermes* (*Constrictotermes*) *cavifrons* (Holmgren).

Type-locality.—Kartabo, British Guiana.

Other locality.—Kalacoon, British Guiana.

This is very distinct from the preceding species in its much smaller size, more robust antennae, broader head with more strongly impressed front and in the radically different structure of the abdominal exudatoria.

One specimen in a vial with a series of the females represents a phase of the male of this species. The structure of the head and thorax is similar to that of the female, except the median membranous band on the head is much narrower. The elytra are separated for their entire length (in the female of *schiödtei* they are connate as in *eurymedusa*) and less narrowed at the tips. The abdomen is small, entirely chitinized, compressed dorso-ventrally and margined at sides, quite a typical Staphylinid abdomen. The antennae of the specimen are broken but the basal joint is proportionately shorter than in the other specimens.

Among the series with inflated abdomens there is some variation in the length of the antennal joints and in individuals cleared in xylol I have noted differences in the internal chitinous structures in the terminal abdominal segments, which indicates that both sexes are present. So the one that I take for the male may be a phase in the imaginal development of the female. In fully developed specimens it is probable that both sexes are very similar in habitus.

It appears certain that we have two species of *Spirachtha* living in the same locality with the same host termite, another character similar to that of *Corotoca*, which Schiödte records in the same manner.

Corotoca guyanae sp. nov.

Female.—Length (in alcohol, with abdomen recurved) 2.60 mm.

Chitinous portion dark brown, except on median abdominal segments, where it is higher; lateral part of gaster yellow. Shining and every finely coriaceous.

Erect hairs fine on head, thorax and elytra, course on abdomen and shorter on appendages; one pair on vertex, numerous on ventral surface of head; scattered and sparse on thorax and elytra; abundant on gaster and arranged in three rows on each dorsal band, more scattered on the sides.

Head, excluding eyes, a little longer than broad, front shallowly impressed and, between eyes, with a v-shaped suture and a median vertical impression extending about one-third the length of head. Clypeus transverse, broadly concave at anterior border. Eyes large and convex, occupying two-thirds the sides of head. First antennal joint elongate, clavate, concave at outer border, about two-thirds as long as head; second joint half as long as the third, which is three times as long as broad, remaining joints gradually shorter, the penultimate about twice as long as broad; apical joint slender, shorter than the two preceding joints together. Pronotum a little broader than long, separated from head by a membranous collar, anterior border broadly concave; sides very broadly and obtusely angulate at anterior third, straight and moderately convergent posterior to this; surface trifoveolate, the anterior pair of foveae more elongate and less impressed than the posterior, median one; surface between the impressions low and rounded. Elytra together broader than long, sides nearly straight, posterior angles narrowly rounded, posterior border convex. Abdomen greatly inflated and projected forward; apical segment completely chitinized, penultimate segment chitinized on apical half, remaining segments (visible from above) largely membranous, each with a narrow chitinous band. Legs slender, posterior tibiae slender.

Host.—*Nasutitermes* (*Constrictotermes*) *cavifrons* (Holmgren).

Type-locality.—Kartabo, British Guiana.

Described from seven specimens taken from several nests of the host species.

C. guyanae resembles *C. melantho* Schiödte in having the front foveolate, and *C. phyllo* Schiödte in having the disc of pronotum trituberculate and the posterior tibiae linear instead of fusiform. It differs from *phyllo* in its broader pronotum, the much less pronounced tubercles and from both of the described species in the shape of the elytra, which have the outer, posterior angles broader and not acuminately produced. The maxillary palpi are markedly different in *guyanae*, the third joint instead of being thickly oval and about as long as the second, is greatly enlarged, nearly three times as long and twice as broad as the second.

Thyreoxenus gen. nov.

Female.—Small, robust species, largely membranous, abdomen strongly inflated and permanently projected over meso- and metanotum. Head very small, broader than long, not constricted behind. Labrum membranous, broad, rather narrowly concave at middle of anterior border. Mandibles small, slender, arcuate, acute at tips. Mentum broad, trapezoidal, nearly straight in front. Maxillary palpi 4-jointed, basal joint small, second joint slender, third joint thicker and oval, terminal joint small, awl-shaped. Ligula short and broad, indistinctly bilobed. Labial palpi 3-jointed. Antennae 11-jointed, first joint scapiform, remaining joints (except the apical) short; apical joint elongate, its sides parallel to near apex, then converging into a short, connate tip. Eyes small, oval, situated at sides of head. Prothorax large and convex, three times as broad as head and partly enveloping it in front; membranous except for a transverse chitinous plate on anterior half of dorsum and very narrow lateral bands that connect it with a transverse band on the sternum; dorsal plate divided at middle by a longitudinal incision, which does not extend to the anterior or posterior borders; prosternum with a median, elongate, lobe-like membranous production. Meso- and metasternum strongly chitinized, not separated by a suture, elongate, subquadrate, obtusely carinate at middle, the carina terminating anteriorly in a flat, triangular area; posterior border projecting as a broad, obtuse triangle between the posterior coxi. Elytra small, strongly divergent posteriorly, each about twice as long as broad, with straight, subparallel sides, posterior border oblique, with corners rounded. Wings reduced to elongate, oval, pad-like vestiges. Abdomen strongly inflated, elevated and projected forward, five ventral segments visible from above; dorsal sclerites (not visible except when gaster is straightened) chitinized; ventral sclerites largely membranous but with thinly chitinous plates in front at middle; apical and penultimate sclerites chitinous, between them with a large, rounded collar-like membranous inflation.

Legs short and rather stout, femora irregularly constricted at middle. Tarsi 4-4-4 jointed; metatarsi short. Anterior and middle coxi widely separated, elongate, conical; posterior coxi less widely separated and shorter.

Male.—Similar in form to female, but smaller and more slender, with the chitin on the ventral (upper) abdominal sclerites limited to well defined, transverse bands at the anterior border of each segment except the terminal, which is chitinous throughout.

Genotype.—Thyreoxenus parviceps, sp. nov.

Though evidently a member of the tribe Corotocini *Thyreoxenus* in an aberrant genus, even in this aberrant tribe, and sharply distinct from the others in the structure of the abdomen, the unusual development of the membranous areas, in the collar-like development near the tip of the abdomen and especially in its very small head.

It is represented in the collection by three species, two small and largely white in color and one large form with dark brown pigmentation over nearly the entire body. Each appears to be a guest of a different species of Nasutitermes.

Thyreoxenus parviceps sp. nov.

Length.—(In alcohol) 2.50-2.75 mm.

Membranous portion white; chitin of head, pronotum and the femora and tibia dark brown, elsewhere pale brown tarsi white. Appendages and abdomen with rather short, erect black hairs, their points of insertion on the abdomen marked by small, fuscous dots.

Head a little broader than long, sides behind eyes nearly straight. Eyes occupying anterior half of sides of head. Basal antennal joint as long as the four following joints together;

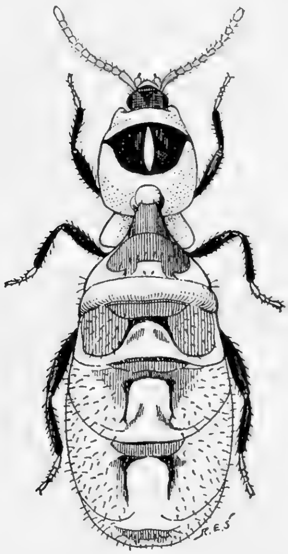

FIG. 29. *THYREOXENUS PARVICEPS* SP. NOV.

joints 2-10 subequal, only slightly larger apically, a little broader than long; terminal joint a little shorter than the two preceding joints together. Median membranous projection of mesosternum longer than broad (seen from behind) and rounded at apex; from beneath, about twice as broad as long. Posternum transversely impressed posterior to middle. Chitinous bands on upper (ventral) abdominal sclerites narrow, arranged in three sided figures.

Host.—*Nasutitermes* (*nasutitermes*) *costalis* (Holmgren).
Type-locality.—St. Joseph, Trinidad.
Other localities.—Georgetown and Kartabo, British Guiana.

Thyreoxenus pulchellus sp. nov.

(Fig. 30)

Female.—Length 2.50 mm.

Differing from *Th. parviceps* in the arrangement of the chitinous areas on the upper surface of the abdomen; the penultimate segment is evenly chitinous, the third (from the apex)

FIG. 30. *THYREOXENUS PULCHELLUS* SP. NOV.

is chitinous at the sides and in front and membranous at middle, the latter portion not bordered by a strongly chitinized margin; the fourth segment is thinly chitinous, except for a narrow, median surface rounded in front; the fifth segment is still more thinly chitinized except in front and the median, entirely membranous portion is oval in shape; the last segment (visible from above) has a transverse bar in front, similar to *parviceps*. The collar-like, membranous projection between the apical and penultimate segments is proportionately larger than in the other species.

Host.—*Nasutitermes* (*Nasutitermes*) *ephratae* (Holmgren).

Type-locality.—Kartabo, British Guiana.

Thyreoxenus major sp. nov.

Length.—(In alcohol) 3 mm.

Larger and more robust than *parviceps* and much darker in color, with the upper surface of the abdomen brown and the second, third and fourth (from the apex) segments each with a large, quadrate median blotch considerably darker than the rest. Sides of prothorax thinly chitinized and infuscated.

Head subopaque; chitinized portions of thorax and abdomen shining. Median plate on pronotum with sparse, fine, erect hairs, much shorter than those on abdomen. Hairs on abdomen long, rather stiff and erect. Sides of prothorax uneven, impressed at middle, roundly tuberculate in front. Membraneous collar-like process on abdomen nearly absolete. Each segment of the abdomen (above) broadly impressed posteriorly to the front border; front borders elevated at middle into a rather coarse and blunt carina, which is distinctly lighter in color than the surrounding surface.

Host.—*Nasutitermes* (*Nasutitermes*) *guayanae* (Holmgren).

Type-locality.—Kartabo, British Guiana.

Described from a unique specimen.

Eburniola gen. nov.

Head small, elongate, thin in profile; only slightly narrowed behind; vertex with a strong, narrow, longitudinal impression that terminates on the front in a broad impression, which is bordered arcuately in front; anterior portion of front not produced, truncate. Clypeus membranous, strongly transverse, concave at front border. Labrum corneous, broad, anterior border scarcely concave. Submentum nearly oval, disc with a pair of conspicuous setae. Mentum small, slightly transverse; excised at middle of anterior border. Ligula very small and slender, apparently simple. Labial palpi 3-pointed, minute. Maxillary palpi 4-jointed; basal joint very small, second joint oval, a little longer than broad; third joint twice as long as broad, moderately compressed, about as broad basally as at apex, the sides little convex, rather strongly setose; terminal joint less than half as long as the third, broadly awl-shaped. Eyes situated in front of sides of head, little convex, their outer border on a plane with outline of sides of head, in outline 4-sided rather than oval, with the nearly straight sides separated by rounded angles. Antennae situated in very small sockets at sides of anterior border of front, 11-jointed, very thick; first joint nearly as long as the three following joints together, thickly clavate and about half as long as head; second joint transverse; joints 3-10 thick, about as long as broad, subequal, quadrate in outline and not separated by constrictions; terminal joint elongate oval, one and two-thirds times as long as the penultimate.

Pronotum strongly impressed over the greater portion of the disc, anterior border elevated and narrowly rounded, posterior border sloping; sides inflexed, concealing side pieces. Elytra well developed, separated from front to rear by a narrow, triangular fissure. Chitinous portion of posternum transverse, truncate in front and behind. Mesometasternum longer than broad, median portion flat; posterior border truncate and not at all projecting between coxae. Abdomen permanently recurved, large and deeply and broadly inflated, largely membranous, nearly flat above, the marginal line weakly impressed; ventral segments strongly convex, with strong impressions between; six segments visible from above. Legs short, femora and tibae not flattened, the middle and posterior pair somewhat arcuate. Anterior coxae elongate, conical, posterior and middle shorter and conical, all moderately separated, the posterior more widely than the others. Tarsi 4-4-4 jointed, middle and posterior metatarsi elongate, but shorter than the remaining joints together.

Genotype—*Eburniola leucogaster* sp. nov.

Eburniola leucogaster sp. nov.

(Fig. 31).

Length.—(With abdomen straightened) 1.50-1.75 mm.

Pale brown, abdomen mostly ivory white, with the chitinized portions a little darker brown than the head and thorax. Gaster, especially at sides, strongly shining, remainder feebly shining and coriaceous. Head, thorax and elytra without erect hairs; pubescence sparse and exceedingly minute. Dorsal abdominal segments with an inconspicuous, erect hair on each side; apical and penultimate segments thinly covered with recumbent, very fine yellow hairs. Basal ventral segments with abundant long and fine erect hairs, which become sparser and shorter on the apical segments and are lacking on the penultimate and terminal segments. Appendages with moderately abundant erect hairs.

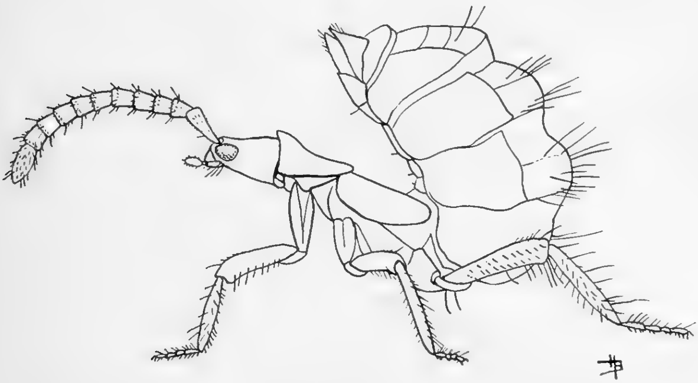

FIG. 31. *EBURNIOLA LEUCOGASTER* SP. NOV.

Head distinctly longer than broad, slightly narrowed in front. Eyes less than half as long as head. Antennae reaching to posterior end of elytra, very stout, nearly one-third as broad as head. Pronotum a little broader than long and a little broader than the head; anterior and posterior corners rounded. Elytra at base slightly broader than the pronotum, broader than long, sides divergent, arcuate at basal half, nearly straight at apical half, posterior border straight, inner angles broadly rounded, outer angles subacute. Abdomen longer than the remainder of body, more than twice as broad as the elytra; dorsal chitinous plates 1-4 very short, extending the width of the segments, each with the anterior margin broadly concave at middle; penultimate and apical segments entirely chitinized, subquadrate in shape, strongly transverse, less than half as long as the segments, extending at sides as thin lines which become obsolete before attaining the dorsum. Anterior femora of subequal width throughout; middle and posterior tibial very gradually enlarged from base to apex.

Host.—*Nasutitermes* (*Nasutitermes*) *guayanae* (Holmgren).

Type-locality.—Kartabo, British Guiana.

Other locality.—St. Joseph, Trinidad.

Described from a series of ten specimens.

Perinthus tarsatus sp. nov.

Length.—2.50 mm.

Dark brown, abdomen and appendages paler than head and thorax, moderately shining, with abundant very fine, short yellow pubescence and in addition with coarse and long black hairs arranged as follows: five on pronotal margins; two on elytral margins; one on each elytron; a series of four (interspersed with shorter and finer hairs) at the posterior border of each abdominal segment above and from four to six beneath. Antennae with a series of long hairs at the apex of each joint.

Head a little broader than long, front not margined, rather flat, vertex convex. Antennae distinctly longer than the head and pronotum together, basal joint slightly shorter than the second and third together, joints 4-11 strongly compressed, a little longer than broad; terminal joint suboval, one and one-third times as long as the penultimate. Pronotum about one-third broader than long, narrowest in front, sides convex, anterior and posterior corners broadly rounded, anterior border concave, posterior border concave at sides, slightly convex at middle. Elytra basally as broad as the pronotum, sides feebly convex, posterior angles obtuse, posterior border nearly straight. Abdomen longer than remainder of body, connate, first five segments margined. Tarsal claws long and very slender.

Host.—*Nasutitermes* (*Nasutitermes*) *surinamensis* (Holmgren).

Type-locality.—Kartabo, British Guiana.

P. tarsatus is nearest to *silvestrii,* but that species has antennal joints 7-10 slightly transverse, the terminal joints is twice as long as the penultimate and the body above is not setose.

Perinthus wasmanni sp. nov.

Length 1.60-2 mm.

Dark reddish brown, elytra darker than the rest and the abdomen and appendages paler. Moderately shining and microscopically punctate and covered with rather abundant, fine and short yellow pubescence and in addition fine, long and erect hairs arranged as follows: six on lateral margins and twelve on the disc of pronotum; two at the lateral margins and two on the disc of each elytron; a row of four at the posterior border of each abdominal segment above and a row of six to eight beneath. Antennae with shorter and rather stiff hairs. Legs with dense short hairs.

Head broader than long, rounded at sides, front flat, vertex convex. Antennae slightly shorter than the head and prothorax together; the first joint a little shorter than joints 2-3 together, joints 2-3 suboval and equal in length; joints 4-10 strongly compressed, subequal, slightly broader than long, terminal joint nearly as long as the two preceding joints together. Pronotum about one and two-fifths as broad as long, narrowest in front, sides moderately concave, anterior and posterior corners rounded, posterior border concave at sides, convex at middle. Elytra as broad basally as the pronotum, together more than twice as broad as long, sides nearly straight, anterior corners broadly rounded, posterior corners obtusely angulate.

Host.—Nasutitermes (*Nasutitermes*) *ephratae* (Holmgren).

Described from a small series.

This species in habitus closely resembles *dudleyanus* Casey from Panama but may be distinguished by the relatively short elytra. In *dudleyanus* the length of the suture is nearly two-thirds that of the pronotum; in *wasmanni* it is less than half.

Perinthus vestitus sp. nov.

Length 1.90-2 mm.

Reddish brown, elytra darkest, abdomen and legs lightest. Head, thorax and abdomen very distinctly, though shallowly punctate and thickly covered with semi-recumbent, yellow pile much longer than that of *wasmanni* or *tarsatus* and in addition with a series of four strong black hairs on the lateral borders of pronotum, two on the outer margins of the elytra and a row on the ventral abdominal segments; abdomen also with long, fine and yellow hairs on the posterior margins of the segments.

Head barely broader than long; front flat, vertex convex. Antennae much shorter than head and pronotum together, first joint nearly as long as the second and third together, second and third joints elongate, sub-cylindrical, remaining joints compressed, all a little longer than broad, terminal joint nearly as long as the two preceding joints together. Pronotum about one-fourth broader than long, only slightly narrower in front than behind, sides feebly convex, anterior border nearly straight, posterior border feebly convex at middle. Elytra a little narrower than pronotum, together much broader than long, sides nearly straight, posterior corners angulate, posterior borders straight. Abdomen rather broadly margined.

Host.—*Nasutitermes* (*Nasutitermes*) *octopilis* (Banks).
Type-locality.—Kartabo, British Guiana.

The comparatively long and dense pubescence and the arrangement of the setae, with the more elongate and different shaped pronotum distinguish *vestitus* from the other species of *Perinthus.* The long hairs on the dorsal segments of the abdomen are unusually fine and are yellow in color, similar to the shorter hairs.

Tribe Oxypodini

Termitogaster simulans sp. nov.

(Fig. 32).

Length (with abdomen straight) 3 mm.

Head, thorax and elytra dark brown; front of head, abdomen, ventral surface and antennae reddish brown, legs and palpi yellowish brown. Rather strongly shining and finely alutaceous; outer and inner inflexed portion of elytra densely punctate. Erect hairs on head, thorax and elytra, short and fine, several at sides of occiput, four rows of 4-5 each on pronotum and a row of four on each elytron; each dorsal sclerite of abdomen with two pairs of longer, black, erect hairs, one pair at middle of basal border and one at middle of posterior third, the apical borders with a row of long recumbent

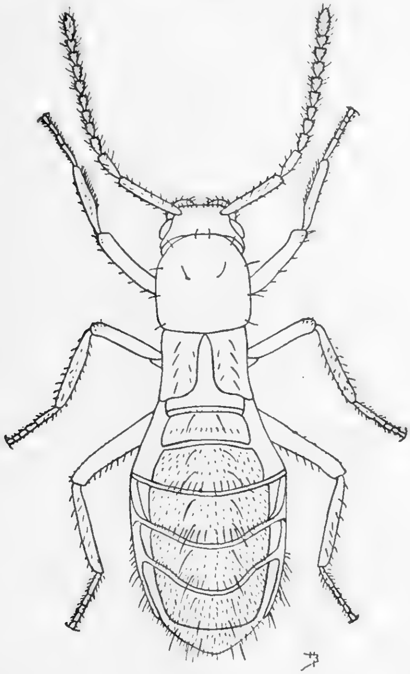

FIG. 32. *TERMITOGASTER SIMULANS* SP. NOV.

yellow hairs; sides of dorsum and the sides and ventral surface with moderately dense yellow pubescence; appendages with short and rather stiff, flattened, oblique yellow hairs.

Head about as long as broad, distinctly widest at occipital border which is broadly arcuate; front concave on either side, longitudinally convex at middle to opposite antennal surface, where there is a broad, transverse elevation with an oblique anterior face and truncate borders. Labrum distinct, convex at sides, strongly excised at middle of anterior border. Eyes prominent, oval, a little less than half as long as head. First antennal joint a little shorter than head, in cross section subquadrate; second joint nearly four times as long as broad and one and two-thirds times as long as the second; third joint more than half as long as the second, distinctly longer than broad; joints 4-10 gradually shorter, the tenth scarcely longer than broad; terminal joint elongate-oval, narrowed and rounded at tip. Pronotum a little longer than broad, with nearly straight subparallel sides, with strongly arcuate anterior border and rounded angles, posterior border, narrowly and shallowly concave at middle; surface with a longitudinal very shallow median impression in front of middle and a flattened triangular area at middle near posterior border. Elytra at base as broad as pronotum, similar to those of *simopelta* but with the posterior margin concave and the outer angles less projecting. Abdomen large, evidently not held erect, in all the specimens before me it is strongly compressed and about twice as long as broad. It may not be as strongly compressed in life, as a distinct marginal line is present, but it is so in the alcoholic as well as in the dried specimens before me) ; segments comparatively long, each with a transverse carina posterior to middle; membranous portions narrow, not visible in all specimens. Legs slender, middle and posterior femora strongly flattened and bent; tibiæ moderately flattened; metatarsi shorter than the remaining tarsal joints.

Host.—*Nasutitermes* (*Nasutitermes*) *costalis* (Holmgren).
Type-locality.—Kartabo, British Guiana.

Described from nine specimens taken with several colonies of the host termite.

In three of my specimens the sixth abdominal segment has the border evenly emarginate, as described by Casey in the male of *Termitogaster fissipennis,* the others, presumably females, have the border produced, but rounded instead of angulate.

The resemblance to a worker termite is strong even in dried and pinned specimens and must be strikingly so in the living beetle. From the structure of the abdomen, it is evidently carried straight, or but slightly elevated.

Termitogaster simopelta sp. nov.

(Fig. 33).

Length (with abdomen straightened) 2.50 mm.

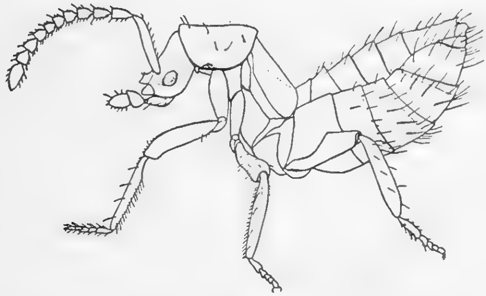

FIG. 33. *TERMITOGASTER SIMOPELTA* SP. NOV.

Color pale yellowish brown, elytra a little darker than the remainder; exposed membraneous portions white. Integument alutaceous, shining, the gaster more than the rest.

Erect hairs short and rather stiff, black in color, lacking on head, ten on disc of pronotum, two on each elytron; a row of 4-6 at the middle of each dorsal abdominal sclerite (the posterior border of each sclerite with a thin row of recumbent hairs); more abundant on ventral surface of abdomen; short on appendages where there are also abundant, fine and short, erect yellowish hairs. Ventral surface of thorax with dense and very fine yellow pubescence.

Head about as long as broad, vertex transversely convex, front concave, except near anterior margin where there is a transverse ridge, thick basally and acute above (appearing dentiform from the side), anterior border obliquely concave at sides, acutely excised at middle, with a thin, sharp triangular erect tooth at either side of incision. Clypeus very short and broad, strongly concave at middle of anterior border. Labrum transverse, longitudinally impressed at middle and convex at sides. Eyes oval, rather strongly convex, nearly half as long as head, situated in front of middle of sides. First antennal joint a little shorter than head, in cross section subquadrate, the sides somewhat flattened, and seperated from each other by an angle; second and third joints a little thicker than the others and about twice as long as broad, following joints scarcely longer than broad and decreasing in length to the penultimate which is as broad as long; apical joint oval, less than twice as long as broad and narrowed at tip. Pronotum about as long as broad, sides and anterior border nearly straight, posterior border rounded at middle, disc broadly concave in front of middle. Elytra together longer than broad at base; narrowly connected at base, the remainder broadly separated; each elytron two and one-half times as long as broad, with feebly concave outer border, straight innner border and concavely oblique posterior border with the outer angles slightly produced. Abdomen widely inflated, two and one-half times as broad as the pronotum, all segments, except the apical, margined; membranous portions narrow, in some specimens not visible between the dorsal sclerites. Legs moderately long; femora and tibiae strongly flattened; posterior femora on upper border concave at basal five-eighths, then oblique, the margin forming, in outline, a broad triangle posterior to middle; anterior tibiae with a brush of coarse, rather flat yellow hairs, arranged in two rows; each metatarsus a little shorter than the other tarsal joints together.

Host.—*Nasutitermes* (*Nasutitermes*) *costalis* (Holmgren).
Type-locality.—Kartabo, British Guiana.

Termitogaster emersoni sp. nov.

(Fig. 34).

Female.—Length (in alcohol and with abdomen straightened) 3 mm. Color brown, pronotum dark brown to black, membranous portions white. Shining. Sparse erect hairs on head, three rows of four each on pronotum, one on each elytral disc, one at the side of each dorsal abdominal sclerite (a row of recumbent hairs on the apical margins) and scattered and more abundant on the vertical surface.

Head a little broader than long, front broadly concave, sides posterior to eyes feebly convex, occipital border broadly rounded; anterior border very slightly concave. Labrum trans-

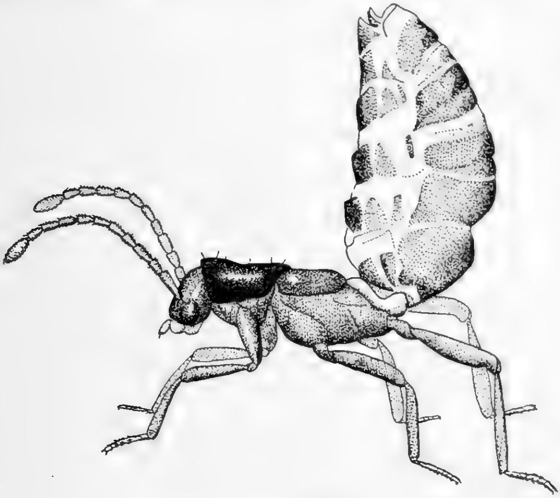

FIG. 34. *TERMITOGASTER EMERSONI* SP. NOV.

verse, broadly concave in front. Eyes oval, less than half as long as head and situated near anterior border. First antennal joint as long as head, second and third joints nearly three times as long as broad, joints 3-10 proportionately shorter, but all distinctly longer than broad, decreasing in length apically; terminal joint less than twice as long as the penultimate. Maxillary palpi with the basal joint very small, second joint broader than long, its greatest width at anterior border, which is nearly straight and rather pointed at the angles, outer surface convex, inner surface concave; third joint as long as the second, longer than broad, gradually narrowed apically; apical joint minute and spiniform, less than half as long as the third. Joints of labial palpi very small and slender. Mandibles stout, acuminate apically, thickened at middle. Pronotum wider than the head, about as broad as long and slightly broader in front than behind, sides and posterior border convex, the angles broadly rounded, anterior border moderately projecting and rounded at the middle; surface in front of middle with a pair of broad and rather shallow impressions and behind middle with a pair of smaller and less distinct pits. Scutellum distinct, broadly triangular. Elytra shorter than the pronotum, separated at apex by a V-shaped area about half their length, together much broader than long, humeri subgibbous, sides feebly arcuate, posterior angles projecting and narrowly rounded, posterior border concave. Abdomen widely inflated, longer than the remainder of body, more than twice as broad as elytra, sides arcuate, broadly margined, the segments separated by broad bands of membrane. Legs moderately long and slender, middle and posterior metatarsi long, anterior metatarsus one and one-half times as long as the second joint.

Host.—*Nasutitermes* (*Nasutitermes*) *ephratae* (Holmgren).
Type-locality.—Kartabo, British Guiana.
Other locality.—St. Joseph, Trinidad.

Described from a series of specimens taken from several nests.

This species is near *T. brevis* but distinct in its larger size, more elongate structure, the more shallowly impressed front of head and in the strongly impressed pronotum and the separated elytra, as well as in having the membranous portions more developed than in the other species of Termitogaster.

Termitogaster brevis sp. nov.

Female.—(in alcohol and with abdomen straightened) 2.75 mm.

Chitinous parts brown, pronotum dark brown to black, membranous portions white. Shining, microscopically punctate. Erect hairs black, fine, scattered on anterior portion of head; arranged in four rows of five on the pronotum; one on each elytron at base; four on each abdominal sclerite above, shorter on ventral surface; posterior margin of each abdominal segment with a row of very fine recumbent hairs.

Head broader than long, vertex rather strongly longitudinally impressed at middle and with more shallow impressions lateral to this; anterior portion of front broadly and shallowly impressed tranversely and separated from the remainder by a carinae that extends transversely in an irregular arc across the front; anterior border broadly and strongly excised. Eyes oval, convex, occupying anterior half of sides of head. First antennal joint as long as head, somewhat flattened basally; second and third joints subequal, less than twice as long as broad, remaining joints gradually shorter to the penultimate, which is scarcely longer than broad, terminal joint shorter than the two preceding joints together. Pronotum slightly transverse, a little broader in front than behind, sides and posterior border feebly convex, anterior border nearly straight, posterior angles broadly rounded; surface with a strong pit at middle and a more shallow pair in front of this, posterior portion with a shallow transverse groove near the border. Elytra connate, together strongly transverse, broadest behind, sides nearly straight, posterior border very broadly concave, posterior angles rounded, not produced. Abdomen short and thick, more than twice as broad as elytra, with rather weak lateral margins. Legs short and rather slender. Femora and tibiae moderately flattened.

Host.—*Nasutitermes* (*Nasutitermes*) *costalis* (Holmgren).
Type-locality.—Kartabo, British Guiana.
Other locality.—St. Joseph, Trinidad.

Described from a series taken in nests of the host.

Superficially this species appears identical with the genotype, *T. insolens* Casey from Panama, but comparison with the type shows a number of differences in the structure of the head, which, in *insolens*, is comparatively longer; the median vertical impression is feeble, the anterior portion of front is not so distinct from the remainder and the anterior border is broadly arcuate, instead of excised as in *brevis*.

The maxillary palpi of *brevis* are shorter and broader than in *emersoni*, the third joint is oval, much less than twice as long as broad and distinctly shorter than the second.

Host.—*Nasutitermes* (*Nasutitermes*) *guayanae* (Holmgren).
Type-locality.—Kartabo, British Guiana.
Other locality.—St. Joseph, Trinidad.

Described from a series of ten specimens.

Perinthus tarsatus sp. nov.

Length.—2.50 mm.

Dark brown, abdomen and appendages paler than head and thorax, moderately shining, with abundant very fine, short yellow pubescence and in addition with coarse and long black hairs arranged as follows: five on pronotal margins; two on elytral margins; one on each elytron; a series of four (interspersed with shorter and finer hairs) at the posterior border of each abdominal segment above and from four to six beneath. Antennae with a series of long hairs at the apex of each joint.

Head a little broader than long, front not margined, rather flat, vertex convex. Antennae distinctly longer than the head and pronotum together, basal joint slightly shorter than the second and third together, joints 4-11 strongly compressed, a little longer than broad; terminal joint suboval, one and one-third times as long as the penultimate. Pronotum about one-third broader than long, narrowest in front, sides convex, anterior and posterior corners broadly rounded, anterior border concave, posterior border concave at sides, slightly convex at middle. Elytra basally as broad as the pronotum, sides feebly convex, posterior angles obtuse, posterior border nearly straight. Abdomen longer than remainder of body, connate, first five segments margined. Tarsal claws long and very slender.

Host.—*Nasutitermes* (*Nasutitermes*) *surinamensis* (Holmgren).
Type-locality.—Kartabo, British Guiana.

P. tarsatus is nearest to *silvestrii,* but that species has antennal joints 7-10 slightly transverse, the terminal joints is twice as long as the penultimate and the body above is not setose.

Perinthus wasmanni sp. nov.

Length 1.60-2 mm.

Dark reddish brown, elytra darker than the rest and the abdomen and appendages paler. Moderately shining and microscopically punctate and covered with rather abundant, fine and short yellow pubescence and in addition fine, long and erect hairs arranged as follows: six on lateral margins and twelve on the disc of pronotum; two at the lateral margins and two on the disc of each elytron; a row of four at the posterior border of each abdominal segment above and a row of six to eight beneath. Antennae with shorter and rather stiff hairs. Legs with dense short hairs.

Head broader than long, rounded at sides, front flat, vertex convex. Antennae slightly shorter than the head and prothorax together; the first joint a little shorter than joints 2-3 together, joints 2-3 suboval and equal in length; joints 4-10 strongly compressed, subequal, slightly broader than long, terminal joint nearly as long as the two preceding joints together. Pronotum about one and two-fifths as broad as long, narrowest in front, sides moderately concave, anterior and posterior corners rounded, posterior border concave at sides, convex at middle. Elytra as broad basally as the pronotum, together more than twice as broad as long, sides nearly straight, anterior corners broadly rounded, posterior corners obtusely angulate.

Host.—Nasutitermes (*Nasutitermes*) *ephratae* (Holmgren).

Described from a small series.

This species in habitus closely resembles *dudleyanus* Casey from Panama but may be distinguished by the relatively short elytra. In *dudleyanus* the length of the suture is nearly two-thirds that of the pronotum; in *wasmanni* it is less than half.

Perinthus vestitus sp. nov.

Length 1.90-2 mm.

Reddish brown, elytra darkest, abdomen and legs lightest. Head, thorax and abdomen very distinctly, though shallowly as broad; joint longer than the two preceding joints together. Pronotum longer than broad, widest at anterior corners which are rounded, sides feebly concave, anterior, posterior borders arcuate, surface moderately and evenly convex. Scutellum small, transverse. Elytra together much broader than long and broadest behind, each less than twice as long as broad;

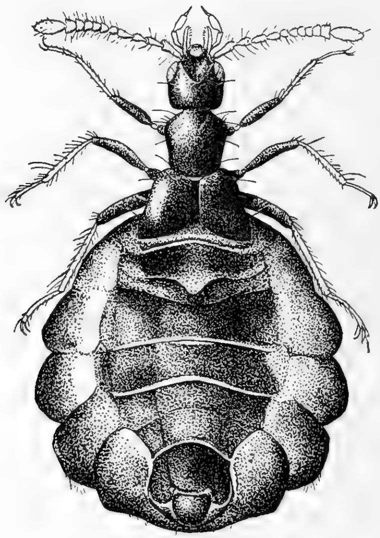

FIG. 35. *CORYMBOGASTER MIRANDA* SP. NOV.

humeri elevated and convex, sides at middle exceedingly shallowly concave, behind straight and divergent, and forming, with the oblique, nearly straight posterior border a distinct angle; inner corners broadly angulate. Abdomen nearly four times as broad as elytra and in profile three times as deep as metathorax; dorsal surface with an elevated median portion, feebly convex and separated from the flat lateral areas by a poorly defined longitudinal impression; sides separated by a strong marginal impression.

Host.—*Cornitermes* (*Cornitermes*) *pugnax,* Emerson.
Type-locality.—Kartabo, British Guiana.

Described from six specimens.

The description and figure based on the specimens which have the abdomen the least distended. In these the membranous portions are of limited to small portions along the margins of the dorsal surface. Other specimens have the membrane developed to such an extreme that the chitonized portions appear as small plates, the large gibbosites at the sides are greatly reduced, with the chiton showing only as a pair of very narrow, parallel plates. In one the abdomen is at least three times as long as broad and even on the dorsum the plates extend scarcely half its width.

Termitophya punctata sp. nov.

(Fig. 36).

Length.—2.75-3 mm.

Head, thorax, elytra and appendages dark brown; abdomen pale brown, each segment with a darker median blotch. Shining. Head with coarse regular separated punctures; smooth between. Pilosity stiff and erect, moderately long, very sparse except at the tip and on the ventral surface of the abdomen and on the legs, two of them near the inner border of eyes, three near the lateral borders of pronotum and two pairs on each elytral disc; one at middle of margin, stout semi-recumbent black hairs in a row of six at the posterior margins of the dorsal abdominal segments; head, thorax and elytra with very minute recumbent whitish hairs.

Head a little broader than long, front and vertex broadly convex, sides immediately in back of eyes subparallel, anterior border nearly straight. Labrum broad, strongly though very narrowly excised at middle, membraneous at middle, corneous at sides, the sides elevated into low tubercles in front. Eyes moderately convex, occupying front half of sides of head. Antennae a little longer than head and pronotum together; first joint swollen, much broader than the others and nearly as long as the second and third together; second joint shorter than third, remaining joints subequal, terminal joint shorter than the two preceding joints together. Pronotum somewhat broader than head, a little longer than broad, broadest in front of middle and as broad in front as behind; anterior border straight, posterior border evenly convex, anterior corners rather narrowly rounded, posterior corners very broadly rounded, sides only feebly convex. Elytra as broad as pronotum, together broader than long, sides nearly straight, posterior corners rounded, border concave at middle. Abdomen con-

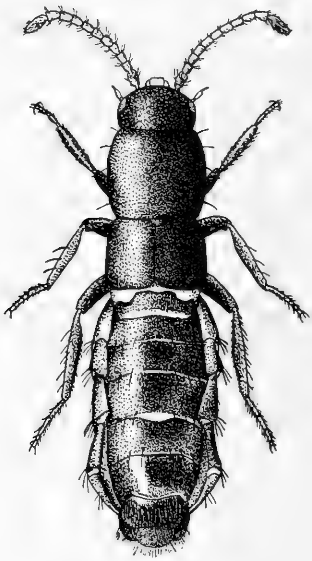

FIG. 36. *TERMITOPHYA PUNCTATA* SP. NOV.

siderably longer than the head and thorax together, broadly margined at sides for entire length; feebly convex above and rather strongly below; penultimate tergite trapzoidal, twice as broad as long and straight at the posterior border; last tergite subtriangular, with the apex narrowly rounded.

Femora strongly compressed, tibiae less compressed; posterior metatarsus one and three-fourths times as long as the remaining joints together; claws moderately long and slender.

Host.—*Nasutitermes* (*Nasutitermes*) *guayanae* (Holmgren).
Type-locality.—Kartabo, British Guiana.

Described from four specimens.

This, and the following two species belong to the genus *Termitophya*, though none of the specimens before me bear strong cerci on the last dorsal segment, as figured by Wasmann. (Tijdschr. Ent., vol. 45, 1902, pl. 9, fig. 1) and possibly represent the opposite sex.

T. punctata is near *T. heyeri* Wasm. but has the pronotum proportionately longer and rounded instead of angulate at the anterior corners. The punctation of the head is similar in both species.

Termitophya amica sp. nov.

Length.—(with abdomen straightened) 2.75-3 mm.

Head, thorax and elytra dark brown to black; appendages and abdomen pale brown, the latter with the median portion of dorsum dark. Shining; head with fine, though distinct, separated punctures and the intervals between with short and irregular, fine and dense striolae. Pronotum and elytra smooth; abdomen and appendages coriaceous. Erect hairs fine, black, sparse on appendages, a pair on head at inner border of eyes, three on the pronotal margins, two on each elytron. Dorsal abdominal segments 1-4 with a row of six coarser, recumbant hairs at apical margin; segment 5 with a pair of erect hairs; ventral segments with sparse, erect black hairs and, apically with elongate recumbant yellow hairs. Microscopic yellowish pubescence sparse on head and body, more distinct on legs.

Head broader than long, sides posterior to eyes slightly convex, occipital border broadly arcuate, anterior border straight, front flattened, at middle very shallowly impressed. Labrum large, entirely corneous, impressed at middle, narrowly excised at tip. Eyes moderately convex, a little longer than their distance to the posterior margin of head. First antennal joint stout, nearly as long as second and third together, third joint distinctly larger than the second, scarcely longer than broad, remaining joints a little longer than broad and becoming slightly narrower toward apex; terminal joint a little shorter than the two preceding joints together. Pronotum a little longer than broad, as broad in front as behind, with feebly arcuate sides and posterior border, straight anterior border and broadly rounded angles; surface evenly convex. Elytra at base a little narrower than the pronotum at its widest part, together broader than long, sides straight, little divergent, posterior angles evenly rounded, the borders feebly convex and meeting at broad angle. Abdomen elongate, flat above, sides elevated as broad margins. Legs short, the femora broader than in *T. punctate* and distinctly though narrowly concave at middle of flexor border.

Host.—*Nasutitermes* (*Nasutitermes*) *guayanae* (Holmgren).
Type-locality.—Kartabo, British Guiana.

Described from five specimens.

This species is very close to *T. punctata,* differing, in addition to the broader legs, in the punctation of the head, in the arrangement of the erect hairs on the elytra and in having the pubescence more conspicuous.

Termitophya flaviventris sp. nov.

Length.—(with abdomen straightened) 3 mm.

Head, thorax and elytra rather pale brown; ventral surfaces and appendages lighter; dorsal surface of the abdomen yellowish, except for a median brown stripe. Shining, head finely and shallowly punctate; abdomen coriaceous. Erect hairs fine and shorter than in the other species; lacking on dorsal portion of head; four on sides of pronotum, two on each elytron. Coarser, black, semi-recumbent hairs arranged in rows of six unequal in size at the apical margin of abdominal segments 1-4 and one on either side of the same segments, one pair on penultinate segments and a row, mixed with long yellow hairs at the tip of apical segment; arranged in four irregular series on each ventral segment. Long and very fine yellow recumbent hairs scattered on dorsal surface of abdomen and arranged in rows at apices of ventral segments. Pubescence fine and recumbant, yellow in color, more conspicuous than in *punctata* and *amicus* and sparsely and regularly distributed on head, thorax and appendages.

Head transverse, similar to that of *amicus;* clypeus strongly and broadly convex. Labrum deeply and acutely incised at apical borders. First antennal joint much thicker than the others, a little shorter than joints 2-3 together; second joint thicker and somewhat shorter than the third, which is about twice as long as broad; remaining joints gradually decreasing in length; terminal joint one and three-quarter as long as the penultimate. Pronotum a little broader than long, straight in front, feebly convex at sides and posterior border, with the corners broadly rounded; surface moderately convex except in front of middle when it is very shallowly impressed. Elytra at base slightly narrower than pronotum; sides straight. Posterior angles broadly rounded; posterior borders obliquely convex and meeting at an obtuse angle. Abdomen elongate, the sides elevated as strong margins. Legs short; femora and tibiae broad and strongly compressed.

Host.—Nasutitermes (*Nasutitermes*) *costalis* (Holmgren).

Type-locality.—Kartabo, British Guiana (Aug. 1), St. Joseph, Trinidad.

Distinct from *T. amica* in its paler coloration, more distinct pubescence, the arrangement of the erect hairs and in the more slender antennae, all joints of which are more elongate in *flaviventris.* The two species are otherwise very similar.

Trachopeplus gen. nov.

Head suboval, broader than long, front with two strong lateral impressions confluent with antennal fossae, and a small median impression. Eyes rather large, oval and convex. Clypeus membranous, very short and broad, anterior border straight at middle. Labrum coriaceous, short, divided into two lobes by a strong, triangular median incision. Gula very short, with sides straight and divergent behind and not separated from submentum by a suture. Submentum large, a little broader than long, flat behind, oblique and a little narrowed in front, sides of posterior portion and the anterior border straight. Labium transverse, subquadrate. Ligula large broadly incised apically. Labial palpi 3-jointed; basal joint longer than broad and a little thicker than the second; second joint distinctly longer than the basal; apical joint minute. Maxillary palpi 4-jointed, basal joint small, second joint twice as long as broad, very narrow at base and gradually thickened toward apex, outer surface convex, inner surface concave, the third joint a little longer than the second, elongate oval in outline and two and one-half times as long as broad, with convex outer surface and shallowly concave inner surface; apical joint exceedingly short and blunt at tip. Antennae 11-jointed, not thickened apically, first joint strongly scapiform, remaining joints elongate. Pronotum broad, strongly excised at middle, sides inflexed. Pronotum transverse, anterior border membranous; anterior half composed of a transverse chitinous plate that extends laterally as narrow bands joining to the side pieces; posterior half membranous. Meso- and metathorax together a little longer than broad, anterior border strongly concave, posterior border projecting between coxae and truncate at tip, surface flat in front, convex behind. Scutellum distinct, transverse. Elytra elongate and widely separated. Abdomen inflated, carried forward over the elytra and posterior portion of pronotum; six segments visible from above; all segments margined at sides.

Legs short and stout, femora and tibiae strongly flattened. Tarsi 5-5-5 jointed; metatarsus broad, a little shorter than the other joints together; fourth and fifth joints anchylosed; tarsal claws very slender.

Genotype.—Trachopeplus setosus, sp. nov.

Trachopeplus setosus sp. nov.

(Fig. 37).

Length.—(with abdomen straightened) 3 mm.

Head, antennae, pronotum and elytra dark brown to black, abdomen and ventral surface red-brown, legs yellow-brown. Shining, very finely punctate, pronotum and elytra with small tubercles, each bearing a hair. Front with sparse, rather strong punctures, elytra densely, rather coarsely but shallowly punctate. Hairs black, very stiff, erect and moderately long and abundant on head, thorax, elytra, and appendages; on the abdomen they are semirecumbant and irregular in length and thickness, arranged in two rows of 10-12 on segments 2-5, one row on the basal segment; ten rows on the apical segment, and abundant on ventral surface (where arranged in three irregular rows) and legs.

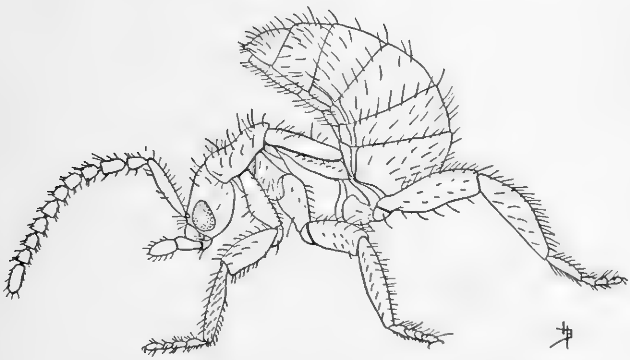

FIG. 37. *TRACHOPEPLUS SETOSUS* SP. NOV.

Head broader than long, sides in back of eyes convex, posterior borders rounded; border feebly arcuate; antennal foveae extending to the vertex as a pair of broad, shallow depressions; anterior portion of front flat, the border a little produced and truncate apically. Clypeus broad and narrow, entirely membranous. Labrum distinctly concave at middle of anterior border. First antennal joint about as long as the head, third joint twice as long as broad, a little longer than the second and one and one-half times as long as the third; joints 3-10 distinctly longer than broad, gradually decreasing in length; terminal joint elongate, shorter than the two preceding together, with parallel sides and rounded tip. Eyes nearly half as long as head, convex, situated near front of sides. Pronotum transverse, as broad in front as behind. Sides very feebly concave, anterior border convex at middle, narrowly concave at sides; posterior border broadly arcuate at middle, nearly straight at sides; disc in front of middle broad with a deep transverse impression two-thirds its width, the surface anterior to this nearly flat, posterior to it, convex. Elytra at base as broad as pronotum and about as long, widely separated from front to rear; each elytron nearly twice as broad as base as at apex, with straight outer border, feebly concave inner border and oblique, slightly arcuate posterior border; exterior corners subangulate. Abdomen a little less than twice as broad as pronotum, dorsal surface nearly flat, sides elevated as prominent margins Legs rather short, femora and tibiae broadly flattened.

Host.—*Nasutitermes* (*Nasutitermes*) *acajutlae* (Holmgren).
Type-locality.—Kartabo, British Guiana.

Described from two specimens. (Mouth parts on slide.)

The shape of the head, the profoundly impressed pronotum, the structure of the maxilles and tarsi and the tuberculate nature of the pronotum, as well as the abundant and vary coarse and stiff hairs are distinctive and separate *Trachopeplus* from *Termitogaster,* with which is resembles somewhat in habitus and in the form of the antennae.

While there are five tarsal joints, the fourth and fifth are closely jointed and appear superficially as one, but in a balsam mount the suture is distinct, and furthermore marked by the arrangement of the hairs, which, with the other characters, place the genus in the Coloderae group.

Xenopelta gen. nov.

Robust; gaster moderately inflated and held elevated. Head elongate, front strongly and broadly impressed between eyes, abruptly elevated and longitudinally carinate at middle in front of antennal sockets, anterior border broadly angulate at middle and slightly projecting over base of clypeus. Clypeus membranous, strongly transverse, concave at anterior border. Labrum entirely membranous, strongly and broadly excised at middle of anterior border, with the surface of the lateral portions convex. Mandibles stout basally, slender and acute at apical half, unidentate on inner border. Mentum longer than broad, its surface flat, front border moderately elevated. Ligula very small, apparently simple. Labial palpi 3-jointed, the basal and second joints much thicker than the terminal. Maxillary palpi 3-jointed; basal joint very small, second joint with the upper surface greatly produced into a chitinous, asymmetrical, arcuate lobe, that extends nearly to the apex of the third joint, basal portion flat; third joint thick, strongly convex above and nearly straight beneath. Antennae 11-jointed, not thickened apically; first joint scapiform. Eyes large, situated at sides of head. Prothorax elongate; disc of pronotum strongly impressed, sides elevated into thick rounded margins, anterior border elevated, projecting, narrowly rounded; posterior margin with flat surface and broadly rounded border. Elytra well developed, a little broader than long. Abdomen moderately inflated, more convex beneath than above; seven segments visible from above, all segments, except the terminal, broadly margined, lateral borders and the areas between the segments, both dorsally and ventrally, with narrow bands of white membrane.

Prosternum in front of coxae elevated into a ridge which is projecting and triangular at middle. Metasternum transverse, surface at middle convex; posterior border truncate between coxae. Anterior coxae large and conical, approximate. Middle and posterior coxae short,, rather broad, separated. Legs flattened, tibiae especially so, the hind tibiae with the border very thin and with an indication of a submarginal line on inner surface. Tarsi 5-5-5 jointed, the joints sharply distinct; hind metatarsus a little shorter than the remaining joints together.

Genotype.—Xenopelta cornuta, sp. nov.

Xenopelta cornuta sp. nov.

(Fig. 38)

Female.—(length with abdomen straightened) 2.75 mm.

Dark reddish brown to black, gaster lighter, projecting tip of front and the apical half of tarsi yellow brown; feebly shining, the appendages more than the rest. Head and body rather coarsely, densely punctuate; appendages similarly, but much more finely sculptured; tibae with coarse setigerous punctures.

Hairs black in color, lacking on head, a row of three on lateral borders of pronotum, two on each elytron, an oblique row of 10-12 on the posterior margins of abdominal segments 2-5 and a few near the basal border; one pair on penultimate abdominal segment; finer and rather abundant on ventral surface of abdomen; shorter on appendages.

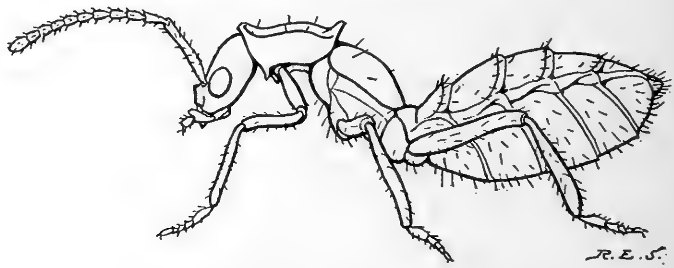

FIG. 38. *XENOPELTA CORNUTA* SP. NOV.

Head longer than broad and a little broader behind than in front, sides nearly straight, occipital corners and border broadly rounded. First antennal joint nearly as long as the head; joints 2-4 somewhat thicker than the following, the second twice as long as broad, remainder gradually decreasing in length to the penultimate which is about one and one fifth times as long as broad; terminal joint elongate oval, shorter than the two preceding joints together. Eyes less than half as long as head, situated a little in front of middle. Pronotum a little broader than head, broadest at anterior third; anterior angles rounded; depression occupying the larger part of the surface, deepest a little in front of middle with a large, shallow fovea at bottom on either side. Elytra broadest behind, with straight sides, rounded posterior corners and concave border. Abdomen one and three fourths times as broad as elytra.

Host.—*Nasutitermes* (*Nasutitermes*) *guayanae* (Holmgren).

Type-locality.—Kartabo, British Guiana.

Described from two females.

The basal point of the maxillary palpi is very small and visible only when the mouth-parts are dissected out.

Xenogaster fossulata sp. nov.

Female.—(length)—2.80 mm.

Head, pronotum and gaster coriaceous shining, elytra densely punctate and less shining. Hairs yellowish, fine and silky, moderately abundant on head, thorax and elytra and appendages. Dorsal segments of abdomen with a row of longer, nearly recumbant hairs at posterior border; ventral surface with fine long hairs.

Ferruginous, abdomen and legs lighter.

Head longer than broad and broader behind than in front, flat above, except for shallow elongate impressions that extend from antennal insertions a little more than half the distance to occipital border. Labrum broad, nearly straight in front. Maxillary palpi large, with the second joint distinctly longer, though more narrow than the basal; apical joint small, subulate and less than half as long as the penultimate. Eyes large, nearly flat, occupying anterior three-eights of sides of head. Antennal scapes moderately thick, extending a little less than the distance to posterior border of head, first funicular joint subcylindrical and twice as long as broad, second joint similarly shaped but shorter, joints 3-9 subquadrate in profile, slightly transverse, apical joints but little broader than the others; terminal joint oval, about as long as the two preceding joints together. Pronotum longer than broad, sides in front of middle slightly convex, behind middle straight and very feebly convergent, anterior corners subangulate, posterior border truncate; dorsum strongly impressed at middle with the sides forming rounded borders to the pit, which is deepest in front and sloping behind with the surface of the posterior, sloping portion very feebly convex toward the basal half. Scutellum large. Elytra at base a little broader than pronotum, divergent behind, widely separated, the inner border slightly concave, outer borders nearly straight, posterior border rounded at tip. Abdomen not strongly inflated, sides only slightly convex, dorsal surface flat, strongly margined and elevated at sides.

Host.—*Nasutitermes* (*Nasutitermes*) *intermedius* (Banks).
Type-locality.—Kartabo, British Guiana.

Ceratoxenus gen. nov.

Physogastric species with the abdomen carried upward and forward over the thorax. Head broader than long, not constricted behind, margined in front, with projecting, thick spinose developments. Mandibles rather thick, elongate-triangular, curved at tips. Labrum entirely membranous, very strongly transverse, concave at anterior border. Mentum subquadrate, a little broader than long, broadly concave at anterior border. Ligula membranous, simple, transverse. Maxillary palpi 4-jointed, the joints coarse, second joint thicker and about as long as the third, second and third less than twice as long as broad, their outer surfaces convex, fourth joint short, subulate. Labial palpi 2-jointed, the basal joint distinctly thicker than the second. Antennae 11-jointed, first joint scapiform, apical portion slightly enlarged. Eyes a little less than half as long as sides of head. Pronotum with sides inflated vertically; anterior, inferior angles with an elongate acute spine. Prosternum elevated and margined at anterior border; prothoracic hypomera concealed. Elytra well developed, tapering and widely separated behind. Mesosternum as long as prosternum and longer than metasternum, surface behind coxae evenly convex, triangular, projecting, coxae narrowly separated, acetabuli closed. Abdomen about as long as the thorax, strongly convex beneath, plane above, six segments visible from above, margined at sides for entire length. Legs long, rather slender. Tarsi 5-5-5-jointed. Posterior metatarsus much shorter than the remainder of tarsus.

Genotype—*Ceratoxenus tricornis* sp. nov.

Ceratoxenus tricornis sp. nov.

(Fig. 39)

Female.—(length)—2.60 mm.

Head a little broader than long, sides and posterior border moderately rounded, vertex and front broadly impressed; anterior border of front strongly margined, the margin projecting at middle as a broad triangular tooth, at sides as elongate, bluntly pointed, laterally compressed spines. Labrum broad, concave at anterior border, from above entirely concealed by the frontal margin. Mandibles rather thick and not very acute at tips. Antennae extending to posterior end of elytra; scape thick, as long as head from above; funicular joints 1-3 elongate, subcylindrical and equal in length, remaining joints more rounded and, toward apex becoming transverse; terminal joint

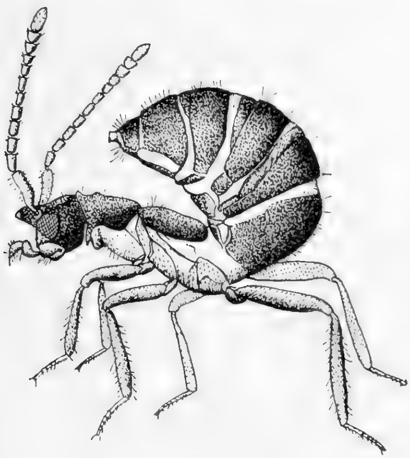

FIG. 39. *CERATOXENUS TRICORNIS* SP. NOV.

oval, less than twice as long as broad. Eye large, moderately convex, slightly emarginate at the border approximate to antennal insertions, occupying most of the front half of sides of head. Pronotum a little broader than long, side pieces nearly perpendicular, inferior anterior angles produced as spines; dorsum with lateral and front borders roundly margined and with a transverse ridge a little in front of middle, the anterior surface evenly concave and the posterior surface impressed and plane. Elytra a little narrowed at base and about as long as pronotum, very broadly separated, (the distance between their tips equal to their length) tapering and narrowly rounded at tips. Abdomen strongly inflated and carried above thorax; dorsal surface flat, sides and venter evenly convex, dorsal segments 1-4 subequal and less than half as long as the corresponding ventral segments. Legs moderately long and slender.

Finely coriaceous and opaque throughout. Rather stiff erect brown hairs sparsely distributed on head and body and appendages. Maxillary palpi with dense yellowish white hairs.

Color ferrugineous, with the abdomen, legs and palpi lighter than the rest; membranous portions pure white.

Host.—Nasutitermes (*Nasutitermes*) *guayanae* (Holmgren).

Tribe—Gyrophaenae

Blapticoxenus gen. nov.

Small, rather flattened species, tapering posteriorly. Head concealed beneath pronotal margin, small, not constricted, front subtriangular, front flat. Antennal fossae with acute margins which terminate at inner border of eye and approximate at middle of anterior border of front. Genae acutely margined. Labrum elongate, nearly straight at anterior border, triangularly depressed at sides, leaving a median portion shaped somewhat similar to an hour-glass, with broad and thin lateral margins. Mandibles small, arcuate, acute at tips, the right one dentate at middle of inner margin. Maxillary palpi 4-jointed, the first three joints elongate and subequal in length, terminal joint short, subulate. Labial palpi small, 2-jointed, the joints subequal. Ligula simple, elongate, rounded in front. Eyes large and convex, with rather large facets, occupying nearly all of the exposed sides of head. Antennae 11-jointed, not geniculate, the first joint much shorter than the second and third together. Pronotum broadly convex, inflexed at sides and in front Prothoracic hypomera not visible. Anterior coxae very large and conical. Mesosternum much larger than pro-or metasternum, not carinate, slightly elevated posterior to coxae, separated from metasternum, coxal cavities closed, coxae approximated. Metasternum very short and conical. Elytra well developed, as broad as pronotum. Abdomen longer than head and pronotum together, tapering behind, first four segments strongly margined, seven segments visible from above, the sixth not impressed and the seventh not elongate. Legs short and rather stout, tibiae not spinose; 4-4-5 jointed. First joint of posterior tarsi elongate.

Genotype—*Blapticoxenus brunneus sp. nov.*

Blapticoxenus brunneus sp. nov.

Length.—1.75-1.90 mm.

Pale brown, shining, minutely punctate. Head, thorax and elytra devoid of hairs; abdomen with exceedingly coarse, black setae at sides and on ventral surface (on ventral surface arranged in rows near posterior margins of segments); legs and antennae with finer, shorter and yellow hairs; apex of the second and third antennal joints with strong, black, hairs.

Head a little broader than long, front flat, triangular, bordered by the distinct carinae that margin the antennal fossae; sides posterior to eyes oblique, slightly concave; posterior border straight. Antennae rather slender, extending a little beyond posterior borders at elytra; basal joint thicker than the others and longer than the second. Second joint very slightly clavate and shorter than the third; joints 3-4-subequal, longer and more slender than the remaining joints which decrease in length toward the tip; terminal joint elongate-oval, rounded at apex, much shorter than the two preceding joints together. Pronotum broader than long, broadest behind middle of sides, with slightly convex sides, broadly rounded anterior corners and border and rounded posterior corners; posterior borders very feebly bisinuate. Elytra more flattened than pronotum, together more than twice as broad as long, slightly broader behind, with nearly straight sides, subangulate posterior corners, posterior border nearly straight at sides and concave at middle. Dorsal abdominal segments 1-5 broader than long, segment 6 twice as long as broad and bluntly triangular in shape.

Host.—*Nasutitermes* (*Velocitermes*) *beebei* (Emerson).
Type-locality.—Kartabo, British Guiana.

Described from three specimens (one on slide).

This genus belongs in the tribe Gyrophaenae, but the joints of the maxillary palpi are unusually elongate. The depressed sides of the front of labrum, the elongate mesosternum are very characteristic.

Family—HISTERIDAE

Thaumataerius gen. nov.

Near *Teratosoma* (Lewis).

Body subquadrate, very long and slender, flattened above. Head elongate, mandibles strong and moderately projecting. Antennae inserted a little in front of middle of inner border of eyes; first joint subclavate, broad and thick, joints 2-8 gradually increasing in size; club large, one jointed, as long as the three preceding joints together, broadly rounded at tips. Antennal fossae visible from front and sides, thinly margined by prosternum and pronotum, capable of containing the entire antennae. Prosternum flat basally, sides between coxae straight, narrowly margined, posterior border truncate; rather strongly, transversely impressed at anterior fourth. Mesosternum flat at middle, about as broad in front as behind. Pronotum with projecting anterior and posterior corners, sides diagonally impressed, with deep, elongate fossae on either side of base. Elytra elongate, flat above, anterior and posterior corners broadly rounded; sutural striae broadly impressed, extending three-fourths the length of elytra; humeri with deep, very short striae, and disc with a similar short and deep stria midway between the humeral and the sutural; anterior border bigibbous, one tubercle at base of each of the short striae. Propygidium broad and feebly convex. Pygidium with three very strong elongate costae, about half as long as the pygidium, the surface between these unevenly concave. Legs slender, moderately long; femora not arcuate; anterior tibiae with short tarsal grooves. Anterior tarsi noticeably shorter and stouter than the others.

From *Teratosoma,* known from a Brazilian species of both termitophilous and myrmecophilous habit, *Thaumataerius* differs in its very slender, elongate form, in the comparatively simple structure of the prothorax, in the shorter and straight legs and in having the pygidium very strongly tricostate. The two genera resemble each other in the non-inflated legs and somewhat in the striation of the elytra, and though distinctly different genera, together constitute a radically aberrant group of the tribe Hetaerimorphini.

Genotype.—*Thaumataerius emersoni,* sp. nov.

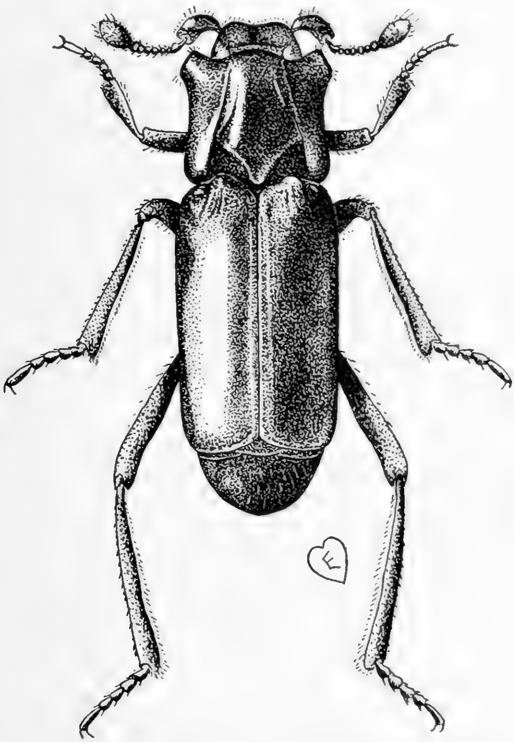

FIG. 40. *THAUMATAERIUS EMERSONI* SP. NOV.

Thaumataerius emersoni sp. nov.

(Figure 40)

Length.—2.10 mm.

Brownish red, shining; minutely punctate; body and appendages with moderately abundant, fine silky yellow hairs, which on the outer edge of the posterior and middle tibiae and shorter and denser and form a well defined brush.

Head longer than broad, not margined; vertex broad, rather strongly impressed. Eyes large, elongate, with very distinct facets. Prothorax as broad as long, slightly broadest behind, sides in front of middle feebly concave; anterior angles obliquely truncate, flattened and submargined at tip; posterior angles prolonged, with convex surface, convex outer border and narrowly rounded tip, separated from disc by strong oblique impressions which are deep basally and become shallow anteriorly; disc convex in front, shallowly concave at posterior half and separated from sides by a pair of oblique striae, one of which terminates in the lateral fossa and one of which extends to form an inner margin to the posterior angulate processes. Elytra together more than twice as long as broad, sides straight and parallel for three-fourths their length, feebly narrowed apically.

Host.—*Mirotermes* (*Mirotermes*) *nigritus* Silvestri
Locality.—Kartabo, British Guiana, July 31.

Volume III, Number 18

GLANDULAR STRUCTURE OF THE ABDOMINAL APPENDAGES OF A TERMITE GUEST (Spirachtha)*

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(Figure 41, Plates XVI-XVII)

INTRODUCTION.

Some of the specimens of *Spirachtha,* collected by Mr. Alfred Emerson of the University of Pittsburgh in nests of *Nasutitermes* (*Constrictotermes*) *cavifrons* (Holmgren) in British Guiana, were given to me to determine whether or not the abdominal appendages are glandular.

Emerson informs me by correspondence that his specimens of *Spirachtha* were identified by Dr. W. M. Mann of the Bureau of Entomology as two new species—*S. schiödtei* and *mirabilis* Mann. The material sectioned by me belongs to the latter species, but Emerson made his observations on both species; however, he says: "As far as I observed, the habits of both of the *Spirachtha* were exactly the same, and both species came from the same nests."

The live insects were fixed by Emerson in hot corrosive sublimate plus a little acetic acid and then allowed to cool, and finally were preserved in 85 per cent alcohol. Parts of the abdominal appendages and the abdomen with the appendages intact were embedded in 60° parraffin. Sections were cut five microns in thickness and were stained in Ehrlich's hematoxylin and eosin. The drawings, except fig. 41, are original and were made at the base of the microscope with the aid of a camera lucida. Figure 41 was made by Emerson from a specimen, but I have added a few hairs and some shading to it.

The following references are all that I can find which relate directly to the abdominal appendages of *Spirachtha.*

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* Tropical Research Station, Contribution Number 138.

Schiödte (1853) says: "The abdomen is furnished with three pairs of appendages, which are elongate, cylindrical, 2-jointed, membraneous, and moveable by muscles at the base. The appendages are perhaps intended for the same purpose as the tufts of hairs on the abdomen of the genus *Claviger*, which are known to be sucked by the ants." The same author (1856, p. 181), after having prepared sections from specimens preserved

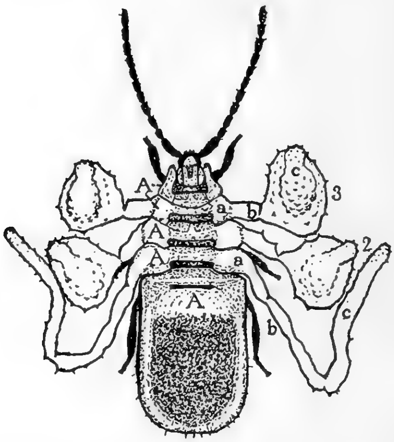

FIG. 41. *SPIRACHTHA MIRABILIS* MANN

Dorsal view showing abdominal appendages (1, 2 and 3), which consist of portions **a**, **b** and **c**; only the last two being glandular. Those portions marked A are the abdomen which conceals all the thorax and head, except parts of the legs, the antennae and anterior part of the head (all in solid black). Greatly enlarged. Photographed and originally drawn by Emerson, but later slightly modified by the writer.

in alcohol, was not able to decide definitely whether or not these appendages are glandular in structure. He says that there is a pair of muscles at the base of these organs, and consequently they are moveable. They are formed from prolongations of the abdominal integument, and have thick walls. Their structure appears to be homogeneous, and their contents is composed of clear granules of an irregular and globular form.

External Structure of Abdominal Appendages.

This staphylinid beetle, about the size of a common pin head, is most remarkable in that the abdomen bends forward so that the latter lies directly over the thorax and head. Further than this, the abdomen (Fig. 41*A*) bears three pairs of appendages (*1*, *2* and *3*), the size and shape of which vary considerably in different specimens. Very few of the specimens, however, have perfectly developed appendages. Emerson says that the appendages were of various sizes or were in various stages of development when observed in the field; some possessed only small knobs on the abdomen, while in a few the appendages were well developed as shown in Fig. 41.

The first pair of appendages (Fig. 41, *1*) is unusually long and filamentous, while the second and third pairs are elongate or club shaped, but when perfectly developed their distal ends (*2* and *3*) are more or less globular in shape, as represented in Fig. 41. The appendages, when fixed in the corrosive sublimate solution, are white, soft and fleshy-like structures, and are easily sectioned. Emerson says that when the insects are alive, the appendages are held up over the abdomen; sometimes those of one side touching those of the other side. The first pair, arising from the fourth abdominal segment, is held up in the air, each resembling the letter S. The second and third pairs, arising from the fifth and sixth abdominal segments, were observed to be slightly moveable through a vertical plane at right angles to the body. Emerson observed that when the appendages were moved, all of them moved at the same instant. He thinks that both sexes develop these extraordinary appendages and that they are postimaginal structures.

Internal Structure of Abdominal Appendages.

Each appendage arises from a fleshy prolongation (Fig. 41, *a*) of the abdomen, and appears to be 2-segmented, but sections show that the articulations between portions marked **a** and **b** and between **b** and **c** are nothing more than constrictions with thinner cuticula than elsewhere. The constriction between **a** and **b** is shallow, while the one between **b** and **c** is deep. Several muscle fibers run diagonally across the portion marked **a**, but only a few other fibers unite with the integument in the constriction, and no muscles were seen in the apparent segments **b** and **c**. Judging from this arrangement, the appendages certainly cannot be moved very much.

A microscopical examination of the integuments (not treated with KOH) of these appendages did not show any pores and only two types of hairs. The cuticula is literally covered with tiny prickles or pseudohairs and (Plate XVI, 5, Hr^1) many comparatively large hairs (Plates XVI-XVII, 5, 14, Hr) were observed arising singly from miniature mounds, widely scattered.

Sections through the portions marked **b** and **c** (Fig. 41) reveal the most peculiar arrangement of tissues that I have ever observed. These portions (Plates XVI-XVII, 12-14) appear hollow, but are really filled with a coagulated liquid, apparently blood (Plate XVII, 14, Bl.). The walls are thick and consist of four layers; the two outermost ones being the cuticula (Plate XVII, E, D), the middle one the hypodermis (Hyp), and the innermost one the basement membrane (M) of the hypodermis. Passing through the hypodermis from the basement membrane to the outer layer of the cuticula there are many dark strands; some of these (S) are attached to the bases of the hairs (Hr), and the others (St) either to the cuticula directly or at the bases of tiny pores (P). These various structures are colored very beautifully in sections passed through alcohol containing iodine, and stained by Ehrlich's hematoxylin and eosin. The blood and basement membrane are colored pinkish by the eosin, but the later takes the deeper color; the hypodermis is stained purple by the hematoxylin; the inner layer of the cuticula (D) and the strands are stained brownish by the iodine; and the outer layer of the cuticula (E) remains unstained, being whitish or semi-transparent.

A more careful study of these various structures shows the following details. The outer and inner layers of the cuticula are practically equal in thickness. The former contains numerous tiny pores (Plate XVI, 11, P) whose outer ends are funnel-shaped, while the inner ends are straight or curved. The pores are practically all single openings, but one double pore (17) was found. These pores are peculiar in that the outer cuticula surrounding them is considerably thicker than elsewhere, thus making semispherical projections which extend into the inner cuticula.

While there is nothing uncommon about the outer cuticula, except its pores, the inner cuticula is very peculiarly modified. The latter usually appears porous or spongy (Plate XVI, 4, 6, 8, D), but may be stratified (5, 11), or may occasionally be

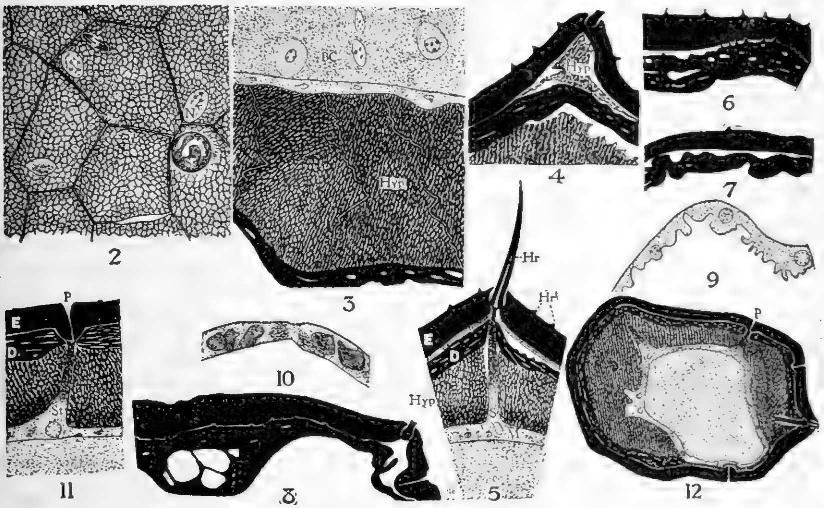

Plate XVI. *S. MIRABILIS* MANN

Internal structure of abdominal appendages.

2, end view of columnar hypodermal cells, showing nucleus (N) and stands (S and St) in cross section; 3, longitudinal view of glandular hypodermal cells (Hyp) and blood cells (BC); 4, 5 and 11, wall of appendage, showing original hypodermis (Hyp^1), hair (Hr), tiny prickles (Hr^1), outer cuticula (E), inner cuticula (D), pore (P), glandular hypodermis (Hyp), basement membrane (M), and strands (S and St) in longitudinal view; 6 to 8, various types of the dermis; 9 and 10, two types of the basement membrane; 12, cross section (semidiagrammatic) of the smaller bulb-shaped end of an appendage, showing all of the internal structures; 2 to 11, X 505, and 12, X 105.

wavy (7). It lies against the outer cuticula and is firmly anchored there by many tiny prickle-like projections (6, 8), extending into the outer layer. In order to distinguish the inner from the outer cuticula in the various drawings, a white space has been left between these two layers.

Section passing crosswise through the hypodermal cells show that these are usually five or six sided columnar cells (Plate XVI, 2), whose cut ends appear net-like and resemble plant cells more than animal cells. Their nuclei (N) are scarcely discernible and only appear as faint elliptical areas which contain a few dark particles with a few radiating lines. It is strange that these nuclei should be so inconspicuous, because ordinarily nuclei are the most conspicuous parts of cells. Perhaps the fixation was not good for these nuclei.

Sections passing lengthwise through the hypodermal cells usually indicate that the hypodermis consists of more than one layer of cells, but upon closer examination it becomes evident that the hypodermis really consists of only one layer (Plate XVI, 3). In longitudinal sections the contents of the cells appear to consist of coagulated streaks, somewhat resembling strings of beads, which generally extend lengthwise through the cell, but sometimes diagonally across it. The longitudinal walls of the cells are conspicuous as dark lines, usually running in zigzag style, while in cross sections the walls appear as curved or straight lines. Under a high magnification each dark line appears double as shown in (2, 3).

Like the inner cuticula and hypodermis, the basement membrane is also unusually developed. So far as I am aware, the basement membrane in sections of insects almost always appears as a single line without nuclei, but in spiders (McIndoo, 1911) it appears as a double line with nuclei. This may be due to the fact that the hypodermis in spiders is always thick, never becomes atrophied, but continues to function as long as the spider lives. This explanation may possibly serve to explain why the basement membrane in these abdominal appendages is so highly developed; here both walls are always discernible (Plate XVI, 5, 9-11), and nuclei are usually seen between them. The inner wall is generally more or less smooth, but occasionally it is very rough and may bear finger-shaped or papilla-like projections (9), which extend into the blood.

For some time the dark strands, already mentioned, were a puzzle to me, but now I believe that I can satisfactorily explain them. They are very conspicuous in all the sections made, and appear in four different conditions; fragments may be seen adhering to the cuticula or bases of the hairs; small isolated portions (Plate XVI, 2, 12, S), may be observed in either cross or longitudinal sections of the hypodermal cells; prolongations (12) of various length may be seen extending from the basement membrane into the hypodermis; and occasionally a complete strand (5, S and 11, St) may be observed. Their outer end (2, S and St) appear to be spongy and in structure are similar to the inner cuticula, but their inner ends seem to be as soft as the basement membrane. Practically every hair has a strand attached to its base, while only about one half of the pores have strands attached at their inner ends. Those strands running to the hairs look darker in sections and are much narrower than are the other ones described. The probable function of these strands is stated under "Interpretation of Results."

In life these abdominal appendages are probably completely filled with blood, because in sections the coagulated remains of the blood almost fill the entire cavity. Two types of blood cells (Plate XVI. 3, BC) were found in the blood. The smaller type, although probably not blood cells at all, is the commoner.

Interpretation of Results.

After a preliminary examination of the sections prepared, my first interpretation of these appendages was that the liquid found in them is a secretion which finds its way to the exterior through the strands and pores. This interpretation was found to be incorrect for the three following reasons: 1 The quantity of liquid contained in all six appendages is more than that of the blood contained in the remainder of the abdomen; thus, the source of any secretion must always be greater than the secretion itself. 2 This liquid contains blood cells, appears the same in structure, and has the same color as the blood found elsewhere. And 3, if the strands were efferent tubes they should be hollow in order to permit the secretion to pass freely to the exterior.

My interpretation now is that the blood passes freely through the basement membrane and inner ends of the strands into the hypodermal cells which act as secreting or gland cells.

If this is true the secretion then passes from the hypodermis into the outer ends of the strands and into the inner cuticula which serves as a reservoir to store the secretion. From this reservoir the secretion passes through the numerous tiny pores to the exterior where it probably spreads over the entire surface of the appendages and abdomen. This view is supported by the following facts. Emerson says that the termites carry these beetles about from place to place and that he often saw them lick not only the abdominal appendages but also the entire bodies of these insects. The inner ends of the hypodermal cells must be extremely active, judging from their deeper staining capacity. The basement membrane and inner ends of the strands contain coagulated particles like those in the blood, thus indicating that the blood passes freely into the hypodermis. The secretion must be different from the blood, because no remains of it can be found in the sections prepared. It may be of an oily or fatty nature and evidently totally soluble in the reagents used.

It would be interesting to know the exact sequence of formation of the various structures in the walls of these appendages. The formation is perhaps about as follows: The original hypodermis (Plate XVI, 4, 5, Hyp^1), little of which remains, first secretes the outer cuticula and hairs, then the inner cuticula; afterwards instead of its becoming atrophied as usual, it becomes greatly hypertrophied and secretes an entirely different substance which probably serves a nutritive purpose. Since the hypodermis is a thick, soft and flabby membrane it needs supports and a means of firmly anchoring it to the dermis. All of this is accomplished by the semirigid strands. Those strands attached to the hairs might originally have been trichogen cells, but now they are entirely different and certainly have a different function. In fact it seems that all the strands have originated as outgrowths from the basement membrane, because they are still attached to it and a large nucleus is usually present in this membrane where a strand departs The strands are attached to the bases of hairs and pores, because these projections serve as good places for attaching them.

The various structures, as described, are present in all parts of the appendages marked **b** and **c** (Fig. 41), but the blood chamber is not always centrally located. Sometimes, as in the smaller bulb-shaped end of an appendage, the blood chamber (Plate XVI, 12) has shifted to one side, totally eliminating the hypodermis from that side. In the portion marked a (Fig. 41) and in the remainder of the abdomen none

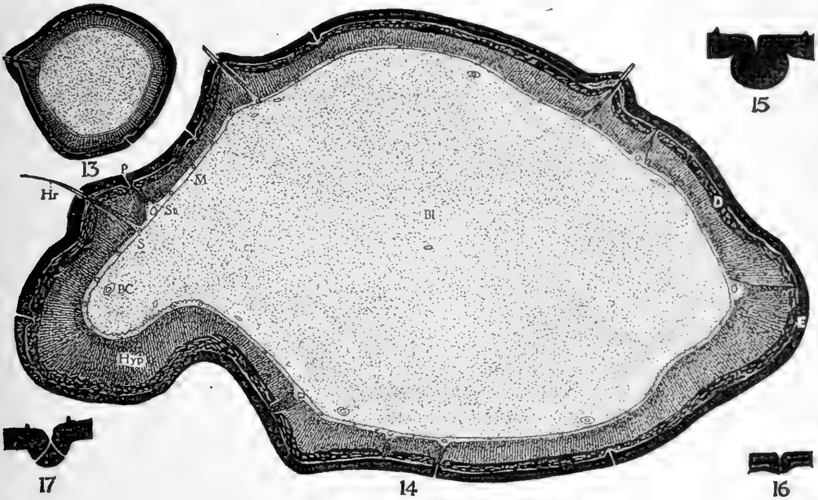

Plate XVII. *S. MIRABILIS* MANN.
Internal structure of abdominal appendages.

13, cross section through portion **b** (Fig. 41) of first appendage; 14, oblique section through portion **c** of second or third appendage, showing following internal structures: pore (P), outer cuticula (E), inner cuticula (D), glandular hypodermis (Hyp.), strands (S and St), basement membrane (M), blood cells (BC), and blood (Bl); both diagrammatic, and both X 105; 15 and 17, various sizes and types of pores, X 505; 15 to 17, sections similiar to 14; 16, from abdomen; 15, largest pore; 16, smallest pore found.

of these structures are unusually developed and only traces of some of them can be found. Starting with the proximal end of portion **b** and following the sections into the abdomen, it is seen that the highly developed hypodermis with its basement membrane suddenly disappears and that the inner and outer cuticula gradually become thinner so that in the portion a all that remains is: 1 a thinner outer cuticula with an occasional pore; 2 a very thin inner cuticula, slightly porous; and 3 a trace of the original hypodermis. In the abdomen the outer cuticula is still thinner and only a trace of the inner cuticula and hypodermis can be found. Here an occasional pore (Plate XVII, 16), the smallest of all, is still present but the inner cuticula is no longer porous. In these sections there is nothing unusual about the anatomy of the abdomen. The greater part of the space is filled with the intestine, cut two or three times thus showing that it is much convoluted. At certain places the intestine seems very large and contains many particles, resembling bits of vegetable matter. Other structures, apparently eggs in their follicles are present; besides muscles, blood and the fat cells. The fat body is comparatively small and seldom lies against the cuticula.

General Discussion.

In referring to the literature on this subject, I find only one insect in which the apparent arrangement of tissues is similar to that already described for *Spirachtha;* yet in this one there is no similarity if these tissues have been correctly named. This staphylinid beetle (*Termitomimus*) was found in considerable numbers by Trägårdh (1907a) in the *Eutermes* colonies of Zululand. Trägårdh says that this genus matches *Spirachtha* with regard to the peculiar development of the abdomen and the mouth-parts. The large abdomen bears no appendages, but curves upward and forward so as to cover completely the thorax and posterior half of the head. For description he has divided the abdomen into a "pseudocaput," a "pseudothorax" and "pseudoabdomen." Sections through the "pseudothoracic" projections show four layers in the thick body wall. He calls the outer and inner layers of the cuticula epiostracum and endostracum respectively. In the position of my glandular hypodermis, he finds a cyanophilous tissue of a spongy appearance which sometimes exhibits a very distinct radial structure, sometimes is concentrically stratified and contains numerous granules which are also to be found in the trichogen cells. He thinks that this tissue is a fluid, which has either passed through the hypodermis and is a derivate from the fat body, or it is a secretion produced by the hypodermis and is coagulated by the method of fixation. It seems to me that this tissue, which is poorly fixed, might correspond to my glandular hypodermis. In the positions of my basement membrane and the strands, running to the hairs, he finds two structures which he calls hypodermis and trichogen cells respectively. He imagines that the secretion passes through the cuticula, although he saw no pores at this place, but at other places in the cuticula near which lie fat cells he saw many extremely fine pores.

Trägårdh found two pairs of glands opening into the cuticular folds at the dorsal side of the neck of *Termitomimus*. He calls them cephalic and prothoracic glands, because the unicellular hypodermal glands of the former lie in the head and those of the latter in the prothorax. Each gland cell opens to the exterior through a tiny pore. He does not think that these glands are in any way connected with the termitophilous life of *Termitomimus*.

While it is exceptionally rare for any adult insect to bear appendages or projections similar to those already described, many larval insects bearing unusual thoracic and abdominal appendages have already been found.

Silvestri (1920) found unusual thoracic and abdominal appendages on certain dipterous and lepidopterous larvae, and also apparently eight pairs of lateral appendages on the coleopterous larva of *Troctontus*, all of which were taken from termite nests in Africa. He seems to have found glands in only the tiny club-shaped appendages of the last named insect. These consist of many very large unicellular, hypodermal glands. They lie in a thick hypodermis and open to the exterior through pores. Silvestri thinks that they secrete a special substance for the termites.

Wheeler (1918) found unusual thoracic and abdominal protuberances or appendages on three species of ant larvae belonging to the genera, *Tetraponera* and *Pachysima*. Speaking of the tubercles of *T. tessmanni*, Wheeler (p. 306) says:

"Sections and stained, cleared preparations of the whole larva show that the various tubercles contain portions of the fat body, at least in the bases of their cavities, and next to the hypodermis a dense, granular substance, evidently a coagulated liquid produced by the underlying adiphocytes, or trophocytes. . . . Around the bases of tubercles are muscles so arranged that their contraction must increase the pressure on the fat and granular liquid and in all probability cause the later to exude through the hypodermis and delicate chitinous cuticle onto the surface. The whole arrangement of the tubercles, in fact, constitutes a system of exudate organs, or exudatoria, as I shall call them, adapted to secrete substances that can be licked up by the ants when they are feeding and caring for the larvae."

Wheeler also studied sections through the appendages of *P. latifrons* and found a similar arrangement of tissues, but in the fat cells in these sections he imagined that he saw urate crystals, which caused him to believe that these cells function as a storage kidney till the malpighian vessels are sufficiently developed to excrete. To me Wheeler has not shown any evidence that these appendages are really exudatory, but it is very probable that they are. He saw no pores in the cuticula and does not say how his coagulated liquid differs from the blood, but in support of his view he claims that we must interpret the exudatoria as very primitive glands, which in all probability have arisen as new formations and not as homologues of the embryonic legs. He (p. 313) says:

"They are, as we have seen, small diverticula like the embryonic legs, consisting of hypodermis and its overlying cuticula and containing a portion of the fat-body separated from the hypodermis by a granular liquid. Now the fat-body of the insects may be regarded as a diffuse ductless gland, the cells (trophocytes) of which take certain substances from the blood in which they lie, store them in the cytoplasm as fat-globules or proteid granules and later return them to the blood in a more finely divided, if not chemically modified form. The exudate which accumulates in the distal ends of the exudatoria is therefore merely blood charged with nutrient substances from the fat-cells, and either filters gradually through the hypodermis and overlying cuticle or is forced through them by muscular pressure. At first sight it would seem that the cuticle must be impervious to such a liquid, but a consideration of the more recent work on the minute structure of chitin * * * shows that there is nothing to prevent the passage of a thin fatty liquid, even if it were not under pressure and even if the cuticle were much thicker than it is in the ant larva. The cuticle is a colloid, either of a reticular structure, as Kapzow believes, or formed of horizontal layers of very fine fibrillæ crossing one another at an angle of 60° as most investigators, including Biedermann and Casper, maintain. Between the fibrillæ are regularly distributed and extremely fine openings or 'pore canals,' through which a liquid might readily pass as if the cuticle were a filter."

In further support of his view, Wheeler cites the work done on certain meloid, cantharid, lampyrid, coccinellid and chrysomelid beetles in which a liquid, usually regarded as blood plasma charged with cantharidin, is discharged from the articulations of their legs. Wheeler has overlooked my work (1916) in which I found gland pores in the femoro-tibial articulations of meloid and coccinellid beetles, and in *Epilachna borealis* I described two types of gland cells which discharge the liquid through these pores. It is also possible that the other named insects have glands which discharge secretions from their legs.

Wasmann (1903), Trägårdh (1907 *a* and *b*) and Holmgren (1909) have published much concerning the exudate organs of myrmecophiles and termitophiles, but considerable of the work done on the finer anatomy is not clear to me, although Wheeler uses their results to support his view.

Wheeler (1910, p. 399) states that students of myrmecophily observed that true guests of ants generally bear tufts of hairs or trichomes which are assiduously licked by the ants, and Wasmann (1903), who has written much about these structures, shows that the trichomes are borne by the integument at points or depressions where clusters of unicellular glands open, and that they function by rapidly diffusing some aromatic secretion. Wasmann thinks that the secretion is not liquid, but perhaps a fatty ether, thus being volatile or etherial. The ants are so fond of it that he thinks it must affect them very much as a good cigar affects a smoker. Wheeler adds: "Perhaps it would be nearer the truth to say that its fascination is more like that of catnip or oil of bergamot on the various members of the cat family."

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Volume III, Number 19

TERMITOPHILOUS APTERYGOTA FROM BRITISH GUIANA*

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University of Illinois.

(Plates XVIII-XXIII).

The material upon which this report is based was collected at the Tropical Research Station of the New York Zoological Society, Kartabo, British Guiana, in 1919 and 1920 by Mr. Alfred Emerson.

The following six species are described, all of which are new, and one of which represents a new genus of Collembola.

Thysanura: *Atelura guiana, A. lepismoidea, A. crispula, A. cucullata, Nicoletia emersoni.* Collembola: *Borecus pinnatus.*

Types of these have been deposited with the New York Zoological Society.

All these forms except the *Nicoletia* are termitophilous. The genus *Atelura,* in particular, is strictly myrmecophilous or termitophilous, and it is appropriate here to bring together the little that has been published on the habits of this genus. Additional observations made by Mr. Emerson, appear beyond.

Habits of Atelura

The statement of Escherich ('04) that all the species of *Atelura* are either myrmecophilous or termitophilous is probably still true. Of twenty-four species that I have found recorded up to the present eighteen are myrmecophilous or termitophilous, as are doubtless also the remaining six (from Africa and Australia), descriptions of which I have not seen.

According to the observations of Janet ('96*a*, '96*b*) on *Atelura formicaria* Heyd. in a nest of *Lasius umbratus* Nyl.,

* Tropical Research Station, Contribution Number 139.

the *Atelura* can get along without the ants provided it has available an appropriate nourishment; but is attracted to the nests of ants by the nutritive fluid that the ants disgorge and feed to each other. As a pair of ants stand mouth to mouth, absorbed in the process of feeding, the *Atelura* rushes in, grabs the drop of food and hurries away. This performance is repeated with other pairs of ants until the hunger of the *Atelura* is satisfied. The guests are tolerated by their hosts for the good reason that by their agility they are usually able to elude the ants, but these interlopers are constantly being chased by their victims, and are sometimes caught and killed.

In regard to the Brazilian species *Atelura termitobia* Silv., Silvestri ('01*a*) gives the following observations.

"In the royal chamber of *Anoplotermes tenebrosus* I found with the king and queen . . . three examples of *Grassiella* [*Atelura*], which were running about unmolested among the workers. I placed the royal pair, some workers and the three individuals of *Grassiella* together in a glass tube and observed that the last-named lived in perfect harmony with the termites, without at any time being pursued by them. Once I saw a *Grassiella* on the back of a queen, while the head of a worker, which had just cleaned the latter, was quite near the head of the *Grassiella.* Perhaps these thysanurans also steal food from the termites, as others do from ants."

Silvestri ('01*a*) observed the minute Brazilian species *Atelura synoeketa* Silv. in the nests of *Eutermes microsoma* Silv., and says concerning them: "In the galleries of *Eutermes* I saw three individuals of *Grassiella* [*Atelura*] rambling around in the midst of the workers, soldiers and larvae, which I captured and placed alive in a glass tube, together with their hosts. They walked about everywhere among the termites, sometimes encountering them head to head without, however, either species making the slightest impression upon the other. I saw also a *Grassiella* enter a gallery in which there were *Eutermes* and emerge from the other side unharmed. Never did I see a *Eutermes* pursue a *Grassiella,* or vice versa."

Thus the species of *Atelura* get food and shelter in the nests of ants and termites, but the benefit is one-sided, for the hosts gain nothing from the association with their guests.

The species of *Atelura* are not usually limited to a single species of host, but most of them occur with a number of different species of ants and termites.

In distribution the genus is widespread, occurring in all the faunal realms. The species are small, as a rule, attaining at most a length of six or seven millimeters.

Mr. Emerson says, in regard to the species of *Atelura* in the nests of termites: "In all cases they seemed to be ignored by the termites. They moved swiftly about among the termites, resting very little. In no case did I observe any hostile actions toward them on the part of the termites. I observed *Atelura lepismoidea* n. sp. several times running about, closely following worker termites (*Nasutitermes* (*N.*) *acajutlae* Holmgren) but did not happen to see them obtain regurgitated food or abdominal secretions from the termites, although it is very possible that at times they obtain food in this way. They seem to be pantermitophilous, as shown by the list of the host species in whose nests they were found."

Atelura guiana sp. nov.

(Plate XVIII, figs. 1 to 11).

General color golden yellow, due to the scales; body color yellowish white. Appendages white except in large specimens, in which the antennae, bases of the legs, and of the pseudocercus ("median cercus") may be brownish yellow. Small individuals are yellowish white throughout. Form subelliptical (fig. 1), broadest across the mesothorax, with width to length as 1:2.5. Thorax five-eighths as long as the abdomen. Abdomen smoothly confluent with the thorax in outline. Body strongly arched. Thoracic terga with rounded lateral borders, projecting far down over the bases of the legs. Antennae (fig. 2) short, about nine-tenths as long as the thorax, or less than one-third the total length, with usually 12 segments, and occa-

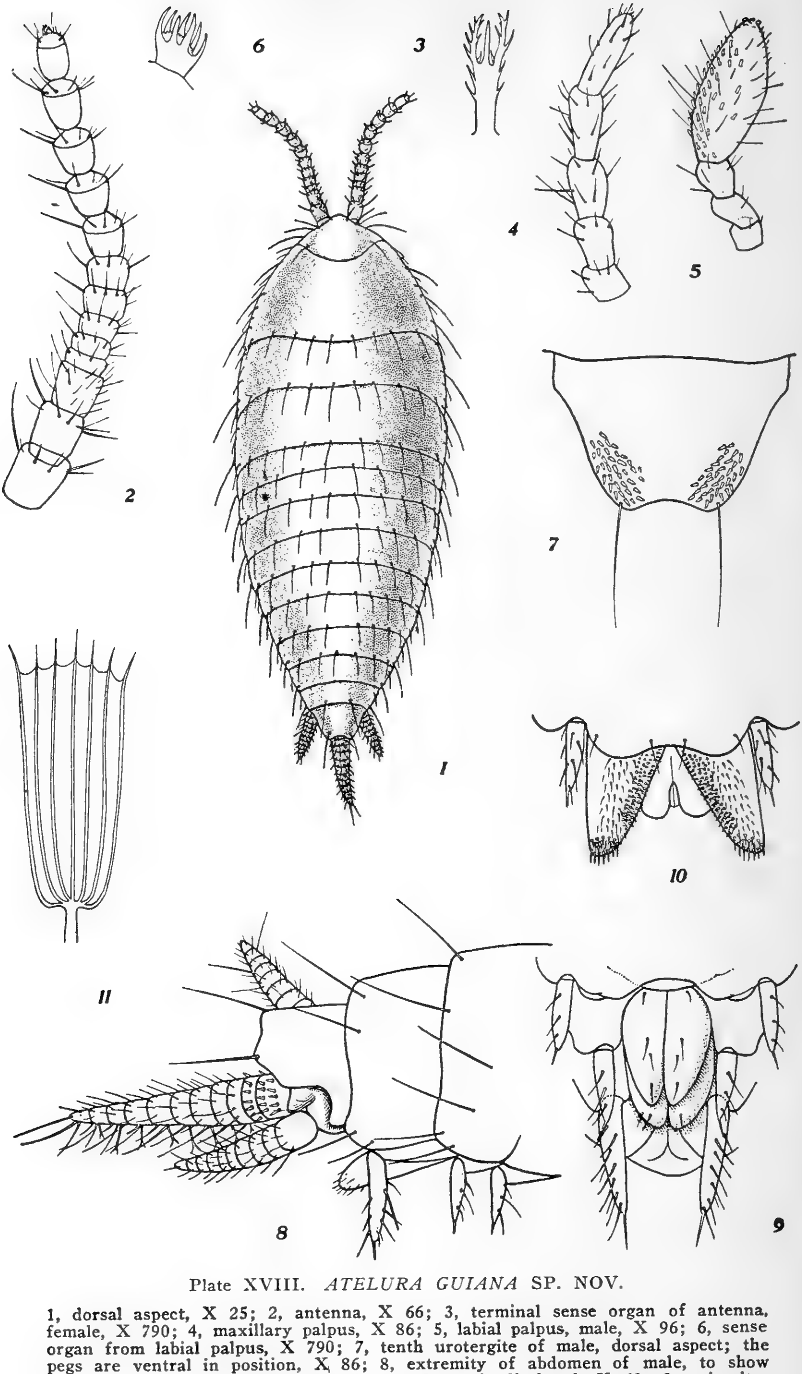

Plate XVIII. *ATELURA GUIANA* SP. NOV.

1, dorsal aspect, X 25; 2, antenna, X 66; 3, terminal sense organ of antenna, female, X 790; 4, maxillary palpus, X 86; 5, labial palpus, male, X 96; 6, sense organ from labial palpus, X 790; 7, tenth urotergite of male, dorsal aspect; the pegs are ventral in position, X 86; 8, extremity of abdomen of male, to show cerci and styli; the lower cercus in the figure is displaced, X 68; 9, ovipositor and styli, ventral aspect, X 85; 10, parameres and penis, ventral aspect, X 85; 11, typical scale from dorsum, X 505.

sionally 11 or 13; distally moniliform; last five segments each with a distal subsegment; apical segment oblong-elliptical, with length to width as 9:5 or 5:3; the three or four segments immediately preceding the apical segment subovate to subglobose; apical segment with a terminal branched sensory organ (fig. 3); second segment in male without a secondary sexual process, but with a ventral circular radiate sense organ. Maxillary palpi (fig. 4) with segments in relative lengths as 8:15:16:18:25; last segment elliptico-cylindrical. Labial palpi (fig. 5) with segments as 6:12:10:40; last segment elliptical, twice as long as broad, with sensory pegs and an apical cluster of six branching sensory papillae of the type shown in fig. 6. Tenth abdominal tergite (fig. 7) with a shallow emargination in both sexes; distal lobes each with about 35 ventral pegs in the male only. Cerci (fig.8) short; lateral cerci with about 10 segments (9-12); pseudocercus ("median cercus") one and one-half times as long as the lateral cerci, with about ten segments (10-12), and with short dorsal pegs on the proximal two segments in the male. Styli (figs. 8, 9) three pairs, on the 7th to 9th abdominal segments, respectively. Dorsal valves of ovipositor (fig. 9) longer than the ventral; ventral valves semi-ovate in ventral aspect, unsegmented. Parameres of male (fig. 10) in ventral aspect subtriangular, blunt, divergent, armed apically with short spines, and mesally with many short hooks. Body segments with dorsal rows of long outstanding hairs, mostly along the posterior border of each segment. Dorsum of head with several short hairs, apically bifurcate. Dorsal scales dense, varying in form and size, but typically as in fig. 11. Maximum length, 3.7 mm.

This species is near the Brazilian *Atelura* (*Grassiella*) *synoeketa* Silvestri ('01*a*, '01*b*) in which, however, the body is anteriorly oval, the antennae ten-segmented and one-third as long as the body, and the latter only 1.6 mm. in length.

Twenty-eight specimens, Kartabo, Bartica District, British Guiana, June 30, July 20, 27, 28, August 11, 20, 21, October 11, 15, November 4; Barakara, Bartica District, July 15. (Field Nos. 91, 108, 151, 208, 236A, 242, 248, 274, 403, 426, 476.)

Atelura guiana occurred in the nests of the following species of termites: *Nasutitermes* (*N.*) *guyanae* (Holmgren), *ephratae* (Holmgren), *octopilis* Banks, *surinamensis* (Holmgren); *Nasutitermes* (*Angularitermes*) *nasutissimus* n. subg. n. sp.; *Anoplotermes* (*A.*) sp. (No. 151); *Mirotermes* (*Cavitermes*) *tuberosus* n. subg. n. sp. All these species build conspicuous, well formed nests above the ground with the exception of *N. octopilis* and *N. nasutissimus*, which have rather loosely constructed nests.

Atelura lepismoidea sp. nov.

(Plate XIX, figs. 12 to 20).

Pale, yellow; appendages white. Body (fig. 12) two-fifths as broad as long, somewhat lepismiform, broadest across the metathorax, not strongly arched. Abdomen confluent with thorax, about 1.4 times as long as thorax, tapering in dorsal aspect, with lateral outlines straight or slightly concave. Thoracic terga rounded laterally and covering the bases of the legs. Head rounded in front. Antennae (fig. 13) as long as the head plus the thorax, with 15, occasionally 16, segments, of which all but the first 6 are subsegmented, segments 7 and 8 each having two subsegments, and segments 9-15 having three; first 6 segments in relative lengths about as 19:17:8:4:5:10; distal segments elongate, elliptical; last segment more than twice as long as broad, with a terminal sensory organ of the type shown in fig. 3; second segment in male without a secondary sexual process. Maxillary palpus (fig. 14) with segments as 13:17:19:22:32; last segment narrowly subelliptical, three times as long as broad, with a single apical branching sensory papilla. Labial palpus (fig. 15) with segments as 9:10:21:46; last segment elliptical, twice as long as broad, with an apical cluster of six sensory papillae of the type shown in fig. 6. Tenth abdominal tergite with a median rounded emargination, deep in the male (fig. 16) and shallow in the female (fig. 17); posterior lobes each with about 20 (17-21), ventral cones or pegs (fig. 16) in the male only. Cerci short; pseudocercus ("median cercus") with ten segments, the proximal two segments bearing a few dorsal pegs in the male (fig. 16), usually four pairs, becoming successively longer;

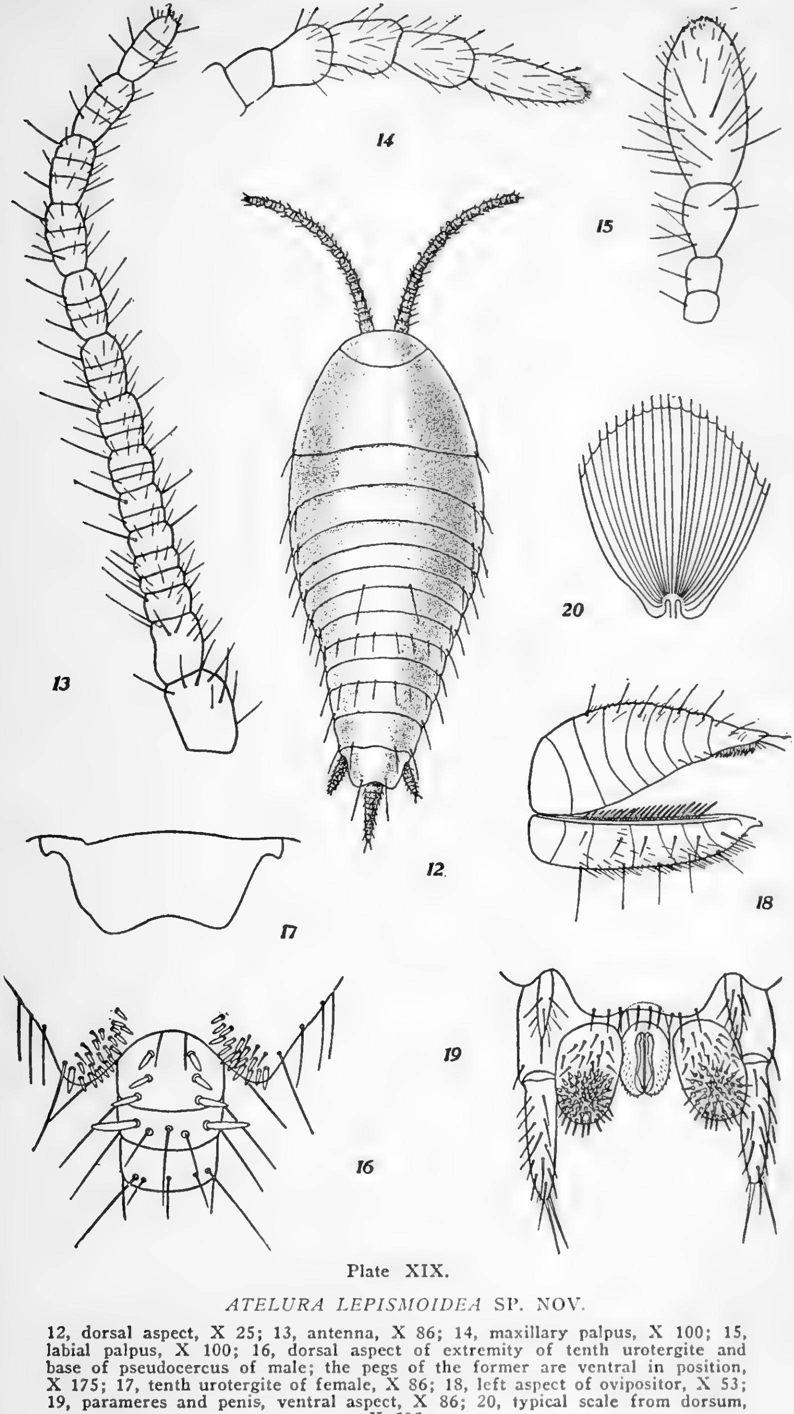

Plate XIX.

ATELURA LEPISMOIDEA SP. NOV.

12, dorsal aspect, X 25; 13, antenna, X 86; 14, maxillary palpus, X 100; 15, labial palpus, X 100; 16, dorsal aspect of extremity of tenth urotergite and base of pseudocercus of male; the pegs of the former are ventral in position, X 175; 17, tenth urotergite of female, X 86; 18, left aspect of ovipositor, X 53; 19, parameres and penis, ventral aspect, X 86; 20, typical scale from dorsum, X 505.

lateral cerci five-sixths as long as the pseudocercus, with 8-10 segments. Styli four pairs, on the 6th to 9th abdominal segments respectively. Ovipositor extending as far as, or slightly beyond the lateral cerci, with both pairs of valves segmented (fig. 18), the ventral valves smaller and slightly shorter than the dorsal. Parameres of male stout, subcylindrical (fig. 19), apically armed with many stiff spines. The long stiff dorsal hairs of the body are limited to the posterior borders of the segments; there are possibly more of these than are shown in fig. 12. Dorsal scales typically as in fig. 20, though varying in form and size. Length, 3.2 mm.

The usual number of antennal segments is 15 in both sexes, but one female had 16, and small specimens (1.7 mm. in length) had only 12, 13 or 14.

Forty-one specimens, Kartabo, Bartica District, British Guiana, July 13, 20, August 7, 18, 21, September 21. (Field Nos. 100, 197, 225, 242, 248, 339.)

Atelura lepismoidea had as hosts these five species of termites: *Nasutitermes* (*N.*) *surinamensis* (Holmgren), *costalis* (Holmgren), *acajutlae* (Holmgren), *ephratae* (Holmgren); *Armitermes* (*N.*) *teevani* n. sp. These build conspicuous, well formed nests above the ground, with the exception of *A. teevani*, the nest of which is usually on the ground.

Atelura crispula sp. nov.

(Plate XX, figs. 21 to 30).

Pale yellow; appendages white. Broadly elliptical (fig. 21); length to breadth as 1.8:1; body strongly arched, reminding one of a "sow-bug"; abdomen smoothly confluent with the thorax in outline, twice as long as the latter. Lateral borders of thoracic terga rounded, extending down over the legs. Antennae short, about as long as the thorax, or about one-third the entire length, with 14 or 15 segments, of which the last 6 or 8 have each two subsegments (fig. 22); last segment elliptical, twice as long as broad, with a terminal branched sensory organ (fig. 23). Maxillary palpi (fig. 24) with segments in relative lengths as 8:12:16:17:20; last segment elongate-conical.

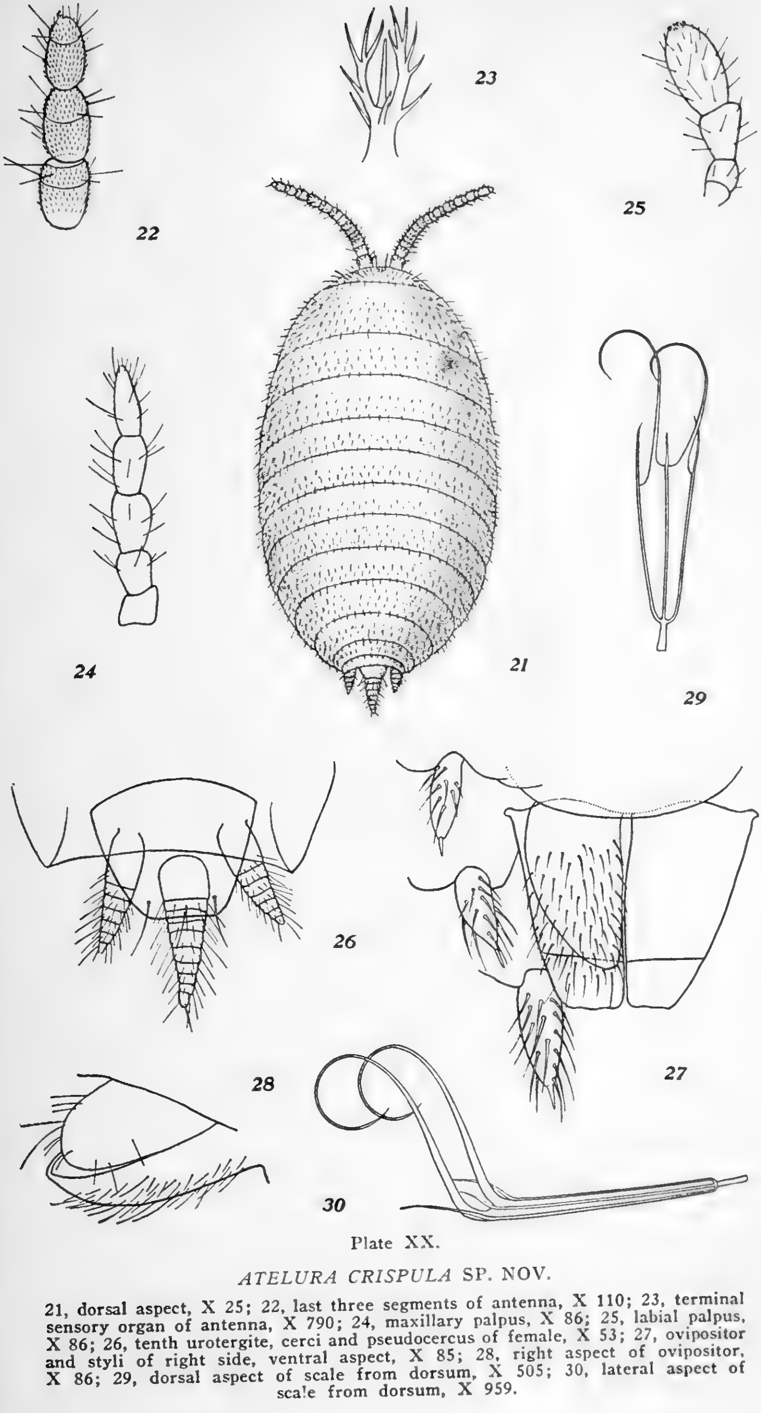

Plate XX.

ATELURA CRISPULA SP. NOV.

21, dorsal aspect, X 25; 22, last three segments of antenna, X 110; 23, terminal sensory organ of antenna, X 790; 24, maxillary palpus, X 86; 25, labial palpus, X 86; 26, tenth urotergite, cerci and pseudocercus of female, X 53; 27, ovipositor and styli of right side, ventral aspect, X 85; 28, right aspect of ovipositor, X 86; 29, dorsal aspect of scale from dorsum, X 505; 30, lateral aspect of scale from dorsum, X 959.

Labial palpi (fig. 25) with segments as 5:7:14:26; last segment elliptical, twice as long as broad, with six branching sensory papillae near the apex. Tenth abdominal tergite subtrapezoidal (fig. 26), with posterior margin entire (feebly emarginate in one specimen) and with postero-lateral borders rounded. Cerci short and stout (fig. 26); pseudocercus ("median cercus") one-fifth longer than the lateral cerci, 10- or 11-segmented; lateral cerci 7- or 8-segmented. Posterior abdominal segments short, bringing the styli close together. Styli three pairs, short and stout (fig. 27), on the 7th to 9th abdominal segments, respectively. Ovipositor short and stout (fig. 28), the ventral valves exceeding the dorsal; dorsal valves short and stout, rounded apically; ventral valves in ventral aspect suboblong, apically truncate, with a subapical transverse suture (fig. 27). Most of the hairs of the body are dense, short and stiff; long suberect hairs occurring on the head. Most of the scales, which clothe the dorsum densely, are of the peculiar and characteristic form shown in figs. 29 and 30, each scale having a pair of long curling branches. Length 2.3 mm.

Six specimens, all females, Kartabo, Bartica District, British Guiana, August 4, 1920 (No. 182).

Atelura crispula had as host *Armitermes* (*A.*) *percutiens* n. sp., which builds a fairly well constructed dirt nest on the ground or very close to the ground.

Atelura cucullata sp. nov.

(Plate XXI, figs. 31 to 39).

Golden yellow; appendages white, with pseudocercus brownish basally. Form elliptical (fig. 31), twice as long as broad, thorax to abdomen in length as 5:9. Abdomen smoothly confluent with thorax in dorsal aspect. Body strongly arched, as in a "sow-bug". Thoracic terga projecting down over the bases of the legs.

Antennae (fig. 32) short and stout, one-tenth the length of the body, 13-segmented, without subsegments; last segment ovate, the three preceding segments cup-shaped, about as broad as long. Maxillary palpi (fig. 33) with segments as 1:3:3:4:5;

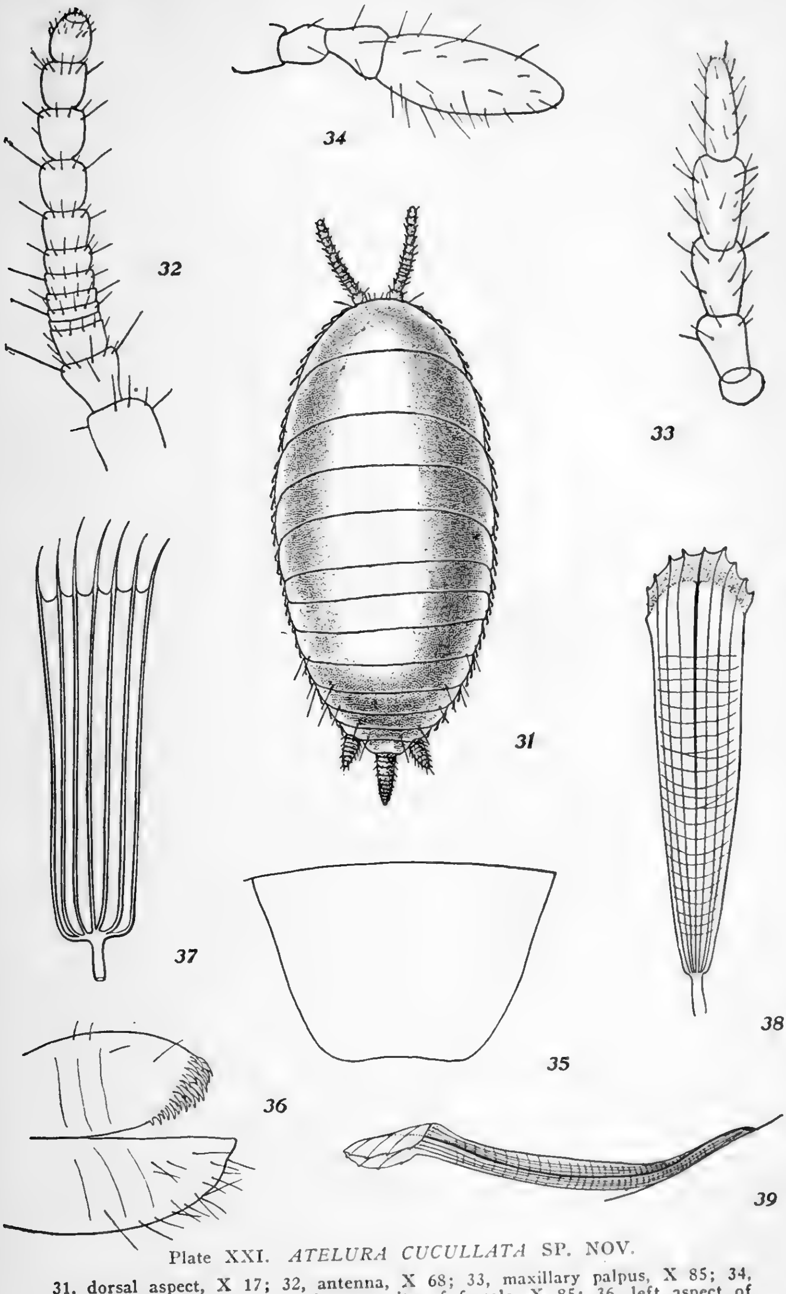

Plate XXI. *ATELURA CUCULLATA* SP. NOV.

31, dorsal aspect, X 17; 32, antenna, X 68; 33, maxillary palpus, X 85; 34, labial palpus, X 85; 35, tenth urotergite of female, X 85; 36, left aspect of ovipositor, X 86; 37, typical unmodified scale from dorsum, X 505; 38, modified scale from dorsum, dorsal aspect, X 505; 39, Modified scale from dorsum, lateral aspect, X 505.

last segment subconical, three times as long as broad. Labial palpi (fig. 34) with fourth segment three times as long as the third and lanceolate-elliptical, with length to breadth as 5:2. Tenth abdominal tergite (fig. 35) trapezoidal, with posterior border feebly emarginate and postero-lateral angles broadly rounded. Cerci short and stout; lateral cerci 8-segmented; pseudocercus ("median cercus") twice as long as the lateral cerci, 11-segmented. Posterior abdominal segments short, bringing the styli close together. Styli three pairs, on 7th to 9th abdominal segments, respectively. Ovipositor (fig. 36) with the ventral valves longer than the dorsal; both pairs segmented; dorsal valves with a terminal cluster of hooks. Dorsum of body without hairs, excepting a few stiff lateral hairs on the posterior abdominal segments (fig. 31). Dorsal scales dense, there being in each transverse series two types of scales, alternating with each other in position: the simple type shown in fig. 37 and a peculiar modified form (figs. 38, 39) in which the distal end is bent downward, forming a kind of hood. Length, 3.6 mm.

Two specimens, both females, Kartabo, Bartica District, British Guiana, September 9, 1920 (No. 321).

Atelura cucullata occurred with *Cornitermes pugnax* n. sp., which builds a nest close to the ground or under the ground, the nest being rather loosely constructed.

Nicoletia emersoni sp. nov.

(Plate XXII, figs. 40 to 48). (Plate XXIII, figs. 49, 50).

Pale yellow; appendages white. Campodeiform (fig. 40), five times as long as broad; body parallel-sided, the last four abdominal segments becoming successivly narrower. Thorax not broader than abdomen, from two-fifths to two-thirds as long as the latter. Head much longer than prothorax, with a median dorsal pentagonal sclerite (fig. 40). Eyes absent. Antennae long (incomplete in the specimens examined); first six segments (fig. 41) in relative lengths as 28:20:9:5:8:10; first segment large, subovate; second cylindrical. In one specimen the first 12 segments are simple (fig. 41) and each of

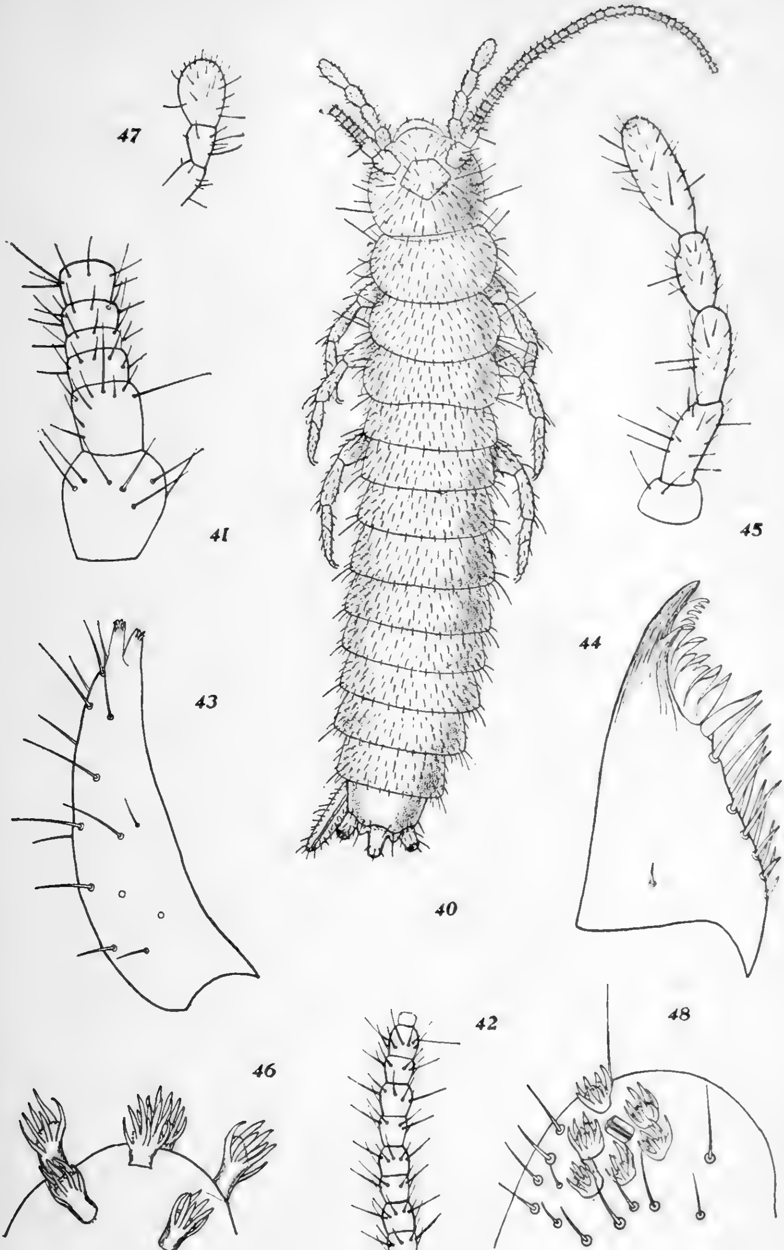

Plate XXII.

NICOLETTA EMERSONI SP. NOV.

40, dorsal aspect, X 25; 41, base of antenna, X 100; 42, distal segments of antenna, each primary segment being divided into two subsegments, X 100; 43, galea of right maxilla, ventral aspect, X 250; 44, lacinia of right maxilla, ventral aspect, X 250; 45, maxillary palpus, X 86; 46, apical sense organs of left maxillary palpus, X 677; 47, end of labial palpus, X 86; 48, subapical sense organs of left labial palpus, X 505.

the remaining 14 segments is divided into two equal subsegments (fig. 42), making apparently 40 segments in all; total number of segments unknown; second segment in male without a secondary sexual process. Galea maxilla (fig. 43) with a pair of terminal papillae. Lacinia (fig. 44) with large apical tooth, small inner subapical tooth, and an inner subapical comb, with series of inner teeth and setae as in fig. 44. Maxillary palpus with segments as in fig. 45; last segment subelliptical, three times as long as broad, with six apical branched sensory papillae (fig. 46), each consisting of a stalk bearing curving branches that surround a central sensory lobe. Last segment of labial palpus (fig. 47) clavate, two-thirds as broad as long, with a group of six distal sensory papillae (fig. 48) like those of the maxillary palpus except in being sessile. Tenth abdominal tergite in both sexes with a shallow median rounded emargination and rounded posterior lobes (fig. 49). Cerci and pseudocercus of unknown length (being broken off). Styli eight pairs, on the second to ninth abdominal segments, respectively; with accompanying eversible vesicles (fig. 50) except on the ninth segment. Ovipositor in form and length as in fig. 40. Parameres of male finger-like in form, each with a terminal seta (fig. 50). Clothing of dense short setae of irregular lengths, with long setae on the head, lateral borders of the thoracic segments, and postero-lateral angles of the abdominal segments. Length, 4 mm.

Nicoletia emersoni approaches *N. neotropicalis* Silvestri ('01*b*), from Argentine, Paraguay and Brazil, but differs from that species in having wider abdominal segments, and the pseudocercus of the male not narrower than the cerci, as well as in other respects. The first three segments of the maxillary palpus lack the spines shown in the figure by Escherich ('04) and the terminal sensory papillae of the maxillary palpus differ in form in the two species.

Two specimens, one of each sex, Penal Settlement, Bartica, March 24, 1919. Not termitophilous.

I take pleasure in naming this species after Mr. Alfred Emerson.

Borecus gen. nov.

Eyes and postantennal organs absent. Antennae short, but longer than the head, four-segmented, without subsegments or rings. Mouth parts biting. Prothorax reduced but not rudimentary. Mesonotum large but not produced over the base of the head. Fourth abdominal segment much longer than the third. Tibiotarsi two-segmented. Unguis with a pair of large inner basal lobes and a pair of smaller outer basal lobes, or pseudonychia. Unguiculus well developed, with a strong outer basal lobe. One tenent hair. Furcula strongly developed, appended apparently to the fifth abdominal segment. Manubrium longer than dentes. Dentes unsegmented, smooth dorsally, without crenulations or rings, and without chitinous hooks, but with two dorsal longitudinal series of large feather-like setae, and clothed ventrally with scales. Mucrones strongly elongate, non-lamellate, tomocerine in type but without the basal tooth, with a large apical tooth, a large subapical dorsal tooth, and a varying number of smaller dorsal teeth between the subapical tooth and the base of the mucro. Dens with an apical pair of long hyaline scales extending under the mucro. Clothing of both scales and setae, the latter mostly fringed and frequently clavate.

This new genus falls near the peculiar genus *Oncopodura*, described from the species *hamata*, from the Crimea, by Carl and Lebedinsky ('05), and represented also by a second species, *crassicornis* Shoebotham ('11) from England and Poland (Stach '21). *Oncopodura* is unlike *Borecus* in having the following differentiating characters: Postantennal organs present or absent. Prothorax rudimentary. Fourth abdominal segment slightly longer than the third. Unguis simple, without inner teeth, without pseudonychia, and without large inner basal lamellae, though narrow pointed lateral lamellae may or may not be present. Unguiculus simple, without teeth or lobes. Tenent hairs absent immediately above the unguis, but a strong clavate hair projects from the tibiotarsus about midway from the base to the apex on the second pair of legs only. Dentes with chitinous hooks, with slender fringed hairs dorsally, but

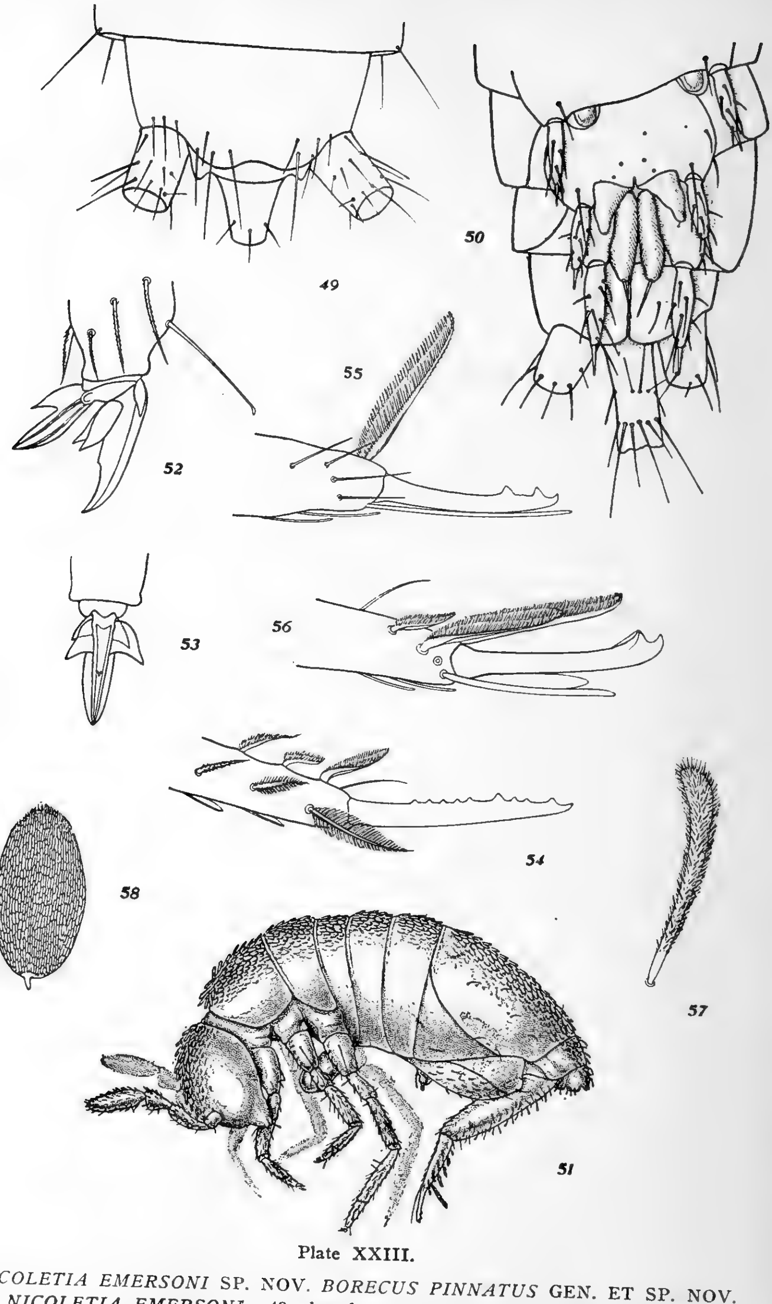

Plate XXIII.

NICOLETIA EMERSONI SP. NOV. *BORECUS PINNATUS* GEN. ET SP. NOV.

NICOLETIA EMERSONI.—49, dorsal aspect of tenth urotergite of female, X 70; 50, ventral aspect of male to show parameres and last three pairs of styli, X 88.

BORECUS PINNATUS.—51, lateral aspect, X 68; 52, right hind foot, X 632; 53, concave aspect of left hind unguis, X 632; 54, left aspect of right mucro and end of dens, X 380; 55, left aspect of left mucro and end of dens, X 588; 56, left aspect of left mucro and end of dens, X 404; 57, dorsal clavate fringed seta from base of dens, X 1008; 58, typical scale from dorsum, X 648.

without broad pinnate setae. Mucro with a well developed hyaline membrane, or lamella.

The genus *Borecus* may be placed with *Oncopodura* in the subfamily Oncopodurinae of the family Entomobryidae. The affinities of *Oncopodura* lie with *Cyphoderus*, as Stach ('21) has pointed out.

Borecus pinnatus gen. et sp. nov.

(Plate XXIII, figs. 51 to 58).

White throughout (fig. 51). Eyes and postantennal organs absent. Antennae longer than the head, varying from slightly longer (in small specimens) up to 1.5 times as long as the head (large specimens); four-segmented, without subsegments; antennal segments varying greatly in relative lengths, but with third segment always much shorter than the second or the fourth; first segment cylindrical; second clavate, becoming subcylindrical with age; third clavate; fourth subconical, elongating with age; third segment with a subapical pair of elliptico-cylindrical sensory pegs lying exposed, not covered by an integumentary fold; fourth segment distally with short curving sensory setae; antennal clothing of abundant short minutely fringed setae, with occasional outstanding simple setae. Mouth parts biting. Prothorax reduced. Mesonotum rounded anteriorly, covering the prothorax, the latter abnormally exposed in fig. 51, but not projecting over the base of the head. Metanotum two-thirds as long as mesonotum. Tibiotarsi with a transverse suture one-third from the apex; femora with a transverse suture near the apex; these sutures not always evident, however. Legs clothed with abundant fringed setae, with one (occasionally two) long stout outstanding fringed setae on each segment of each leg. Unguis (figs. 52, 53) straight basally, curving apically, with a pair of large inner basal sublanceolate lobes extending half the length of the claw; with a pair of smaller basal lateral lanceolate lobes (pseudonychia); and with an obscure tooth (doubled?) or angle near the middle of the inner margin. Unguiculus (fig. 52) large, extending three-fourths as far as the unguis, with a large basal subovate acuminate outer lobe. Hind claws the largest. Tenent hair single, feebly knobbed. Ventral tube with a pair of eversible rounded vesicles. Fourth abdominal segment much longer than the third, varying in relative length but usually from three to five times as long as the latter. Rami of tenaculum quadridentate; corpus with a single ventral seta. Furcula apparently appended to the fifth abdominal segment, attaining the ventral tube in the larger specimens, but not in the smaller. Manubrium elongate, scarcely tapering; dorsally with many setae, either simple, or clavate and fringed; ventrally with scales. Dentes two-thirds as long as manubrium, slightly tapering, one-segmented, smooth dorsally, without crenulations or rings, with two dorsal rows of large pinnae, or feather-like setae (figs. 54-56) which, proceeding posteriorly, become successively larger. The setae of the outer series are 5-10 in number (according to age), the proximal one, two, or more setae being relatively simple and the remainder modified. The setae of the inner series are 4-7, the proximal one or two being simple, and the last of the pinnate setae (subapical) being exceptionally long (figs. 55, 56), sometimes a little longer than the mucro. At the base of the dens dorsally is a stout clavate erect fringed seta (fig. 57). Under the mucro are two long, narrowly elliptical, hyaline, minutely striated scales (figs. 55, 56), one of which may extend beyond the mucro; these scales arising near the apex of the dens. Each dens bears a lateral row of 4-15 simple or feebly fringed setae; ventrally the dentes are clothed with scales. Mucrones (figs. 54-56) one-half to three-fifths as long as the dentes, slender and tapering in dorsal aspect, in form much like those of *Tomocerus*, with a large apical tooth, usually hooked, and a dorsal subapical tooth subequal to the first. Between the base of the mucro and the subapical tooth is a dorsal row of small intermediate teeth (fig. 54), one of which is larger than the others. These intermediate teeth may, however, be absent, as in fig. 56, and when present vary in number from 1 to 11. Mucronal lamellae are absent, excepting in some specimens a minute lamella extending forward from the anteapical tooth as in fig. 56. The scales that clothe the head and body dorsally differ in size and vary in form from elliptical to oval, ovate or roundish, but are commonly elliptical, as in fig. 58. Fringed setae occur on the head anteriorly, on the fourth abdominal segment posteriorly, and on the fifth and sixth abdominal segments, many of the setae on the genital and anal segments being strongly clavate. Length of specimens, 0.54 mm. to 1 mm.

This species varies considerably, some of the variation being correlated with the age of the individual (as indicated by its size), and some being independent of age. The dorsal setae of the dentes increase in number with the age of the individual, and more of them become pinnately modified. In several small specimens, 0.54 mm. to 0.87 mm. in length, the dorsal intermediate teeth of the mucrones were absent; in one individual, 0.9 mm. in length, there was one of these teeth on each mucro; in five specimens, all 1 mm. long, the number of intermediate teeth varied from one to eleven.

Fifteen specimens, Kartabo, Bartica District, British Guiana, June 21, 30, July 13, 30. (Field Nos. 57, 87, 92, 101.)

Hosts.—Rhinotermes (*R.*) *marginalis* (*L.*), *Nasutitermes* (*N.*) *costalis* (Holmgren), *Nasutitermes* (*N.*) *octopolis* Banks, *Nasutitermes* (*N.*) *acajutlae* (Holmgren).

Borecus pinnatus was with four species of termites: *Nasutitermes* (*N.*) *octopilis* Banks, *costalis* (Holmgren), *acajutlae* (Holmgren); *Rhinotermes* (*R.*) *marginalis* (Linné). All but the last of these species build conspicuous, well formed nests above ground.

Mr. Emerson reports that this collembolan was found very often in large numbers in nests, and says, "I think it very likely that the same species is found outside of termite nests, but found one striking illustration of their true association with the termites. One morning I found an entire termite colony of the species *Nasutitermes* (*N.*) *costalis* (Holmgren) migrating over a sandy stretch of ground. The king and queen termites in addition to the workers and soldiers were all going along in a long file from a clump of bamboos to our dwelling. In addition to numerous other guests found among the termites, springtails were also running along the trail and were undoubtedly migrating with the termite colony. To my mind, this is a conclusive proof that the springtails have a distinct liking for life among the termites. They run rapidly about among the termites in the nests and I have never observed any hostile action toward them on the part of the termites. They are also pantermitophilous, as illustrated by the different host species, and in the case where they were found associated with *Rhinotermes* (*R.*) *marginalis* (Linné) there was no particualr nest, the termite colony being very small. It therefore seems to me that the association of the Collembola with the termites is rather more loose than is the case with the species of *Atelura* and most other synoeketes, and it is highly probable that they are not entirely dependent upon the termites for their existence."

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ON THREE APPARENTLY NEW SPECIES OF TERMITAPHIS (Hem. Het.)[1] *

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(Plate XXIV)

The following new species of *Termitaphis* were received for study from Dr. W. M. Mann, to whom they had previously been sent for examination by Dr. Alfred Emerson of the University of Pittsburgh.

The genus *Termitaphis* was first established by Wasmann[3] in 1902, but was not accurately characterized until 1911, when Silvestri[4] described two new members of the genus, presented a critical generic diagnosis and erected a new family in the suborder Heteroptera for its reception. Later, Mjöberg[5] gave a short description of a species obtained in Australia, with the promise to describe it in greater detail at some future date. This extended description has apparently never been published, and the original characterization is too brief to permit a comparison of Mjöberg's species with those described below.

Wasmann's species was obtained in Columbia, and the first species described below may possibly be identical with it, although this cannot be definitely established on account of the incompleteness of the description of the genotype and the probable inaccuracy of the figures given by Wasmann. It has accordingly been described as new.

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* Tropical Research Station, Contribution Number 140.

[1] Tropical Research Station, Contribution Number 140.

[2] The figures illustrating the structural characteristics of these species have been worked out and prepared by Emily Morrison.

[3] Wasmann, E. Species novae Insectorum Termitophilorum ex America Meridionali. In Tidj. voor Ent. vol. 45, 1902, pp. 95-107, 9 pl.

[4] Silvestri, F. Sulla Posizione Sistematica del Genera Termitaphis Wasm. (Hemiptera), etc. In. Boll. del Lab. di Zool. Gen. e. Agraria della. Rsc. Sup. d'Agr. in Portici. vol. 5, 1911, pp. 231-236, fig. I-VI.

[5] Mjoberg, E. Preliminary description of a new representative of the family Termiticorddae Silv. In Entomologisk Tidskrift, etc. vol. 35, 1914, p. 98, 9 fig.

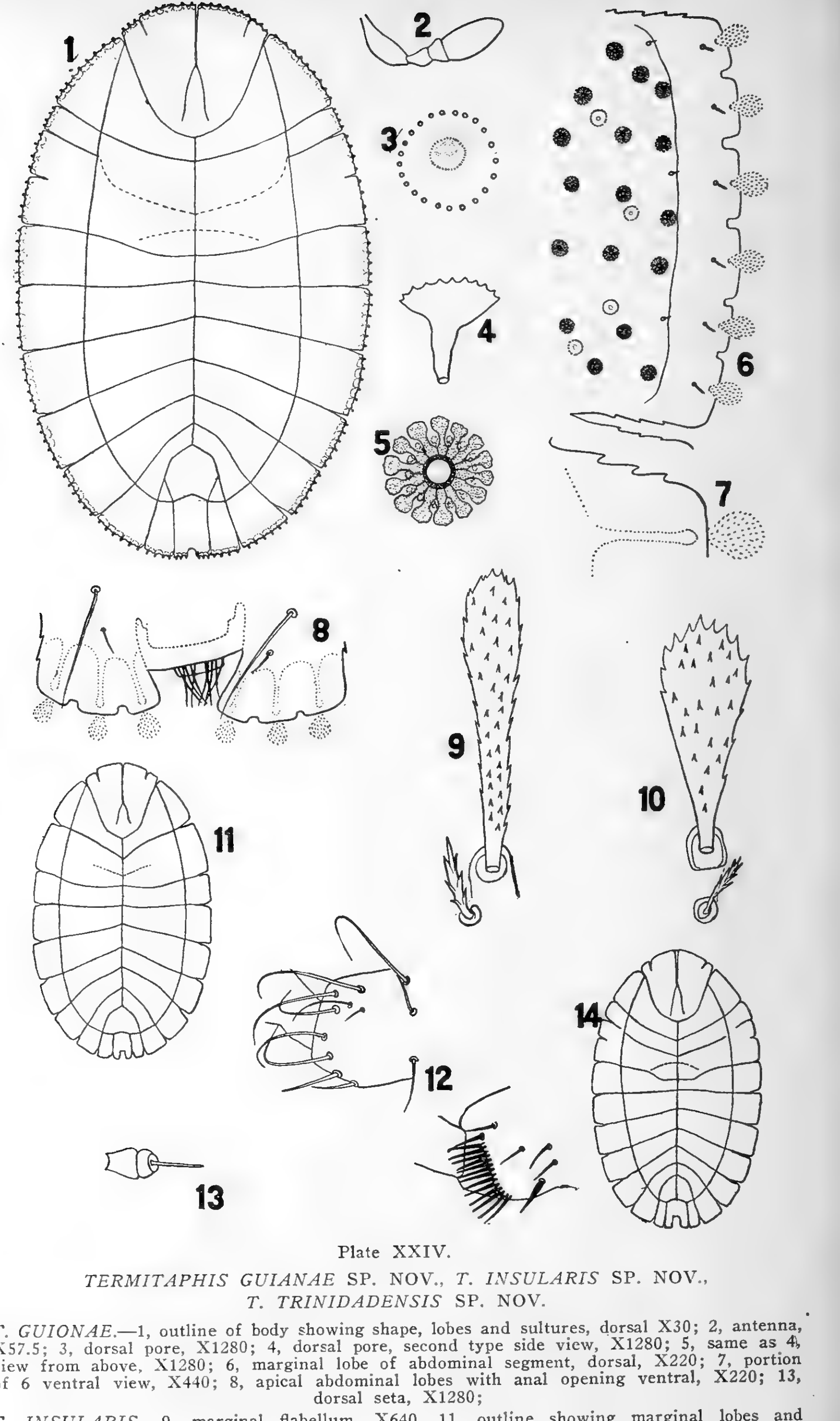

Plate XXIV.

TERMITAPHIS GUIANAE SP. NOV., *T. INSULARIS* SP. NOV., *T. TRINIDADENSIS* SP. NOV.

T. GUIONAE.—1, outline of body showing shape, lobes and sultures, dorsal X30; 2, antenna, X57.5; 3, dorsal pore, X1280; 4, dorsal pore, second type side view, X1280; 5, same as 4, view from above, X1280; 6, marginal lobe of abdominal segment, dorsal, X220; 7, portion of 6 ventral view, X440; 8, apical abdominal lobes with anal opening ventral, X220; 13, dorsal seta, X1280;

T. INSULARIS.—9, marginal flabellum, X640, 11, outline showing marginal lobes and sutures, dorsal, X17.5.

T. TRINIDADENSIS.—10, marginal flabellum, X1280; 12, apex of anterior tibia, two sides, X220; 14, outline of body showing marginal lobes and sultures, dorsal, about X17.5.

Termitaphis guianae sp. nov.

(Plate XXIV, Figures 1 to 14)

Very similar to *T. mexicanus* as described by Silvestri, differing only in certain details: length 2 mm. width 1.44 mm., arrangement of the dorsal sutures, particularly the anterior pseudo-suture of the mesothorax, differing somewhat from that shown in Silvestri's drawing (cf. fig. 1 with fig. III of Silvestri's paper); the fourteen marginal lobes of each half of the body bearing tubes and flabella as follows, counting from the cephalic apex: 7, 3 (head); 9-10 (prothorax); 4, 4 (mesothorax); 4-5 (metathorax); 5-6, 6, 6-7, 6-7, 6, 6, 4, 3 (abdomen) the usual number for each prothorax lobe being nine, for each mesothoracic lobe, four, and for each metathoracic and abdominal lobe, anterior to the last two, six, differing in these from *mexicanus* where the usual number for the mesothoracic lobes is five, for the anterior abdominal lobes, seven, and for apical abdominal lobes, two instead of three flabella; these flabella with minute setae or denticulae over the entire surface as well as along margin and with similar minute setae very numerous on the lobes; lateral margins of each lobe conspicuously serrate, not smooth; derm pores of two sorts, some simple cylindrical tubes surrounded by a circular clear area, and with a funnel-shaped opening, others with an intricate radiate arrangement; with occasional stout setae dorsally, each set at the end of a tube through the derm; with two larger thoracic and six well developed but smaller circular abdominal spiracles followed by an incompletely developed seventh abdominal spiracle; anterior legs in addition to curved hairs and some stiff spines with a straight comb of long stiff hairs at apex of tibia; other characteristics, so far as can be observed, agreeing very closely with those of *mexicanus* as described and figured by Silvestri.

This species has been described from three specimens with the following information:

Kartabo, British Guiana, No. 48. Emerson.

Host.—Leucotermes crinitus (Emerson).

HOLOTYPE.—(A slide mount) and paratypes. Cat. No. 25034, U. S. National Museum.

Termitaphis trinidadensis sp. nov.

Very similar to the preceding, size almost identical, length 2 mm., width 1.5 mm., the chief differences being found in the somewhat more elongate and more slender marginal flabella and in the different numbers of marginal flabella for corresponding lobes of the body, the arrangement of these being as follows: 7:3 (head); 8 (prothorax); 4, 4 (mesothorax); 3-4 (metathorax); 4, 4, 4, 4, 4, 4, 4, 3 (abdomen).

This species has been characterized from a single specimen with the following information:

"Port-of-Spain, Trinidad. 26-XI-20. Emerson. No. 495a."

Host.—*Leucotermes tenuis* (Hagen).

HOLOTYPE.—(A slide mount). Cat. No. 25035. U. S. Nat. Museum.

Termitaphis insularis sp. nov.

Body somewhat more elongate than in the two preceding species, length, 2.75 mm.; width, 1.6 mm.; legs more elongate and more slender than with the last, more nearly resembling those of *T. guianae;* differing conspicuously from all the other accurately described species in that the body has only 12 lobes on each half and from the two preceding species in the much more elongate and slender marginal flabella, these resembling those of *T. subafra* Silvestri; the arrangement of these flabella as follows: 7, 3 (head); 10-11 (prothorax); 11 (meso and metathorax); 6, 7-8, 6-7, 7, 7, 6, 4, 3 (abdomen), the fusion occurring in the meso and metathoracic lobes, usually three on each side; in other respects quite similar to the two species already described.

Characterized from a single specimen with the following information:

"Port-of-Spain, Trinidad. 26, XI, 20. Emerson. No. 495a."

Host.—*Leucotermes tenuis* (Hagen).

HOLOTYPE.—(A slide mount). Cat. No. 25036. U. S. Nat. Museum.

There may be seen in the posterior portion of the abdomen of the specimen on which this species is based, some curled and twisted tubes and some other less definite, apparently chitinized structures which suggest themselves as possibly retracted male sexual organs. No definitely developed copulatory or other external sexual modifications of the apex of the abdomen, such as are to be found in many of the Heteroptera, have been noted in these specimens, and nothing appears to be known regarding the differences in sexes in the genus. Since the last two species described were received in the same container, and were collected from the same nest of termites, the further possibility presents itself that they are the two sexes of one species, although the obvious differences in certain of the comparable structural characters fully justifies their separation at this stage of our knowledge of these insects.

By way of comment, it may be noted that the writer's interpretation of the body segmentation differs from that given by Silvestri in his generic diagnosis and in his figures of both *mexicanus* and *subafra*. In both species Silvestri shows a total of fourteen lobes for each half of the body of which two are allotted to the head, two to the prothorax, two to the mesothorax, one to the metathroax, and one each to five complete and two incomplete abdominal segments. It would appear that Silvestri failed to observe the anterior thoracic spiracles, located close to each prothoracic coxa, and highly probable that his specimens actually possess a partially suppressed seventh abdominal spiracle, as do all of those examined in connection with the preparation of the preceding descriptions.

These two additions give a total of nine more or less developed spiracles for the genus, instead of seven as given by Silvestri, of which the two anterior are slightly but distinctly larger and appear to be placed at the anterior margins of the under surface of the meso and metathorax, leaving seven pairs for the abdomen and resulting in a reassignment of the marginal lobes of those species having fourteen lobes to each half of the body as follows: two to the head; one to the prothorax, two to the mesothorax, one to the metathorax, and eight to the abdomen.

Silvestri's key to the species of this genus may be modified as follows to include the newly described species:

a. Flabella of marginal lobes simple entire setae[6] *circumvallata* Wasm.

aa. Flabella of marginal lobes broader, spatulate, margins minutely serrate.

b. Margin of body with fourteen lobes to each half.

c. Marginal flabella short and broad, at most hardly more than twice as long as wide.

d. Apical abdominal segments with two flabella on each lobe; anterior abdominal segments normally with seven flabella on each margin *mexicanus* Silv.

dd. Apical abdominal segments with three flabella on each lobe; anterior abdominal segments normally with six or fewer flabella on each margin.

e. Anterior abdominal segments normally with six flabella on each margin; legs relatively slender............*guianae,* sp. nov.

ee. Anterior abdominal segments normally with four flabella on each margin; legs relatively short and stout............*trinidadensis,* sp. nov.

cc. Marginal flabella elongate, slender, the length much more than twice the width............*subafra* Silv.

bb. Margin of body with twelve lobes to each half; flabella elongate............*insularis,* sp. nov.

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[6] Based only on figures and description of Wasmann.

ON FOUR TERMITOPHILOUS MILLIPEDS FROM BRITISH GUIANA*

By Ralph V. Chamberlin

(Plates XXV, XXVI, XXVII)

The types of the new millipeds here described were taken by Mr. Alfred Emerson from nests of termites at Kartabo, Bartica District, British Guiana, in December, 1919, and August, 1920. All three pertain to the Cryptodesmidae in the broad sense, a group of mostly very small polydesmoid forms which in tropical regions appear to be rather numerous and widespread although commonly overlooked because of their small size and obscure habits. A number of species have previously been reported as occurring in termite nests and others in ant nests.

Leuritus gen. nov.

Body consisting of the head and twenty segments.

Head concealed from above by the collum which projects widely beyond it. Antennae moderately long, with the fifth joint much longer than the sixth.

Collum with a broad horizontal border which is divided by radial sulci into twelve lobes. Central region of collum moderately convex and tubercular.

The keels of the succeeding tergites wide and horizontal, the lateral border divided into three areas by radial sulci excepting the fifth, which shows two, and the most caudal ones, which show a fourth lobe in some degree developed. The poriferous keels in respect to lobation not differing from the non-poriferous. Repugnatorial pores minute, situated near caudalateral corner of keels of segments V, VII, XI, X, XII, XIII, and XV to XIX; pores not opening on special cones or lobes and detected with difficulty. Tergites between keels bear-

* Tropical Research Station, Number 141.

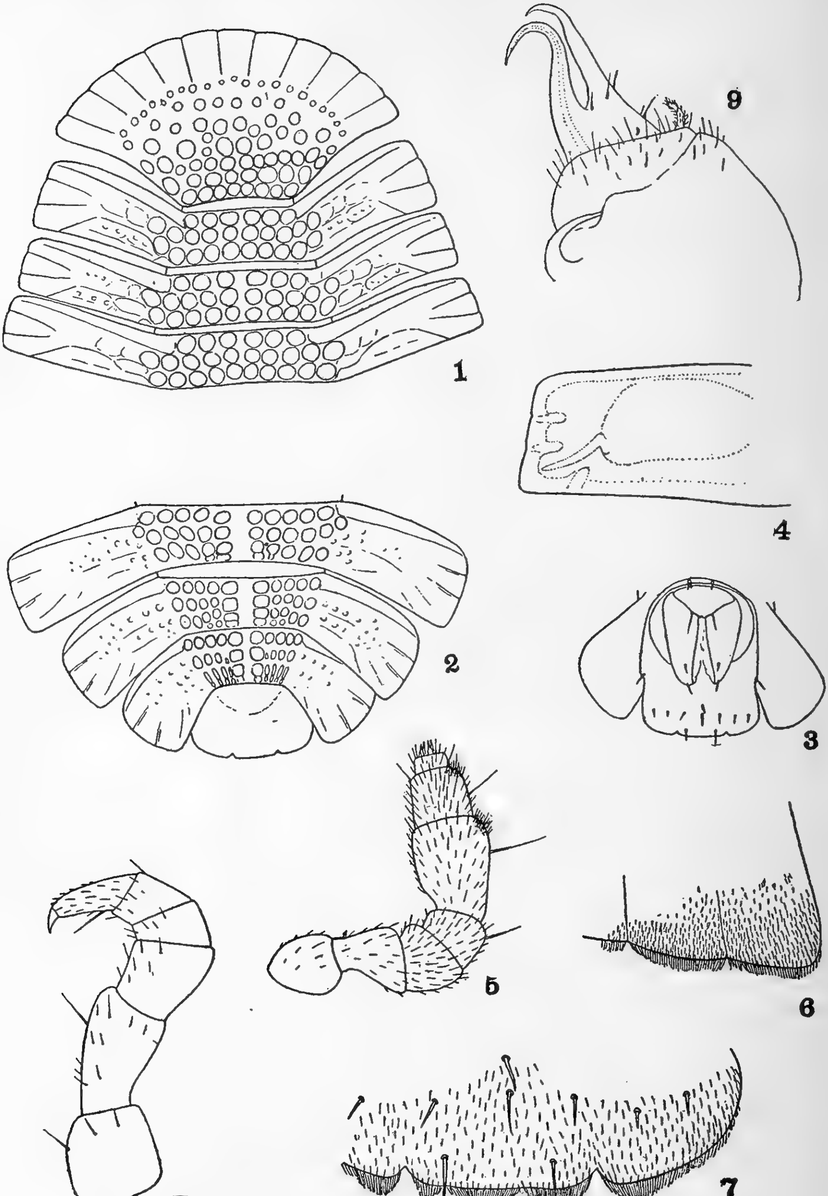

Plate XXV.

GASATOMUS EMERSONI SP. NOV., *TIDOTERUS SEQUENS* SP. NOV.

1, the four anterior tergites from above; 2, the four posterior tergites from above; 3, caudal end of body from below; 4, keel of thirteenth segment cleared and view by transmitted light to show the course of the repugnatorial duct; 5, antenna; 6, portion of collum more highly magnified to show hairs; 7, caudal portion of anal tergite from below under higher magnification to show hairs and setae; 8, a leg; 9, a gonopod of male in subcaudal view.

ing three transverse rows of tubercles, none of them specially enlarged to form more prominent longitudinal series.

Last tergite broad, flat, rounded behind, the margin tri-lobed; widely surpassing the anal valves.

Second article of legs longer than the third and than the sixth.

Gonopods of male with the basal joint enlarged as usual, but the telopodite extending beyond it and clearly exposed. The telopodite deeply furcate, the two branches slender, smooth and curved.

Genotype.—*Leuritus termitophilus* sp. nov.

In the general form and proportions of the collum and keels much resembling the West Indian genus Tridesmus; but the posterior lobes of the poriferous keels are not at all enlarged as in that genus and the caudal tergite is broad and rounded instead of triangular. It is also quite distinct in the structure of the gonopods.

Leuritus termitophilus sp. nov.

(Plate XXV, Figures 1 to 7)

General color flavous, often appearing in part brownish because of adherent foreign material. Surface of tergites densely clothed with very short hairs which are evident particularly on borders of keels and collum. (Cf. pl. XXV, figs. 6 and 7.)

The head is compressed dorsoventrally and presents a sharp transverse edge across vertex and down each side. Sulcus sharply impressed across vertex, furcate below, sending a branch to base of each antenna. A deep groove on each side of the head above into which the basal articles of the antenna fit. Labral margin with three teeth.

Fifth joint of antennal article about two-thirds as thick as long and twice as long as the sixth article. (Cf. pl. XXV, fig. 5.)

Collum depressed, broad; rim broad, with deep radial sulcis, but with the corresponding marginal notches slight; surface within the border tubercular. (Pl. XXV, fig. 1.)

On the keels of the following tergites in general the anterior border is elevated; the lateral lobes indicated by radial furrows but the marginal notches slight or obsolete. Dorsum of tergites between keels densely tubercular, the tubercles not unequally developed in a way to leave longitudinal series of more prominent ones; tubercles in general in three transverse rows on each tergites; the tubercles form also longitudinal rows which on each tergite tend to run ectad of directly forward from caudal end. (Pl. XXV, figs. 1 and 2.) The course of the duct from the repugnatorial gland to the pore is indicated in pl. XXV, fig. 4.

The anal tergite with caudal margin broad, at middle nearly straight, the lateral corners rounded; sides subparallel; surface clothed with very fine short hairs; on ventral surface a transverse series of seven short setae, with two on median lobe caudad of these and one cephalad of them. (Cf. pl. XXV, figs. 3 and 7.)

The gonopods of the male as represented in pl. XXV, fig. 9.

Length, 4.5 mm.; width, 1.5 mm.

Locality.—British Guiana, Kartabo, Bartica District, Aug. 16, 1920. Fifteen specimens, some of which are only partly grown, taken from the nest of *Nasutitermes* (*Nasutitermes*) *brevipilus* (Emerson).

Stenitus gen. nov.

Consisting of the head and twenty segments.

Fifth joint of antennae much exceeding the sixth.

Collum high and convex, with sides steep; the rim depressed and descending almost in line with the sides above it, narrow, with ten areas separated by radial sulci.

Keels of tergites in general short and bent downward, the lateral border of the keels of the second tergite showing three areas or lobes separated by sulci, the succeeding ones showing only two. Tergites between keels tubercular, the tubercles forming distinct longitudinal rows of which one a little each side of middle and one on each side are higher or more prominent, especially on the more posterior tergites; three tubercles in each row on each segment. Repugnatorial pores minute as in Leurodesmus, situated toward posterior lateral corner on segments V, VII, IX, X, XII, XIII, and XV to XIX inclusive.

Anal tergite large and freely exposed, caudally well rounded.

Second joint of legs longer than second and than sixth.

Genotype.—*S. guiananus* sp. nov.

Stenitus guiananus sp. nov.

(Plate XXVI, Figures 1 to 8)

General color flavous.

Median sulcus across vertex of head deep, furcate below, a branch running to each antennal socket. Vertex protruding each side of sulcus and densely granular. Head with a furrow on each side for the reception of the basal joints of the antennae. Fifth joint of antennae less than two times longer than wide and between four and five times longer than the sixth joint. (Pl. XXVI, fig. 7.)

Collum strongly tubercular excepting over the rim. Rim strongly depressed, the radial lines distinct, the corresponding marginal notches not deep.

Keels of the second tergite with marginal notches weakly developed; the notches scarcely evident on following keels when viewed at right angles to their surface, but when viewed obliquely the radial furrow may give the appearance of a marginal notch. Cf. pl. XXVI, figs. 1, 2 and 3.) Four rows of tubercles along the dorsum more prominent, particularly the two submedian ones; two rows of smaller tubercles between each two more prominent rows.

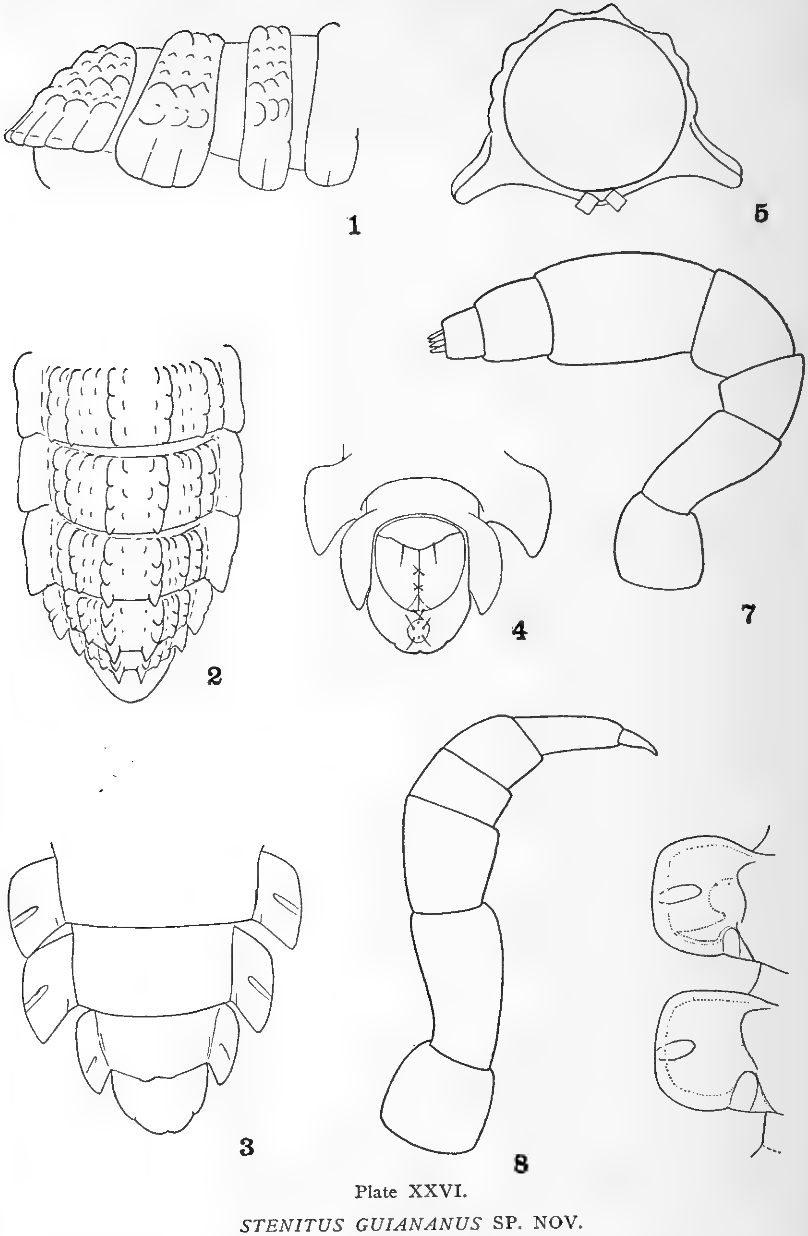

Plate XXVI.

STENITUS GUIANANUS SP. NOV.

1, anterior tergites in lateral view; 2, posterior tergites, dorsal view; 3, posterior end of another specimen in outline, with tergites depressed to bring keels into a more nearly horizontal position; 4, caudal end, ventral view; 5, sixth segment, anterior view, in outline; 6, tenth and eleventh keels viewed at right angles to surface; with course of repognatorial duct indicated on the tenth by dotted line; 7, antenna in outline; 8, a leg in outline.

The anal tergite much exceeding the nineteenth, caudally rounded, the margin notched at median line and on each side as shown in pl. XXVI, fig. 4.

Proportions of joints of legs as shown in pl. XXVI, fig. 8.

Length, 4.4 mm.; width, 7 mm.

Locality.—British Guiana, Kartabo, Bartica District. One adult female, all but the four anterior segments of another, and three immature specimens taken Aug. 16, 1920, from a nest of *Nasutitermes* (*Nasutitermes*) *brevipilus* (Emerson).

Gasatomus gen. nov.

Consisting of the head and twenty segments.

Head completely covered by the collum. Fifth joint of antennae much exceeding the sixth in length.

Border of collum nearly horizontal; divided by radial furrows into twelve areas or lobes, with corresponding marginal notches or crenations. Collum within the border convex and strongly tubercular.

Keels of succeeding tergites of moderate length; presenting laterally three lobes or areas separated by sulci and corresponding marginal incisions excepting the fifth, which have but two lobes, and the seventeenth, eighteenth, and nineteenth, which have four. Each repugnatorial pore opening at the apex of a special and prominent process projecting laterad from the posterior lobe. Pores present on segments V, VII, IX, X, XII, XIII, XV and XVI. Posterior margin of keels incised.

Last tergite freely exposed; much exceeding the processes of the nineteenth keels; with six marginal lobes or crenations.

Second joint of legs longer than the third and than the sixth.

Genotype.—*G. emersoni* sp. nov.

Much suggesting Cynedesmus, a genus known from Central America, the West Indies, and the Canary Islands. From that genus it differs clearly in the lobation of the keels.

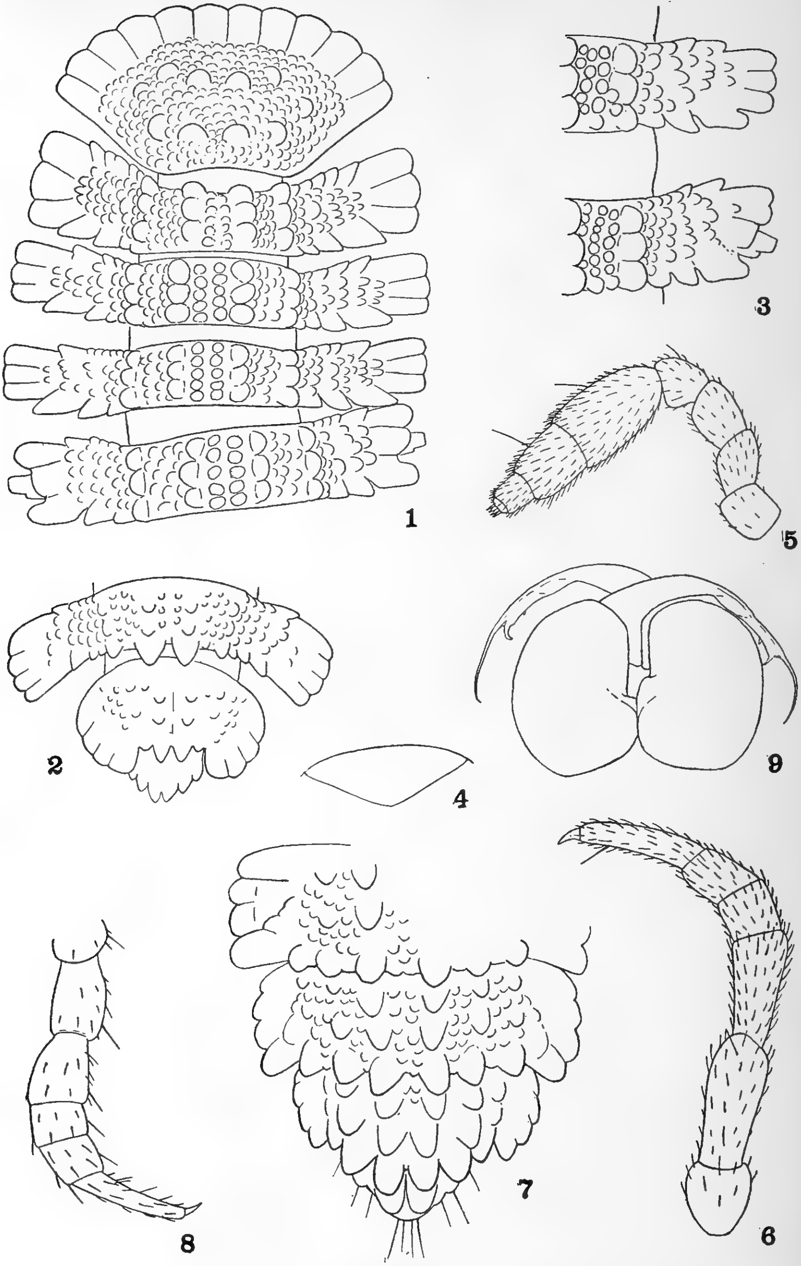

Plate XXVII.

GASATOMUS EMERSONI SP. NOV., *TIDOPTERUS SEQUENS* SP. NOV.

GASATOMUS EMERSONI.—1, anterior end, dorsal view; 2, caudal end, dorsal view; 3, eleventh and twelfth right keels, dorsal view; 4, anal scale; 5, antenna; 6, a leg.

TIDOPTERUS SEQUENS.—7, caudal end of body, dorsal view; 8, leg of eleventh degment; 9, gonopods of male, subventral view.

Gasatomus emersoni sp. nov.

(Plate XXVII, Figures 1 to 6)

Fulvous, appearing brown from adherent foreign material.

Vertex and frons of head densely granular; head smooth below level of antennae. Fifth joint of antennae about one and two-thirds times as long as thick, and not fully twice as long as the sixth article. (Pl. XXVII, fig. 5.)

Border of collum horizontal, its upper surface a little concave; the radial furrows sharply impressed and the corresponding marginal notches pronounced. Central portion of collum strongly convex and densely tubercular, with two transverse rows of larger tubercles as shown in pl. XXVII, fig. 1.)

The keels of the following tergites are trilobed laterally excepting those of the fifth, which are bilobed, and these of the seventeenth, eighteenth and nineteenth, which are four lobed. Caudal margin of keels with two principal lobes separated by narrow incisions, and a minor one proximad of these; the anterior margin with one distinct incision at base of the anterior lateral lobe. On the dorsum between the keels four longitudinal series of enlarged tubercles which greatly exceed the intervening ones in size, the three tubercles of each of these series on each tergite more or less confluent at base. Tubercles of the smaller size are also present on the keels excepting on the lateral lobes. The posterior tubercles of the two submedian principal series on the more caudal tergites are enlarged and project caudad from the plate. See further pl. XXVII, figs. 1 and 2.

Anal tergite with six small lobes or crenuli as shown in pl. XXVII, fig. 2. The anal scale broadly triangular, the caudal angle obtuse. (Cf. pl. XXVII, fig. 4.)

Form and proportions of joints of legs as shown in pl. XXVII, fig. 6.

Length, 7 mm.; width, 1.2 mm.

Locality.—British Guiana, Kartabo, Bartica District. Two females taken Aug. 30, 1920, from nest of *Nasutitermes* (*Subulitermes*) *baileyi* (Emerson).

Tidopterus gen. nov.

Composed of head and twenty segments.

Head nearly wholly covered by the collum from above. Fifth article of antennae but little longer than the sixth.

Border of collum divided by radial sulci and marginal notches into ten lobes.

Keels of succeeding tergites narrower than in Gasatomus, but the lateral margins lobed as in that genus, excepting that the sixteenth as well as the seventeenth, eighteenth, and nineteenth keels, has four marginal lobes. Pores present on segments V, VII, XI, X, XII, XIII, and XV. The pore processes as in Gasatomus as to form and position.

Nineteenth tergite with median caudal border bowed caudad beyond the caudal processes of keels, not forming the bottom of a quadrate excision between the latter. Last tergite exposed from above; bearing two large tubercles which conceal or nearly conceal it from above; margin not caudally incised at middle behind but with crenations, which are typically setiferous, on each side.

Second joint of legs not much differing in length from third, but both the second and third joints shorter than the sixth.

Telopodite of gonopods conspicuously exposed.

Genotype.—*Tidopterus sequens* sp. nov.

Related to Cynedesmus and Gasatomus but differing from both in lacking pores on the sixteenth segment and in the form of the nineteenth and twentieth tergites.

Tidopterus sequens sp. nov.

(Plate XXVII, Figures 7 to 9)

General color flavous.

Head with vertigial and frontal regions densely granular or finely tubercular on each side of the sulcus. The vertex of the head protrudes a little beyond the collum at the middle in dorsal view. Fifth article of antennae nearly equal in length and thickness; not much longer than the narrower sixth article, the lengths of these articles being about as 5:4.

Border of collum nearly horizontal, narrow, the incisions between the lobes deep. Convex surface densely tubercular, with two transverse rows of larger, well separated tubercles.

Dorsum of the following tergites in general strongly convex and densely tubercular, with four principal longitudinal series of larger tubercles. These higher tubercles are proportionately larger on the more caudal tergites where those at caudal border project conspicuously caudad. The keels are obviously narrower than in the type of Gasatomus, showing but a single lobe on caudal margin; but the lateral lobation and the form and relations of the pore bodies are essentially the same as in that genus.

Anal tergite exposed in dorsal view but its margin concealed, or nearly concealed, in dorsal view by the two large, contiguous, caudally projecting and distally rounded tubercles which it bears. (Cf. pl. XXVII, fig. 7.) Anal scale triangular.

The telopodites of the gonopods of the male are comparatively large and conspicuous. They cross each other at the middle line, each passing in front of and curving back on the outside of the enlarged basal joint of the opposite gonopod. (Cf. pl. XXVII, fig. 9.)

Length, about 6 mm.

Locality.—British Guiana, Kartabo, Bartica District. One male taken, Dec. 18, 1919.

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23. TWO MYRMECOPHILOUS PHORIDÆ FROM BRITISH GUIANA

By CHARLES T. BRUES

PUBLISHED BY THE SOCIETY
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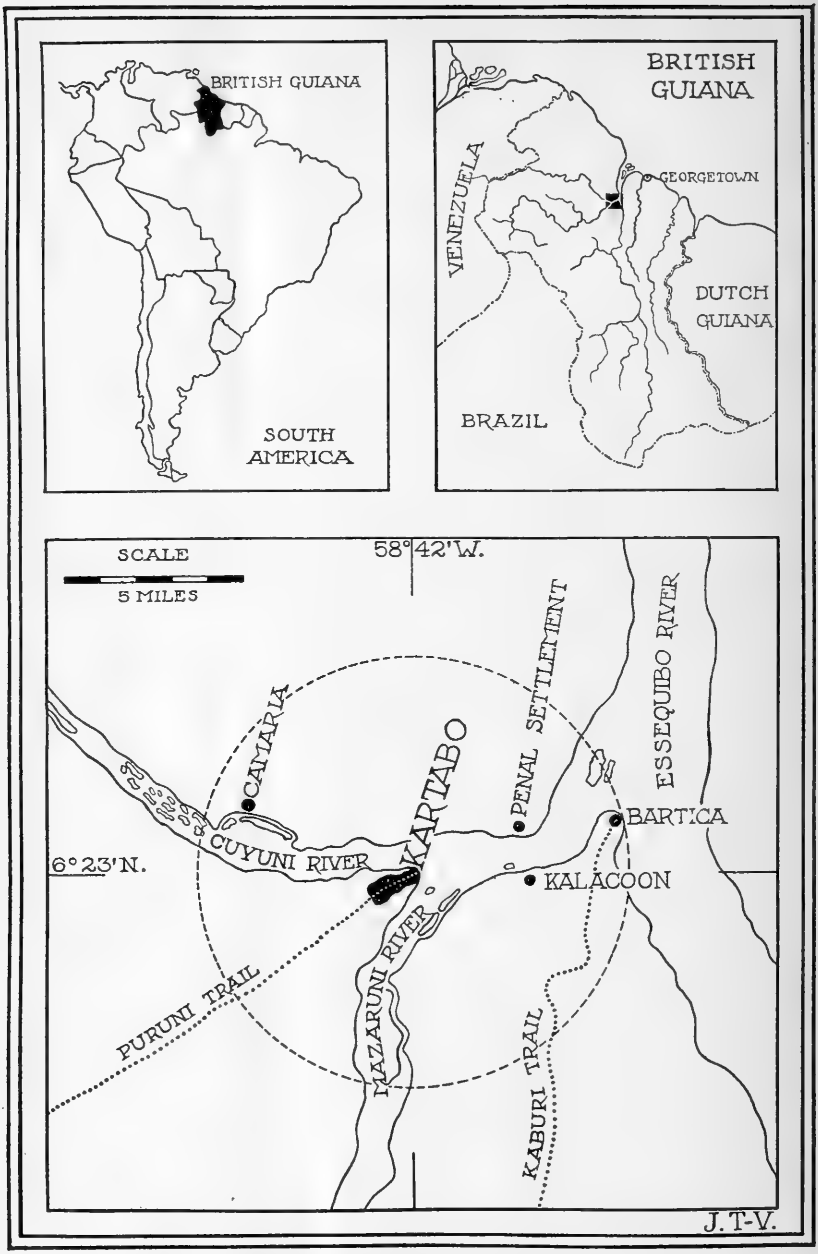

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TERMITOBRACON, A TERMITOPHILOUS BRACONID FROM BRITISH GUIANA[1]*

By CHARLES T. BRUES.

(Figs. 42-43)

In the autumn of 1920, I received from Mr. Alfred Emerson a most extraordinary termitophilous Hymenopteron of the parasitic family Braconidæ. During the course of his extensive studies on termites and the other insects which occur with them, carried on in the vicinity of the tropical station of the New York Zoological Society, at Kartabo, British Guiana, Mr. Emerson obtained specimens of both sexes of this strange insect. From observations on its behavior and the reactions of the termites he assures me that it is undoubtedly a true termitophile and his conviction is fully borne out by its structural characteristics.

The males have the eyes and wings greatly reduced in size and the neuration of the latter are consequently highly modified. From observation Mr. Emerson found that they made no attempts to fly, but moved slowly about the nest among the termites which displayed no hostility, but appeared rather to be friendly toward them. A worker termite was once observed by Mr. Emerson to lick one of the females. The females, in contrast to the males, have the wings fully developed and are undoubtedly able to fly readily. This disparity is in itself very unusual, as there are scarcely any Hymenoptera, or other insects for that matter, in which the females are fully winged and the males apterous or partially so. A similar condition does exist, however, in the fig insects of the family Agaonidæ where the females are winged and the males apterous and a group Idarninæ of a related family of Chalcid-flies, the Calli-

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[1] Contribution from the entomological laboratory of the Bussey Institution, Harvard University, No. 184.

* Tropical Research Station, Contribution Number 142.

momidæ, parasitic on the fig insects show a similar condition. Another family of Chalcid flies, the Eulophidæ, contains Melittobia, a widely distributed genus parasitic on various wasps and bees which is subapterous in the male although the female shows no reduction in wing size, while another Eulophid, Perissopterus, parasitic on scale insects, sometimes has subapterous males. In a few other Hymenoptera the male is dimorphic or polymorphic in the development of the wings. Thus the males of a certain species of Pezomachus (*P. flavocinctus* Ashm.) belonging to the Ichneumonidæ have three types of males, a fully winged one, a subapterous one and an entirely wingless one, but in this case the female is apterous. Such is the case also in the Bethylid, *Cephalonomia urichi,* which I have recently shown to have both winged and wingless males. On the other hand the Trichogrammatid Oöphthora has winged females and both alate and apterous males Still more recently Picard has shown that a Braconid (*Sycosoter lavagnei*) parasitic on *Hypoborus ficus* has winged and apterous forms, both sexes being represented by individuals of each type. He has shown further, in this case, that while the four forms occur at the same time, the winged ones are most abundant in warm weather and the wingless ones most numerous in the spring and autumn, while only apterous ones occur during the season of hibernation. Whether the present Braconid may also be dimorphic cannot be stated, but on account of the rarity of such an occurrence, there seems to be no valid reason for assuming that it is.

The male is also much lighter in color than the female, and such is the case also in Melittobia, in at least some of the species.

Most termitophilous insects are physogastric, having the abdomen considerably swollen or enlarged and frequently turned either upwards or downwards, out of the plane in which it normally rests. Termitobracon shows no distinct physogastry in either sex, but the abdomen of the male is perhaps somewhat larger than usual in other male Braconidæ. It is, however, distinctly curved downwards, and when the body is thus partially curled, the aborted wings rest upon its dorsal surface with their surface bent in conformity to the latter. This bending takes place almost entirely at two points, the base and apex of the stigma.

Termitobracon appears to be the first Hymenopteron ever found as a termite guest[2], and is possibly parasitic upon the termites themselves although it is, of course, quite possible that it may attack some other insect which occurs regularly in their nests. I have examined several thousand termites taken from the nest in which the parasites occured, but have been unable to find any parasitic larvae either in the bodies of the termites, attached to them, or free in the alcohol, so that the host of Termitobracon must remain doubtful. Its size is, however, just about that of the larger termite workers, as might very likely be the case if it should be an internal parasite.

Termitobracon gen. nov.

Female.—Body, including the legs and wings, densely clothed with very fine yellowish hairs. Head strongly transverse; eyes small, hairy; antennae 14-jointed, filiform, the scape short, simple at tip and very closely united with the pedicel; flagellum beyond the third joint marked by fine longitudinal ridges, the first three joints strongly emarginate at tip; ocelli minute, in a small triangle; clypeus semicircular, not emarginate, not horned nor toothed; mandibles small, acute, without teeth near apex. No parapsidal furrows; propodeum simple, convex. Abdomen short, oval, with seven well developed segments, first segment with lateral carinae, but otherwise not sculptured; ovipositor issuing near the middle of abdomen, but not extending far beyond the apex, sheaths slender, but dilated near the apex. Legs rather stout, the basal and apical joints of tarsi elongated, the others very short. Wings rather large,

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[2] Since this was written Cushman (Proc. Entom. Soc. Washington, vol. 25, p. 54, 1923), has described a genus of Braconidæ, Ypsisterocerus, represented by two species collected in termite nests by Dr. W. M. Mann in Bolivia. Ypsistrocerus and Termitobracon are quite closely related, but differ in a number of good structural characters in spite of the fact that both occur in the nests of the same species of termite. Cushman has made Ypsistrocerus the type of a new subfamily (Ypsistrocerinae) to which Termitobracon must now be added.

stigma broad, dark, but not heavily chitinized, the radial cell broad, attaining the wing tip; three cubital cells although the transverse cubiti are in great part hyaline; nervulus strongly postfurcal; nervellus interstitial; hind wing without nervulus or marginal vein.

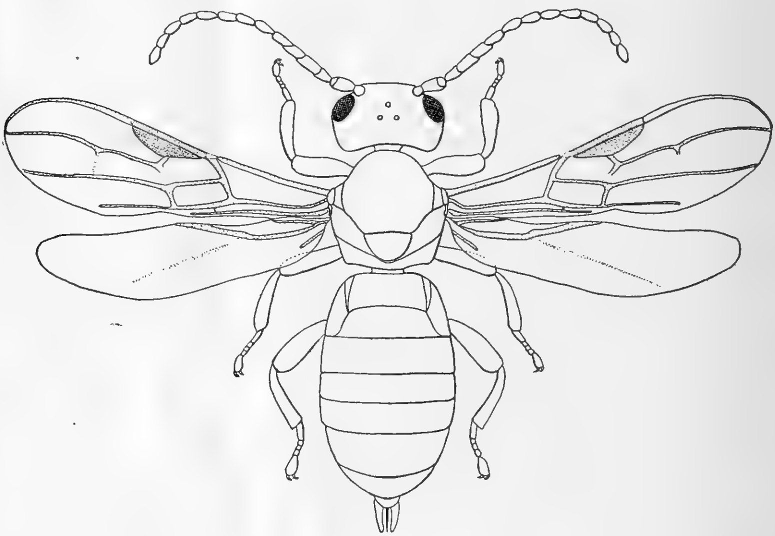

FIG. 42. *TERMITOBRACON EMERSONI* SP. NOV.
Female.

Male.—Subapterous, the wings greatly reduced in size, curved over the abdomen at rest and distinctly bent at each end of the stigma, reaching just beyond middle of abdomen. Eyes minute, ocelli wanting. Legs stouter than those of the female. Color of body much lighter.

Type, the following species:

Termitobracon emersoni sp. nov.

(Figs. 42-43)

Female (Fig. 42).—Length 2.2-2.3 mm. Fuscous, the head black, except about the mouth; thorax distinctly darker than the abdomen, especially in front above; legs brownish yellow, the tibiae and tarsi lighter than the femora. Antennae yellowish, the first three joints of flagellum much darkened and the last seven joints very pale; clypeus and mandibles, except their black tips, honey-yellow; propleura on anterior edge and spot on mesopleura below, yellow; propodeum anteriorly and at the sides stained with yellow; abdomen darker at the sides of the first segment and along the posterior margins of the second and fourth segments; ovipositor black, its sheaths pale; wings brownish-hyaline, a weak cloud in the upper part of the radial cell; venation dark fuscous. Head two and one half times as broad as thick antero-posteriorly, rounded and narrowed behind the eyes, which are broadly oval, quite small, as long as the

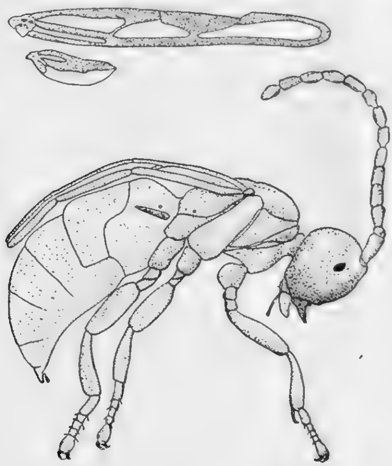

FIG. 43. *TERMITOBRACON EMERSONI* SP. NOV.
Male.

scape of the antenna; antennae 14-jointed; scape short, the pedicel closely attached to it, rounded; first joint of flagellum short, second to fourth longer, about twice as long as broad; following quite distinctly oval the last pointed at tip. Malar space twice as long as the eye; surface of head smooth; ocelli forming an equilateral triangle. Mesonotum and scutellum smooth and shining, not very strongly convex. Propodeum smooth above, without sculpture. First abdominal segment carinate at the sides, the space between the carinae twice as broad as long; surface smooth and polished as is the remainder of the abdomen; second and third segments of equal length, together as long as broad, the articulation between them very faint; fourth and fifth segments equal in length and width, each slightly shorter and broader than the third; sixth much longer and narrower; seventh half the length of the sixth; eighth minute; ovipositor but slightly exserted. First section of radius very short; one-fourth as long as the second which is slightly shorter than the third; radial cell attaining the wing tip; cubitus arising at the middle of the basal nervure, the transverse cubiti not complete, the first pigmented, except below, the second indicated by the absence of trichiation; nervulus entering near the middle of the discoidal cell; nervellus interstitial; hind wing with only the basal and submedian vein and a stump of the anal, nervulus wanting; subdiscoidal indicated as a faint cloud extending to the wing margin.

Male (Fig. 43).—Length 1.9 mm. Almost entirely light testaceous, the head blackened above, the carinae on the first abdominal segment black and the hind margins of the third to fifth segments infuscated. Eyes much smaller, scarcely as long as the diameter of the pedicel of the antennae.

Four females and three males from Kartabo, British Guiana, collected by Mr. Alfred Emerson in a nest of *Nasutitermes* (N.) *ephratae* (Holmgren), July 28, 1920.

Mr. Cushman has kindly compared a specimen of Termitobracon with the unique types of his two species of Ypsistrocerus and considers the two genera to be undoubtedly closely related in spite of many obvious differences, some of which may be tabulated as follows:

Maxillary palpi 2-jointed; labial palpi apparently wanting; joints of the filiform antennal flagellum all of similar form; first and second cubital cells fused (female); Stigma narrow (female) .... Ypsistrocerus Cushman.

Maxillary palpi 3-jointed; labial palpi 2-jointed; basal three joints of antennal flagellum each with an oblique emargination at apex, following joints oval; first and second cubital cells separated (female); Stigma broad (female) .... Termitobracon Brues.

TWO MYRMECOPHILOUS PHORIDÆ FROM BRITISH GUIANA[1]*

By Charles T. Brues

(Fig. 44).

In September, 1920, Mr. William Beebe, director of the Tropical Research Station of the New York Zoological Society at Kartabo, British Guiana, in company with Mr. Alfred Emerson, obtained two remarkable species of Phoridæ along the trails of the legionary ant, *Eciton burchelli.* This ant is abundant in the region of the Station and like the other species of the genus undoubtedly harbors many myrmecophilous insects of various kinds.

On examining the specimens, which they kindly sent me for study, I find that one form represents a new genus, quite different from any of those heretofore described and that the second is identical with a species first made known only a few years ago from Southern Brazil, where it was found with another species of Eciton having somewhat similar habits.

As is the case with many of the myrmecophilous Phoridæ, only the wingless or subapterous female of these two species has so far been obtained.

Apterophora gen. nov.

Female.—Wingless, but with the eyes large, half as high as the side of the head; ocelli present; antennæ small, round; palpi simple, with stout bristles at apex; proboscis slender, four times as long as the head-height, geniculate at the middle, with the apical half directed forward. Three transverse series of frontal setæ, the lowest two proclinate, close together; a pair just above these erect or slightly proclinate; upper row of four, two of which are next to the ocelli. Head, seen from above,

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[1] Contribution from the entomological laboratory of the Bussey Institution, Harvard University, No. 185.

* Tropical Research Station, Contribution Number 143.

much produced medially in front. Dorsum of thorax somewhat wider than long, no scutellum; a large humeral bristle on each side and a posterior row of stout bristles; pleura oblique, fully twice as high as the length of the dorsum. Abdomen with five very heavily chitinized black dorsal plates which are only slightly separated by pale membrane in engorged specimens; ventral surface membraneous, nearly white, without any chitinous plates. Legs rather slender, the anterior coxæ as long as the femora; all tibiæ without preapical spines or bristles.

Type *Apterophora caliginosa* sp. nov.

This is similar to Enderlein's genus Crepidopachys (Enderlein '12) from Southern Brazil on account of its long proboscis, but the type of this is a winged insect and it is difficult to make further comparisons. The sex is not given by Enderlein, and if his description should apply to a male, the genus might be related to the present one. I suspect that his examples were females, however, from the description of the apex of the abdomen and particularly the long proboscis, in spite of the fact that the greatly thickened costa suggests that they might be males. Even if the latter should be the case, I do not believe that the two could possibly be congeneric or even closely related, as the long proboscis is the only striking similarity.

Among the genera known to have wingless or subapterous females, two have a similarly lengthened proboscis. Psyllomyia Loew (Loew '57, Wassman '00; Brues '01; Schmitz '14) a guest in the nests of *Dorylus helvolus* in South Africa has a long, slender, geniculate proboscis which is, however, not much longer than the head. It has also a dark, heavily chitinized abdomen like Apterophora, but the wings are present as large broad pads. The eyes are much smaller, the ocelli absent, and the legs very stout in Psyllomyia. In the absence of males, therefore, it seems unwise to regard them as possibly congeneric.

Rhynchomicropteron Annandale (Annandale '12; Schmitz '14 and '15) known by two species, one from Ceylon as a guest of *Lopopelta ocellifera* Rog. and another from Bombay as a guest of *Prenolepis longicornis* Latr., is very similar in some respects to Apterophora; it has a very long, slender, geniculate proboscis and a similarly formed head and thorax. It differs greatly in having well developed digitiform wing pads, in having the ocelli absent, and is practically blind, as the compound eyes are mere vestiges, each composed of half a dozen separate ommatidia. The most striking differences are seen in the abdomen which is entirely membranous, without any clearly chitinized plates, and in the dorsum of the mesothorax which bears a longitudinal impression and distinct median suture, something of very rare occurrence in insects.

Apterophora caliginosa sp. nov.

(Fig. 44).

Female.—Length 1.7-1.9 mm. Head, thorax, abdominal plates, and four posterior coxæ deep, shining black; legs and proboscis honey-yellow; antennæ pale yellow; palpi fuscous; membranous parts of abdomen white, with a slightly sooty tinge. Head distinctly wider and longer than the thorax, the front obtusely triangularly produced between the antennæ, frontal bristles well developed, but not very strong. Eyes oval, contiguous, with the antennal excavation and the posterior margin of the head; cheek one-third the height of the eye, each with a tuft of four or five small bristles anteriorly above the insertion of the palpus, but without bristles behind; postocular bristles weak. Antennæ round, small, with apical, strongly pubescent arista which is one-third longer than the head-height. Proboscis stout at the base, but narrowed and very slender beyond; geniculate just before the middle, the basal part straight, at rest bent somewhat beneath the body and extending to the tip of the front coxæ; apical part curved, projecting forward with the upper margin convex; tip obliquely truncate, with a few minute bristles. Palpi with a few moderately large bristles below near apex. Surface of head impunctate. Mesonotum one-fourth wider than long; anterior margin arcuately excavated, the humeri rounded; spiracles visible from above, just behind the humeri; posterior margin slightly convex. Macrochaetæ not strong, disposed as follows: a weak post-humeral one, a series of six longer ones along the posterior margin, one at each extreme lateral angle and four between these, the median two farther apart than the others. Surface indistinctly punctate. Abdomen highly convex above, the plates densely and finely punctate; first (visible) one the largest, nearly three times as long and wide as the mesonotum, almost twice as broad behind as in front, the posterior margin nearly straight and fringed with long, bristle-like hairs; second plate only half

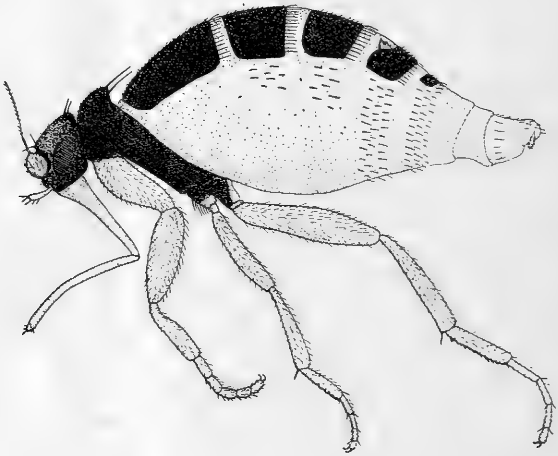

FIG. 44. *APTEROPHORA CALIGINOSA* SP. NOV.

as long as the preceding, but of equal width, similarly punctate and fringed along the posterior margin; third distinctly shorter and narrower, fringed; fourth (really the fifth) segment smaller, the gland opening filling a large anterior emargination of the plate; fifth very small, not fringed like the others; apex of abdomen of the usual tubular, retractile form. All of the abdominal plates clothed with fine, pale, glistening pubescence. Legs slender, although the anterior tibiæ are slightly thickened; spurs of four posterior tibiæ small, but distinct; hind metatarsi each with seven transverse rows of dense fine recumbent bristles.

Described from two specimens, both the type and paratype, as well as several other specimens which I have not examined, taken at the same time near a trail of the army ant, *Eciton burchelli,* at Kartabo, British Guiana. Concerning their relationship to the ants, Mr. Emerson writes that the first specimen was seen by Mr. Beebe in the ant trail and that further careful search was rewarded by the finding of several others.

ECITOPHORA COMES SCHMITZ.

Zool. Jahrb. Abth. f. Syst., vol. 36, p. 524 (1914).
Brues, Psyche, vol 30, p. 21 (1923).

Three females from Kartabo, British Guiana taken at the same time that the previous Phorid was obtained, prove to belong to this species.

The types were found with *Eciton predator* Sm. at São Leopoldo, Rio Grande do Sul in southern Brazil, but the Guiana examples agree in all details with Schmitz's description and excellent figures.

It is evident, therefore, that this myrmecophile is widely distributed in tropical South America and that it occurs with at least two species of Eciton, *E. burchelli* and *E. predator*.

Ecitophora is much like Ecitomyia Brues, with which Schmitz has compared it, and differs in only a few details. In view of the numerous monotypic genera in this group and as Schmitz has already erected the genus Ecitophora for this species I have used the name although I am by no means satisfied that the two genera can be maintained. Nevertheless Ecitophora is readily separable by the presence of ocelli and the complete absence of the plate on the third abdominal segment, although the minute fourth and fifth plates are fully chitinized and fully colored.

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