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CONTENTS

Plates I–V

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THE LARVAE OF THE HARPALINAE UNISETOSAE[1] (COLEOPTERA, CARABIDAE)

BY HUNG-FU CHU, PH.D.
INSTITUTE OF ZOOLOGY, NATIONAL ACADEMY OF PEIPING, CHINA

CONTENTS

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Contribution from the Entomological Laboratories of the University of Illinois, no. 263.

I. INTRODUCTION

In the summer of 1944, Dr. Walter Valentine Balduf asked the United States National Museum for the loan of some coleopterous larval specimens for the writer. Mr. C. F. W. Muesebeck of the Museum wrote to Dr. Balduf stating that Drs. A. G. Böving and W. H. Anderson had suggested that the writer take the larvae of the group Harpalinae Unisetosae as his research subject and that there was sufficient material in the U. S. National Museum collection to furnish work for his doctor's thesis. The writer took their advice and carried on this work when he received the approval of Drs. William P. Hayes and Walter Valentine Balduf.

The larvae of Carabidae can be separated from Cincindelidae by the absence of hooks on the tergum of the fifth abdominal segment, and also be easily distinguished from Omophronidae by the terminal setae of the tarsus which are much shorter than the claws and the retinaculum is single or absent in the Carabidae.

Harpalinae Unisetosae is a group belonging to the family Carabidae, Order Coleoptera. In this country, little work has been done on the larvae of this group, although our knowledge of the adults is fairly extensive.

The present work is a study on the taxonomy of the larvae and also deals with the morphological and biological aspects. The species investigated are listed below with their geographical distribution:

CHLAENIINI Redtenbacher

Chlaenius Dejean

C. pennsylvanicus Say.—Canada, California, Indiana, Oregon, Arizona, Louisiana.

C. tricolor Dejean.—Mexico, Canada, S. California, Guatemala, Florida, Indiana.

C. prasinus Dejean.—Texas, Indiana, Middle States, Colorado, Florida, Arizona.

C. cumatilis LeConte.—S. California, Arizona.

C. sericeus Forster.—Rocky Mountains, Canada, Indiana, Utah, Illinois.

Oödiini Horn

Oödes Samouelle

O. sp.—Maryland.

Harpalini Casey

Nothopus LeConte

N. zabroides LeConte.—Texas, Colorado.

Cratacanthus Dejean

C. dubius (Beauvois).—New Jersey, Arizona, Indiana, District of Columbia, Pennsylvania.

C. sp.—Missouri, Iowa.

Harpalus Latreille

H. caliginosus? (Fabricus).—Indiana, Maine, California, Illinois, Texas, Florida, Arizona, Iowa.

H. sp.—Illinois.

H. viridiaeneus Beauvois.—Rhode Island, Lake Superior, Florida.

H. vagans LeConte.—Indiana, Missouri.

H. erythropus Dejean.—Manitoba, New Hampshire, Rhode Island, Missouri, Iowa, Indiana, Illinois.

H. compar LeConte.—Rhode Island, New York, Indiana, Florida, Lake Superior, Illinois.

H. pennsylvanicus Say.—Rhode Island, Lake Champlain, Florida, Lake Superior, Colorado, Mississippi, Canada, Louisiana, Arizona, Indiana, District of Columbia, North Carolina.

H. dichrous Dejean.[2]—New York, Missouri, Indiana.

Anisodactylus Dejean

A. californicus Dejean.—S. California.

A. (or close) *sp.*—Alaska.

Amphasia Newman

A. interstitialis (Say).—Long Island, Missouri, Indiana, New York.

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[2] Thanks for Dr. F. van Emden in making the following correction: "*dichrous* is actually not a *Harpalus* at all but belongs to the genus *Trichotichnus,* and this genus has definite relationship with the Acupalpina though it does not belong to them. It is more or less intermediate between Harpali and the Anisodactylina and is more closely related with *Selenophorus.*"

Anisotarsus Chaudoir

A. sayi (Blatchley).—Indiana, Illinois.

Stenocellus Casey

S. rupestris (Say).—Long Island, North Carolina, Missouri, Florida, Michigan, California, Indiana, Illinois.

Stenolophus Stephens

S. conjunctus (Say).—Canada, Rhode Island, California, Florida, Michigan, Indiana, Mexico, Guatemala, Missouri.

S. sp.—Oregon.

Agonoderus Dejean

A. lineola (Fabricius).—Delaware, Texas, Utah, Arizona, Indiana, S. California, Maryland.

A. pallipes (Fabricius).—Indiana, Michigan, California, North Carolina, Texas, Arizona, New York.

Cratocara LeConte

C. capitata Chaudoir

II. ACKNOWLEDGMENTS

The writer wishes to acknowledge his great indebtedness to Dr. William P. Hayes, Professor of Entomology, University of Illinois, under whose supervision this work has been carried on, because his kind suggestions and extensive experience inspired and aided the writer in countless ways. The writer also gratefully acknowledges his sincere appreciation to Dr. Walter Valentine Balduf, Professor of Entomology, University of Illinois, for his advice and suggestions during the Summer Session of 1944 while Dr. Hayes was away from the University.

The writer wishes to extend his thanks to Drs. W. H. Anderson and A. G. Böving of the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, who have suggested this group for the subject of this thesis. For the loan of collections of the larvae, the writer is indebted to Mr. C. F. W. Muesebeck for the species obtained from the U. S. National Museum, Washington, D. C.

III. REVIEW OF LITERATURE

Morphology.—Dimmock and Knab ('04) have reviewed and discussed the characters of carabid larvae. Böving ('10, '11) made good morphological studies on the larval heads of *Oödes* and *Anisodactylus*. The following authors contributed a large amount of morphological work although not on Unisetosae larvae: Kemner

('12) worked on the morphology of *Amara similata, Emus hirtus,* and *Creophilus maxillosus;* van Emden ('19) worked on *Pheropsophus hispanicus;* Lengerken ('22) worked on *Carabus auratus;* Jeannel ('20 and '26) worked on *Trechini;* Oertel ('24) worked on *Carabus;* and Bengtsson ('28) worked on sixteen species of *Carabus.* From the standpoint of comparative morphology there are the works of Crampton ('09) on the thoracic sclerites of insects which includes a carabid larva, Whitehead ('32) on the head-capsule of coleopterous larva which includes *Harpalus honestus,* and Anderson ('36) on the labium of coleopterous larvae which includes *Harpalus sp.*

Biology.—Forbes ('83 and '05), Oertel ('24), Dahl ('26), Blair ('33) and Silvey ('35) observed the larval habits. Webster ('80), Saunders ('83), Massey ('93), Lugger ('99), and Davis ('22) reported the food of different species. Beling ('77), Claassen ('19), Oertel ('24), and Larsson ('39) worked on the metamorphosis. Davis ('22) found a parasite of *Harpalus sp.* The following authors studied the oviposition of some species: Riley ('84), King ('19), Claassen ('19) and Boldori ('33). Balduf ('35) and Clausen ('40) have compiled the biological records.

Taxonomy.—In regard to the European species, Erichson (1841) first attempted a characterization of carabid larvae; Schiödte ('61–'86) made descriptions of Danish species; Meinert ('01) characterized the Danish species; Bengtsson ('28) worked on sixteen species of *Carabus;* Jeannel ('20), Raynaud ('32, '35, '36, '37), Puel ('35) described many French species. In Asia, Gardner ('27, '31, '33, '36, '38) described many Indian species. In America, Schaupp ('79 and '80) described several Carabid larvae; Wickham ('95) made descriptions of *Chlaenius sericeus,* Dimmock and Knab ('04) dealt with *Dicaelus, Pterostichus,* and *Brachinus;* Bryson and Dillon ('41) had a brief description of *Agonoderus pallipes* and *Harpalus caliginosus.* In Böving's and Craighead's ('30) well known paper nineteen subfamilies have been separated on the basis of larval characters. Van Emden ('19) published a key to genera of carabid larvae in German and later ('42) revised and enlarged the German key and published it in English.

IV. METHODS AND PROCEDURES OF STUDY

The specimens were received from the U. S. National Museum, preserved in alcohol, accompanied with data of locality, date collected, collector, and sometimes also habitat. Species were identified by different specialists mostly based upon the reared adults or larvae indicated in the description.

Morphological aspects have been studied in order to find out the diagnostic characters for separating the species. A five per cent potassium hydroxide solution was used to treat the specimen in case it was not preserved in good condition and the insect body was shrunken. The specimen was put in a vial with the potassium hydroxide solution and heated in a beaker containing boiling water for fifteen to forty-five minutes depending upon the condition of the specimen. However, it must not be overtreated, otherwise the muscles and internal organs will be destroyed. It is also important to neutralize the potassium-hydroxide-treated specimen with a few drops of dilute hydrochloric acid. For morphological study, a binocular microscope and a Syracuse watch glass were used. The latter had cotton on the bottom which was fastened with an alcohol insoluble cement in order to keep the cotton fixed on the bottom so as to place the specimen in a good position for observation.

In many cases there were only exuviae available which had to be softened with potassium hydroxide solution and stretched by means of a pair of fine needles. Drawings have been made carefully, not only to show the morphological characters, but also the right positions and proportions of the structures.

The instars of the larvae are difficult to determine unless the specimens are accompanied with the fullgrown larva as well as the reared adult. However, measurements of the width of head and the length of body were made which possibly can indicate the instar of the larva.

A bibliography was worked out before laboratory work was started. The descriptions of color and the measurements of the larvae were based entirely upon the alcohol preserved specimens. The systematic arrangement and the nomenclature have followed Leng's ('20) catalogue. The geographical distribution has also been compiled from Leng's ('20) catalogue and Junk's ('28–'29) catalogue. These were supplemented by the data accompanying the specimens from the United States National Museum.

V. BIOLOGY AND HABITS

According to Forbes ('83 and '05), carabids are herbivorous as well as carnivorous. Forbes ('05) stated that *Anisodactylus* and *Harpalus* feed more or less on vegetation, principally the seeds and tissues of grasses and grains, including corn; so far as the habits of larvae are known, they seem to be much the same as those of their respective adults. *Agonoderus pallipes* is the "Corn Seed Beetle" injurious to seeds. Bryson and Dillon ('41) discuss dif-

ferences in the mandibles of it and *Harpalus*. Lugger ('99) reported that *Agonoderus pallipes* caused injury to the seed and roots of corn; and the adult was also found injuring corn in the ear more frequently than any other ground beetle. He also mentioned *Harpalus herbivagus* and *H. pennsylvanicus,* frequently found in orchards, eating the larvae of the codling moth and the plum-curculio. Packard ('72) stated that *Harpalus caliginosus* eats cut-worms and other injurious larvae. Riley ('77 and '78) found the larvae of *Harpalus* and *Agonoderus* feeding on grasshopper eggs. Quaintance ('12) stated that *Harpalus spp.* feed on curculio larvae. Saunders ('83) mentioned that *Harpalus pennsylvanicus* attacks plum-curculio larvae. Webster ('80) reported the larvae of *Harpalus caliginosus* feeding on the roots of evergreen and *H. herbivagus, H. pennsylvanicus, Anisodactylus baltimorensis,* and *A. sericeus* feeding on grass roots. In the larvae there occur two methods of obtaining food (Balduf '35). It is believed that the larvae of some species chew or bite off tiny morsels of solid flesh from their prey and swallow it entire to be digested in the alimentary canal. On the other hand, Davis ('22) cites an instance in which a carabid larva pierced the skin of a white grub and drew out most of the body fluids in about three hours. According to Davis ('22), the larvae of *Harpalus pennsylvanicus* and to a smaller extent also those of *H. caliginosus,* prey upon the grubs of *Phyllophaga* both in fields and in underground breeding cages.

Ground beetles, so far as known, deposit their eggs either upon objects above ground, or in cavities made in the soil. The female of *Agonoderus pallipes* extends the terminal segments of the abdomen telescopically, and by moving backward pushes it into the earth. The anterior part of the body is elevated by straightening the front and middle legs and the tips of the elytra come to rest upon the soil at the edge of the hole. When the egg has been deposited, the female rapidly conceals it by scraping soil upon it with her hind legs (Boldori '33). Riley ('84) reported the rather remarkable habit of *Chlaenius impunctifrons* which places its eggs on foliage encased in a mud cell. Subsequently, King ('19), determined by the rearing method that not only *C. impunctifrons,* but *C. sericeus* and *C. tricolor* also deposit their eggs in such cells. Claassen ('19) has also studied *C. impunctifrons.* The beetle collects a pellet of mud around the tip of the abdomen. The cell thus formed is in reality a mold of the caudal abdominal segments. The lid of the cell is formed from a thin layer of mud which covers the dorsal portion of these segments. When the egg has been laid

within the cell, the abdomen is withdrawn and used to bend down the dorsal flap or lid and close the cell. Owing to the soft texture of the mud at the time of construction, the lid of the cell is self-sealing. The cases of each species seem to be distinct in their form, size, structure, and immediate location. Those of *C. impunctifrons* are almost always smoothly convex and oblong, and measure about 3.5 mm. in length and 2.28 mm. in width. About ninety per cent of the cells of this species occur on living plants, the under-surface of smooth leaves being most often selected. Their actual distance from the ground varied between a few inches to seven or more feet. On the other hand, *C. aestivus* builds her egg cells on dead twigs and tree trunks. In most recorded instances, the female carabid deposits only one egg at a time whether it be in the soil or in mud cases off the ground (Balduf '35). The number of eggs laid by individual females and the rate of oviposition has been determined in part for several species. *Chlaenius impunctifrons* may construct seven to twenty cells during one night, and eighty-two cells in a season.

There are three instars during the larval development. This number is known to occur in *Chlaenius impunctifrons* (Oertel '24). One *C. impunctifrons* completed its larval growth in twenty-seven days, the first and second instars lasting three days each and the third twenty-one days (Claassen '19). The life cycle usually requires one year from the egg to the adult. The adults live two, three and even four, and in rare instances, five years. The majority winter as adults, reproduction begins in the Spring (Balduf '35). An interesting parasite of *Harpalus pennsylvanicus* (?) larvae was found by Davis ('22) at Mendon, Mich., September 11, 1916. Two larvae were found parasitized by a hymenopteron. The adult of this parasite was not obtained.

Most of the larvae live underground, according to the data of the species investigated. The following have been found in the soil of peach orchards: *Cratacanthus sp., Stenocellus rupestris, Nothopus zabroides,* and *Harpalus pennsylvanicus. Stenolophus sp.* was found in an alfalfa field, *Amphasia interstitialis* in open woods, *Agonoderus lineola* in golf greens, and *Harpalus sp.* in a sandy woods. The following species live near water: *Oödes sp., Chlaenius sericeus,* and *C. prasinus.* It is interesting that some of the *Anisodactylus californicus* specimens studied were found, both as larvae and adult, associated with grasshopper eggs. They are suspected of being predators of the eggs. Silvey ('35) asserted that *Agonoderus pallipes* is a true burrower in the beaches of some fresh-water lakes, while *Chlaenius sp.* is just a beach visitor.

VI. EXTERNAL MORPHOLOGY

The Head

Cranium.—The cranium or the head capsule may be described in two main parts: the frontoclypeal area and the parietals.

Frontoclypeal area.—Evidently the front, the clypeus, and the labrum are fused together since the sutures separating them are obsolete. They form a large triangular piece separated from the parietals by the arms of the epicranial suture (fig. 30, ECS). At the cephalic margin there are lobe-like parts, the mesal one is called the nasale (fig. 30, NS), and the two lateral pieces are called the adnasales (fig. 30, ANS). Each adnasale is quite uniformly triangular in shape while the nasale is greatly varied in its dentation in different species which serve as good diagnostic characters for identification. The anterior tentorial arms can be seen through the surface of the front and are called by some authors the tentorial ribs (fig. 30, TR).

Parietals.—The lateral areas of the cranium, separated from the frontoclypeal area by the epicranial suture, are the parietals. They are bounded anteriorly and posteriorly by the epicranial arms and occipital sutures, respectively. The dorsal aspect of the parietals forming the top of the head constitutes the vertex (fig. 30, V). The lateral parts of the parietals are the genae (fig. 30, G). Six ocelli (fig. 7, OC) are located on the cephalo-lateron on the genae. Cephalad of the ocelli and next to the antenna is the antennal sclerite (fig. 30, AS). There is an ocellar furrow (fig. 30, OCF) extending backwards from the ocelli and sometimes reaching almost to the cervical groove. The latter (fig. 30, C) is a groove with taxonomic significance situated transversely on the gena behind the ocellar furrow. The postgenae (fig. 31, PG) are the regions of parietals on the ventral side of vertex and genae. They comprise almost the entire ventral surface of the head. Between the postgenae is the gular suture (fig. 9, GUS). A pair of dark bars, located on the sides of the gular suture, are the posterior tentorial pits or gular pits (fig. 31, TP). The occiput (fig. 30, OP) is a rim on the caudal margin of the cranium which borders the foramen magnum or occipital foramen. It is separated from the parietals by the occipital suture (fig. 30, OPS).

The Head Appendages

Antenna.—The antenna is located on the cephalo-lateral region, before the ocelli and above the mandible. The basal part

of the antenna is surrounded by a ring-shaped antennal sclerite (fig. 30, AS). The antenna is composed of four segments: the first segment the longest, the second segment almost two-thirds as long as the first, the third, a crooked segment with a sensorial appendage (fig. 30, SAP) on the lateron, almost as long as the second, and the fourth segment the shortest with a sensorial organ (fig. 83, SO) on its apex.

Mandible.—The mandible is a thick, strongly sclerotized piece with a broad, triangular base, having its mesal surface much thinner than the latero-dorsal area and differentiated into a large middle tooth called the retinaculum (fig. 84, R) and sometimes some small mandibular teeth (fig. 76, MDT) are present on the cutting edge between the apex and the retinaculum. At the base of the cutting edge there is a cluster of hairs called penicillus or penicillum (fig. 84, P). Two articulations are present: one on the dorsal side, the preartis (fig. 84, PRA), another on the ventral side, the postartis (fig. 84, POA). The extensotendon (fig. 84, ET) on the ectal aspect and the rectotendon (fig. 84, RT) on the mesal aspect are well developed. The latter is much larger than the former. The mandibular scrobe (fig. 84, MS) is a longitudinal depression on the ectal aspect of the mandible present in most genera except *Chlaenius, Oödes,* and *Stenocellus.*

Maxilla.—The maxilla is composed of five different parts. At the base is the cardo which is composed of two pieces: the mesal part is the paracardo or subcardo (fig. 29, PC) and the ectal part is the eucardo or alacardo (fig. 28, EC). On the dorsal surface of the paracardo there is a group of granulose processes known as the granulose knob of the cardo (fig. 29, GKC). Cephalad of the cardo is the stipes (fig. 29, STP) which is a long segment with fine and long hairs along the entire mesal margin and also some long setae on the lateral and dorsal surfaces. The maxillary palpus (fig. 29, MXP) is a four-segmented structure with a palpifer joining it to the stipes. The first segment is short, the second segment, the longest, almost three or four times as long as the third, the fourth segment is shorter than the third. In some species the fourth segment is wanting. The palpifer is a part of the stipes and almost invisible. Next to the maxillary palpus, on the mesodistal edge of the stipes, is the galea (fig. 29, GA), sometimes known as the outer lobe, which consists of two segments known as the proxigalea and distagalea. Meso-caudad of the galea is the lacinia (fig. 29, LA) also known as the inner lobe, which is more sclerotized than the galea. It bears a seta on the apex or sometimes on the side. In

Anisotarsus (fig. 44, LA) the lacinia is fused with the stipes and forms a lobe-like process of the stipes.

Labium.—The labium consists of two parts: the prementum (fig. 27, PM) and the mentum (fig. 27, MT). On the cephalic edge of the prementum there is a small, chitinous, bisetose ligula (fig. 27, LG) and a pair of two-segmented palpi (fig. 27, LBP). The first segment of the labial palpus is twice as long as the second segment with setae or bare. The second segment is sometimes subdivided into a small third segment. Along the sides of the prementum are a number of strong setae located next to the ligula. The mentum is membranous, shorter than the prementum, with a group of hairs on the dorsal aspect and also a group of hairs on the latero-basal part. It lies caudad of the prementum.

The Thorax

Cervicum.—The cervicum or neck region (fig. 36, CV) is the flexible intersegmental region between the head and the prothorax. It is entirely membranous.

Prothorax.—The prothorax is the largest segment of the thorax. The tergum is covered by a heavily sclerotized and usually highly colored tergite. There is a longitudinal suture along the meson and a short, transverse, crescent-shaped furrow on each lateral half of the tergum. The surface of the tergite is covered with setae. The propleuron consists of an anterior episternum (fig. 34, EPS) and a posterior epimeron (fig. 34, EPM), the two being separated by a pleural suture. The prosternum (fig. 47, PS) is triangular in shape and the rest of the sternum is membranous.

Meso- and *metathorax.*—The mesothorax and metathorax are similar enough to be described together. They are narrower and shorter than the prothorax. A praetergum (fig. 34, PTG) is present on each tergum and is separated from the tergum proper by a transverse keel. The surface of the tergum is covered with setae. There is a longitudinal suture extending along the meson dividing the tergum into two equal parts. The meso- and metathoracic pleura are similar in form and development. Besides the episternum and epimeron, there are two sclerites above these which are the anepisternum (fig. 51, AES) and the anepimeron (fig. 51, AEM). The spiracles of the mesothorax (fig. 19, MTS) are elliptical and situated cephalad of the episternum and beneath the tergite. The mesothoracic spiracle is about twice as large as the first abdominal spiracle and three or four times larger than the remaining abdominal spiracles. The sterna of the mesothorax and metathorax

are mostly composed of a single area and appear to be membranous (figs. 39, 49). However, in *Chlaenius sericeus* (fig. 47) there is a sclerite with five setae in the center of the sternum and a pair of smaller sclerites each with a single seta located before it, and also a very small sclerite with a single seta situated mesad of the coxa (fig. 47). Caudo-mesad of each leg are the small pits which mark the invagination of the furcae (fig. 49, FP).

Leg.—The legs of the prothorax, mesothorax, and metathorax are very similar and can be conveniently described together. The trochantin (fig. 19, TN) is the articular sclerite situated at the base of the coxa. The coxa (fig. 4, CX) is the stoutest segment of the leg, and is articulated at its proximal end by a dark and heavily sclerotized acetabulum to the coxal process of the episternum. The length of the coxa is almost equal to the other parts of the leg except that of *Chlaenius* which is shorter. Next to the coxa is the trochanter (fig. 4, TC) which is approximately one-tenth the size of the coxa and articulates to the coxa at its proximal end by a pair of condyles. The dorsal aspect of the trochanter is much shorter than the ventral. There are two long setae on the venter and many spines on the ventro-lateral aspects of the trochanter. Next to the trochanter is the femur (fig. 4, FM) which is attached to the trochanter on its proximal end and to the tibia on its distal end. The femur is slender and long, with short spines on its ventro-lateral sides. The distal end of the femur is stouter than its proximal end. Next to the femur is the tibia (fig. 4, TB), mostly slender and short except that of *Chlaenius* which is almost as long as the femur and much longer than the trochanter. There are also many spines on the tibia. The tarsus (fig. 4, TS) is the distal segment of the leg and usually very short except that of *Chlaenius*. The tarsus bears at its distal end two claws which are usually unequal in size; the cephalic claw is longer than the caudal one. But this is not true in *Chlaenius;* its claws are subequal in size.

The Abdomen

The abdomen is ten-segmented. The first to fifth segments increase in size and from the sixth segment backward a decrease in size occurs. The ninth segment is the shortest and provided with a pair of cerci (fig. 46, CR) on the dorsum. The tenth segment is modified into a tube-like structure or anal proleg.

Terga.—The terga of the abdominal segments are entirely covered by the tergites in *Chlaenius* and *Oödes*, while the rest of the genera are only partially covered by the tergites. In *Chlaenius, Oödes, Nothopus,* part of *Harpalus, Anisodactylus,* and *Amphasia* the

praeterga are present on the first eight terga, while in the rest of the genera, the praeterga are variable. In *Cratacanthus, Harpalus viridiaeneus, Stenocellus, Stenolophus, Agonoderus,* and *Cratocara* they are entirely absent. Some species of *Harpalus* possess praeterga on the first few segments. The tergum of the ninth segment is almost entirely occupied by the bases of the cerci.

Pleura.—There are two pleurites present on the first to the eighth segment, namely, epipleurite (fig. 19, EPP) and hypopleurite (fig. 19, HPP). The epipleurite is located on the middle of the pleuron and the hypopleurite is almost directly beneath it. On the ninth segment there is only one pleurite present.

Sterna.—From the first to the eighth segment, the sternum is composed of five different sclerites. These are the ventrites. The cephalic one is called the anterior ventrite (fig. 32, AV), and the caudal four are known as the postventrites. The anterior ventrite is a slender, transverse sclerite while the mesal postventrite (fig. 32, MPV) is also transverse, but shorter than the anterior ventrite and sometimes divided into two pieces. The lateral postventrites (fig. 32, LPV) are two small separate pieces, each located on the ectal side of the mesal postventrite. On the eighth sternum, the anterior ventrite and postventrites are more or less fused into one piece, while those of the tenth segment are entirely fused. In *Chlaenius sericeus* the praeventrites are present on the cephalic margins of the first eight segments. They are four small sclerites each with a seta (fig. 2).

Tenth segment.—The tenth segment is modified into a tube-like structure which acts as an anal proleg and is often armed with a pair of protrusible tubes (fig. 6, PT) which may be adorned with crochets.

Cerci.—The cerci are a pair of dorso-apical appendages on the ninth segment (fig. 46, CR). In some species they are filiform and provided with numerous hairs and longer than the abdomen (some *Chlaenius*), while some species have shorter ones with nodules bearing setae.

Spiracles.—There is a pair of spiracles on each of the first eight abdominal segments. The spiracles are annular and small, and are located above the cephalic margin of the epipleurite. The first pair of abdominal spiracles is slightly larger than the following pairs.

Setal Arrangement

Head setae.—The setal arrangement of the head has a more or less definite pattern which may be described as follows: On the antennal sclerite there is almost uniformly a pair of setae, one on

the dorsal aspect and another on the ventral. These have not been found in *Agonoderus lineola* and *Cratocara capitata.* In the nasale region three pairs are generally present. Some species have only two pairs (*Chlaenius pennsylvanicus, C. tricolor, Oödes sp., Nothopus zabroides, Anisotarsus sayi,* and *Stenolophus sp.*). Four pairs are present in *Chlaenius sericeus* and *Harpalus compar.* Several exceptional cases are those in *Cratacanthus sp.* which has five pairs while *Chlaenius cumatilis* and *C. prasinus* have seven and eight pairs respectively. In the adnasale region two setae are commonly present, except that *Harpalus sp.* has one only, *Chlaenius prasinus* possesses seven, and *C. pennsylvanicus* and *Oödes sp.* each has three. In the area of the tentorial rib and the frontal suture usually one seta is present (*Chlaenius pennsylvanicus, C. tricolor, C. sericeus, Oödes sp., Harpalus sp.,* and *H. compar*), or two setae in *Chlaenius cumatilis, Cratacanthus dubius, Harpalus caliginosus, H. viridiaeneus, H. vagans, H. erythropus, H. pennsylvanicus, H. dichrous, Anisodactylus sp., A. californicus, Anisotarsus sayi, Stenocellus rupestris, Stenolophus sp., Agonoderus pallipes* and *Cratocara capitata,* or three setae in *Chlaenius prasinus, Amphasia interstitialis,* and *Agonoderus lineola.* Two exceptional cases are those of *Cratacanthus sp.* and *Nothopus zabroides* which have four and nine setae respectively. On the cardo there is uniformly only one seta present. On the lacinia there is also one seta. In some species it is inserted apically in such as *Chlaenius, Oödes, Amphasia interstitialis,* and *Stenocellus rupestris,* while in other species it is located laterally. On the first segment of the galea usually there is but one seta, but it has not been found in *Chlaenius pennsylvanicus, C. cumatilis, Nothopus zabroides, Cratacanthus sp., Stenocellus rupestris,* and *Stenolophus sp.* On the mandibular scrobe there is usually only one seta present. In the case of *Chlaenius prasinus, Oödes sp., Cratacanthus dubius, C. sp., Harpalus dichrous,* and *Anisodactylus sp.* there are two setae in the scrobe. It is interesting that the genus *Agonoderus* has one seta in the scrobe and another seta above it. In the ocellar area there is usually one seta above and one below the ocelli, *Agonoderus* has three setae above and one below, while *Chlaenius prasinus* and *Stenocellus rupestris* have a total of four setae in the ocellar area.

Thoracic setae.—The setae of the thoracic terga of *Chlaenius* and *Oödes* are almost too numerous to count. They are short and fine and scattered over the whole surface. While in the rest of the genera it is easier to describe their arrangement, because they are fewer in number. The number and position are variable in different

species. These are shown in the various illustrations (figs. 19–26, 34–40, 51–56).

Abdominal setae.—The setae on the abdominal terga of *Chlaenius* and *Oödes* are very fine and as irregular as those of the thorax. While those of other genera have a fairly definite pattern, which arrangement is shown in the illustrations (figs. 19–26, 34–40, 51–56). The setae on the epipleurite, hypopleurite, anterior ventrite, and postventrites seem to have certain taxonomic importance and those of *Harpalus* have been extensively studied as shown in Table II.

The arrangement of the setae of the remaining parts of the body

Table 1: The Number of Head Setae in Various Species

	Antennal sclerite	Nasale region	Adnasale region	Area between tentorial rib and epicranial arm	Cardo	Lacinia	Galea	Mandibular scrobe	Ocellar region
Chlaenius pennsylvanicus	2	2 pr.	3	1	1	1 ap.*	0	1	2
Chlaenius tricolor	2	2 pr.	2	1	1	1 ap.	1	1	...
Chlaenius prasinus	2	8 pr.	8	3	1	1 ap.	1	2	4
Chlaenius cumatilis	2	7 pr.	2	2	1	1 ap.	0	1	2
Chlaenius sericeus	2	4 pr.	2	1	1	1 ap.	1	1	2
Oödes sp.	2	2 pr.	3	1	1	1 ap.	1	2	2
Nothopus zabroides	2	2 pr.	2	9	1	1 lat.†	0	1	3
Cratacanthus dubius	2	3 pr.	2	2	1	1 lat.	1	2	2
Cratacanthus sp.	2	5 pr.	2	4	1	1 lat.	0	2	2
Harpalus caliginosus	2	3 pr.	2	2	1	1 ap.	1	1	1
Harpalus sp.	2	3 pr.	1	1	1	1 ap.	1	1	2
Harpalus viridiaeneus	2	3 pr.	2	2	1	1 lat.	1	1	2
Harpalus vagans	2	3 pr.	2	2	1	1 lat.	1	1	2
Harpalus erythropus	2	3 pr.	2	2	1	1 ap.	1	1	2
Harpalus compar	2	4 pr.	2	1	1	1 lat.	1	1	2
Harpalus pennsylvanicus	2	3 pr.	2	2	1	1 lat.	1	1	2
Harpalus dichrous	2	3 pr.	2	2	1	1 lat.	1	2	2
Anisodactylus californicus	2	3 pr.	2	2	1	1 lat.	1	1	2
Anisodactylus sp.	2	3 pr.	2	2	1	1 lat.	1	2	2
Amphasia interstitialis	2	3 pr.	2	3	1	1 ap.	1	1	3
Anisotarsus sayi	2	2 pr.	2	2	1	1 lat.	1	1	2
Stenocellus rupestris	2	3 pr.	2	2	...	1 ap.	0	1	4
Stenolophus conjunctus	...	.....	...	...	...	... .	...	...	...
Stenolophus sp.	2	2 pr.	2	2	1	1 lat.	0	1	2
Agonoderus lineola	0	3 pr.	2	3	1	1 lat.	1	2	4
Agonoderus pallipes	2	3 pr.	2	2	1	1 lat.	1	2	4
Cratocara capitata	0	3 pr.	2	2	1	1 lat.	1	1	...

* Seta on apex; † seta on lateral side.

TABLE II: THE NUMBER OF SETAE ON PLEURITES AND STERNITES OF *Harpalus*

	Epipleurite seg. 1–8		Hypopleurite seg. 1–8		Ventrite seg. 1–7		Postventrite (mesal) seg. 1–7		Postventrite (lateral) seg. 1–7	
	Maj.*	Min.†	Maj.	Min.	Maj.	Min.	Maj.	Min.	Maj.	Min.
Harpalus caliginosus	5,5,5, 5,5,5, 5,5	3,1,1, 1,1,1, 1,1	2,2,2, 2,2,2, 2,1	0,1,1, 1,1,1, 1,0	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	1,1,1, 1,1,1, 1	1,1,1, 1,1,1, 1	1,1,1, 1,1,1, 1	2,2,2, 2,2,2, 2
Harpalus sp.	2,2,2, 2,2,2, 2,2	0,0,0, 0,0,0, 0,0	0,0,0, 0,0,0, 0,0	0,2,2, 2,2,2, 2,1	2,2,2, 2,3,2, 2	0,0,0, 0,0,0, 0	2,2,2, 2,2,2, 2	0,0,0, 0,0,0, 0	1,1,1, 1,1,1, 1	1,1,1, 1,1,1, 1
Harpalus viridiaeneus	3,3,3, 5,3,3, 3,3	0,2,3, 3,1,3, 0,0	2,2,2, 2,2,2, 2,0	0,0,0, 0,0,0, 0,0	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	2,2,2, 2,2,2, 2	0,0,0, 0,0,0, 0	1,1,1, 1,1,1, 1	0,0,0, 0,0,0, 0
Harpalus vagans	3,3,4, 7,7,7, 3,3	11,10,11, 11,10,10, 11,12	2,2,2, 2,2,2, 1,1	8,8,11, 9,8,7, 5,5	1,2,3, 3,3,3, 3	0,2,3, 4,4,4, 3	4,4,4, 4,4,4, 4	2,4,4, 4,4,4, 2	3,3,3, 3,3,3, 3	2,2,3, 3,3,4, 3
Harpalus erythropus	2,2,2, 2,2,2, 2,2	2,3,5, 6,4,7, 7,1	3,3,3, 3,3,3, 3,3	0,0,0, 0,0,0, 0,0	2,4,2, 4,4,4, 4	0,0,0, 0,0,0, 0	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	3,3,3, 3,3,3, 3	0,0,0, 0,0,0, 0
Harpalus compar	3,3,3, 4,4,4, 3,2	2,3,3, 3,3,3, 2,2	3,3,3, 3,3,3, 3,3	1,1,1, 1,1,1, 1,1	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	1,1,1, 1,1,1, 1	2,2,2, 2,2,2, 2
Harpalus pennsylvanicus	4,4,4, 4,4,4, 4,4	1,3,3, 2,2,1, 0,0	3,3,3, 3,3,3, 3,3	0,0,0, 0,0,0, 0,0	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	3,2,2, 2,2,2, 2	0,0,0, 0,0,0, 0
Harpalus dichrous	2,3,3, 3,3,3, 3,3	3,3,3, 4,3,5, 5,5	2,2,2, 2,2,2, 2,2	2,2,2, 2,2,2, 0	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	4,4,4, 4,4,4, 4	0,0,0, 0,0,0, 0	1,1,1, 1,1,1, 1	3,4,4, 4,4,4, 4

* Major setae; † Minor setae.

are difficult to describe. They have only been shown in different illustrations.

VII. DISCUSSION OF DIAGNOSTIC CHARACTERS

The characters used for identification were selected from a morphological study and are those which ought to be distinct and easily recognized. In other words, those characters with little diagnostic significance are neglected and not discussed.

The mandibular scrobe is an impression of the ectal aspect of the mandible which is absent in *Chlaenius* and *Oödes*. The setae in the scrobe are variable: in most species only one seta is present, but in *Cratacanthus sp.*, *Harpalus caliginosus*, *H. viridiaeneus*, *H. dichrous*, *Stenolophus sp.*, and *Cratocara capitata* there are two setae. In *Agonoderus*, there is one seta in the scrobe and another located dorsad of it. The mandibular tooth is wanting in most species, but some *Harpalus* possess two or three teeth on the cutting edge and also *Anisodactylus californicus* has one. The ligula possesses two setae on its distal end. The bases of the setae are either contiguous in *Chlaenius*, *Oödes*, *Agonoderus*, and *Stenolophus sp.*, or separate in all the remaining species. The labial palpus is generally two-segmented, but in some species of *Chlaenius* and *Oödes* the second segment is divided into a third small segment. The lacinia or inner lobe is a single segment, usually with a seta inserted laterally and a few apically (*Chlaenius*, *Oödes*, *Amphasia interstitialis*, and *Stenocellus rupestris*). The lacinia of *Anisotarsus* is fused with the stipes forming a finger-like lobe. The nasale varies greatly in different species which has been shown in various illustrations. The ocellar furrow has been used as a good diagnostic character as it is present in most species, but not in *Chlaenius*, *Oödes*, *Harpalus dichrous*, *Anisodactylus sp.*, *Anisotarsus*, *Stenocellus*, *Stenolophus*, *Agonoderus*, and *Cratocara*. The writer has also taken advantage of the absence of a cervical groove to separate *Chlaenius* and *Oödes* from the other genera. Praeterga of the abdominal terga are sometimes entirely wanting, such as *Cratacanthus*, *Harpalus viridiaeneus*, *Stenolophus*, *Stenocellus*, *Agonoderus*, and *Cratocara*. The tarsus is usually a short segment of the leg, but this is not true in *Chlaenius* and *Oödes* which when united with the tibia is longer than the femur. Claws of most species are unequal in length, but in *Chlaenius* and *Oödes* they are equal or subequal. Cerci are quite different in size and structure in the different species: in *Chlaenius* and *Oödes* they are usually extraordinarily long and covered with fine hairs, while in other genera they are short and with nodules

bearing setae on them. *Cratacanthus* possesses four setae on the apex of the cercus which is distinguishable from other genera. The arrangement of the setae on the body and appendages is more or less constant in certain species, but they have not been used in the keys, because the setae seem rather difficult to use for diagnostic purposes.

VIII. CLASSIFICATION

The family Carabidae, commonly called ground beetles, comprises over 17,000 described species and is distributed throughout the world (Imms '36). The Harpalinae is the largest among the four subfamilies with over 10,000 species. There are two Sections (Blatchley '10) of the Harpalinae, namely: Bisetosae and Unisetosae (Leng '20). This recognized system of classification is wholly based upon the characters of adults.

The larval characters of the family as given by Van Emden ('42, p. 3), may be quoted as follows: "Legs consisting of five joints (coxa, trochanter, femur, tibia, tarsus) and one or two claws, *i.e.*, with two joints and the claw(s) after the knee. Labrum and clypeus wholly fused with frontal piece. Mandibles without a suctorial channel, without a prostheca and with a single cutting edge. Maxillae with the cardo very short, formed by two half-rings, which lie in the same axis as the stipes, outer lobe inserted on the stipes. No gills or swimming fringes. Eight pairs of abdominal spiracles subequal in size to the others and in the same sublateral position; ninth and tenth abdominal segments distinct."

The larval characters of the subfamily Harpalinae are compiled from Böving and Craighead ('30) and Van Emden ('42) as follows: antenna not twice as long as mandible; anterior margin of nasale varying much according to genus, but never produced into a pair of strong, conical teeth; mandible falcate or robust, retinaculum well developed; inner edge of mandible in front of retinaculum either entire, or with one to several teeth; ventral and pleural sclerites incomplete, more or less broadly separated from each other, seldom as in Scaritini, but then the maxillary stipes extending into a hairy lobe on inner side of apex, or the abdomen tapering in the normal way; tergites usually exposing spiracles and pleura more or less broadly to come out, the pronotum usually margined.

The larval characters of the Section Unisetosae cannot be given until those of the Bisetosae are studied.

Chlaeniini.—Van Emden ('42, pp. 39, 43) has given the characters of tribes in which *Oödes* is placed in the Chlaeniini: "Head

without a neck-constriction or a cervical groove and keel before base, though the head is somewhat narrowed to base and is provided with a lateral impression behind the temples. Epicranial suture absent or short. Nasale with several acute or blunt teeth. Antennae not much (up to a third) longer than mandibles, with a few setae or pubescent. Mandibles rather slender, not much less than three times as long as wide at base or longer, penicillus present. Maxillae: Stipes rather slender, inner lobe strong with an apical seta, second joint of outer lobe shorter than first. Ligula distinct with two setae, second joint of labial palpi not very slender, often subdivided at apex. Legs with two equal, simple claws. Tergites margined laterally, complete, usually partly hiding the abdominal spiracles in dorsal view. Cerci either fixed and with a few nodules, each of which bears a seta, or fixed or movable and, in second and third stages, without nodules and with numerous small hairs, often irregularly annulate."

Harpalini.—"Frontal piece not reaching hind margin of head, epicranial suture well developed. Head with a cervical groove and keel (*Amblystomus*?). Six ocelli present. Antennae not or slightly longer than mandibles, basal joint the longest, but third sometimes almost as long. Mandibles more or less stout, usually less than two-and-a-half times as long as wide, sometimes prolonged between rectinaculum and apex, the former then rather close to base and the middle part hardly curved and with several blunt teeth on cutting edge; penicillus and rectinaculum present, often 1–5 blunt teeth beyond the latter. Maxillae with the stipes moderately long, inner lobe present; outer lobe and palpus slender; first joint of palpi longer (usually much) than palpiger and second and third joints. Legs with two free unequal claws. Tergites well developed, though often rather pale; incomplete and not margined at sides; tenth segment more or less slender, abdomen not physogastric. Cerci present.

Larval Key to Genera

1.—Abdominal tergites broad, covering the entire dorsum laterally; mandible rather slender and curved (fig. 14); scrobe absent; retinaculum (fig. 84, R) subbasal, slender, and curved backward; bases of ligular setae contiguous (fig. 7); setae of lacinia on apex (fig. 8); ocellar furrow absent; cervical groove absent; stem of epicranial suture very short; head with a transverse constriction; body pubescent; praeterga (fig. 19, PTG) present on the terga of abdominal segments 1–9; tarsus longer than tibia, the length of tarsus

and tibia together longer than femur; claws of each leg subequal; cercus usually very long 2

Abdominal tergites narrow, not covering the entire dorsum laterally; mandible rather stout (fig. 84), scrobe (fig. 84, MS) usually present; retinaculum (fig. 84, R) located near middle of cutting edge, directed more mesad; bases of ligular setae usually separate (fig. 27, LGS); setae of lacinia on side (fig. 29, LA) or on apex (fig. 8); ocellar furrow present and extending backward (fig. 30, OCF) or inconspicuous; cervical groove (fig. 30, C) generally present; stem of epicranial suture long, head without a transverse constriction; praeterga present or absent on terga of abdominal segments; length of tarsus and tibia together not longer than femur; claws of each leg unequal 3

2.—First segment of labial palpus with only three or four setae; body less setose; cercus not very long, with few setae.
Oödes

First segment of labial palpus with more than three setae; body setose; cercus very long, with many small setae.
Chlaenius

3.—Bases of ligular setae separate (fig. 27, LGS) 4

Bases of ligular setae contiguous (fig. 60) 11

4.—Ocellar furrow present and extending backward (fig. 30, OCF) 8

Ocellar furrow absent 5

5.—With a row of setae in the place of ocellar furrow (fig. 41).
Nothopus

Without a row of setae in the place of ocellar furrow 6

6.—Lacinia fused with stipes forming a stout lobe (fig. 44, LA).
Anisotarsus

Lacinia distinct, not fused with stipes, and with a seta on the apex or on the side 7

7.—Seta of lacinia on apex; with one seta on scrobe region; praeterga of abdominal segments wanting; cercus shorter than ninth abdominal segment ..... *Cratocara*

Seta of lacinia on the side; with three setae on scrobe region; praeterga (fig. 19, PTG) present on terga of first to ninth abdominal segments; cercus longer than ninth abdominal segment ..... *Anisodactylus* (pt.)

8.—Apex of cercus with four setae (fig. 46, CR); cercus stouter, shorter than tenth abdominal segment; bases of cerci broadly separated ..... *Cratacanthus*

Apex of cercus with less than four setae; cercus slender, longer than or subequal to tenth abdominal segment; bases of cerci narrowly separated 9

9.—Ocellar furrow rather broad; with a swollen area bearing two setae (fig. 66) above the furrow and behind the ocelli. *Anisodactylus* (pt.)

Ocellar furrow not so broad, without a swollen area bearing two setae above it 10

10.—Praeterga present on first to ninth abdominal segments; seta of lacinia on apex; nasale with two pairs of blunt teeth, each tooth dentated (fig. 68) ..... *Amphasia*

Praeterga never present on fifth to eighth abdominal segments; setae of lacinia on side; nasale not so dentated. *Harpalus* (pt.)

11.—Praeterga present on first to ninth abdominal segments. *Harpalus* (*H. dichrous*)

Praeterga wanting on terga of all abdominal segments 12

12.—Mandibular scrobe well developed, with two setae; seta of lacinia on side 13

Mandibular scrobe wanting, with one seta on that region; seta of lacinia on apex ..... *Stenocellus*

13.—Nasale without a large median tooth; abdominal terga with ten strong setae in two rows, six in cephalic row and four in caudal row; trochanter with less than five spinulae on each side; with two setae on scrobe, no seta on dorsum of mandible ..... *Stenolophus*

Nasale with a large median tooth (figs. 88, 92); abdominal terga with many setae, at least more than ten in two rows; with one seta on scrobe and one seta on the dorsum of mandible (figs. 88, 92) ..... *Agonoderus*

Species Key to Chlaenius

1.—Cerci with setiferous nodules, not longer than last four abdominal segments and without annulated rings 2

Cerci tapering, without setiferous nodules, much longer than last four abdominal segments and bearing irregular annulated rings 3

2.—Nasale with one broad median tooth and two blunt teeth on each side (fig. 17) ..... *pennsylvanicus*

Nasale without broad median tooth but with more than twenty small fine teeth (fig. 13) ..... *tricolor*

3.—Body tricolored; nasale with one very small median tooth and two larger lateral teeth, no fine teeth between the median tooth and lateral tooth (fig. 7); two setae on the back of mandible (figs. 1, 7) ..... *prasinus*

Body not tricolored; nasale with one median tooth and two lateral teeth on each side, with two or more small fine teeth between the median tooth and the lateral tooth (figs. 12, 15); four or five setae on the back of mandible (figs. 2, 3) 4

4.—Nasale with two, small, fine teeth between the median tooth and the lateral tooth (fig. 12); without a knob in the region above ocelli ..... *cumatilis*

Nasale with more than three small fine teeth between the median tooth and the lateral tooth (fig. 15); with a knob in the region above ocelli (fig. 15) ..... *sericeus*

Species Key to Cratacanthus

1.—Nasale region with three pairs of setae (fig. 48); with 4 setae on dorsum of first segment of labial palpus; without a small seta caudad to each abdominal spiracle ..... *dubius*

Nasale region with five pairs of setae (fig. 43); with 2 setae on dorsum of the first segment of labial palpus; with a small seta caudad to each abdominal spiracle (fig. 38) ..... *sp.*

Species Key to Anisodactylus

1.—Ocellar furrow well developed; praeterga present on abdominal segments 1–3 only; a swollen area bearing two setae above ocellar furrow (fig. 66); nasale with 10 median fine teeth and two larger blunt teeth on each side (fig. 66); first segment of labial palpus with one seta on dorsum. *californicus*

Ocellar furrow wanting; praeterga present on abdominal segments 1–9; without a swollen area with two setae above ocellar furrow; nasale with 6 blunt teeth and several small teeth (fig. 70); first segment of labial palpus bare ..... *sp.*

Species Key to Stenolophus*

1.—Cervical groove not conspicuous ..... *conjunctus*

Cervical groove conspicuous (fig. 61) ..... *sp.*

* Since the only available specimen of *S. conjunctus* is incomplete, many diagnostic characters are not known.

Species Key to Harpalus

1.—Bases of ligular setae contiguous (fig. 81); maxillary palpus three segmented; ocellar furrow absent; praeterga present on all abdominal segments (fig. 24); tarsus longer than tibia; tarsus and tibia together almost equal to the length of femur ..... *dichrous*

Bases of ligular setae separate; maxillary palpus four segmented; ocellar furrow present; praeterga on abdominal segments absent or only present on first and second, first to third, or first to fourth abdominal segments, never present on fifth to ninth; tarsus shorter than or subequal to tibia; tarsus and tibia together shorter than the length of femur 2

2.—With 2 or 3 mandibular teeth on cutting edge 4

Without or with a small, not very noticeable tooth on cutting edge 3

3.—Mandibular tooth wanting; 2 or 3 setae on scrobe; praeterga on abdominal segments wanting; nasale as illustrated in figure 83 ..... *viridiaeneus*

Without or with a small, not very noticeable tooth on cutting edge of mandible; one seta on scrobe; praeterga present on 1st abdominal segment; nasale as illustrated in figure 30. *pennsylvanicus*

4.—With a pair of larger teeth on each side of nasale region (figs. 76, 89) 5

With very uniform fine teeth on nasale region (figs. 73, 77, 85) 6

5.—Three mandibular teeth on cutting edge; a row of more than ten spinulae located on frontoclypeal area, parallel to each epicranial arm and just cephalad of epicranial stem (fig. 76); without a furrow present between epicranial arm and ocellar furrow ..... *sp.*

Two mandibular teeth on cutting edge; without a row of spinulae located on frontoclypeal area parallel to each epicranial arm and cephalad of epicranial stem; a furrow present parallel to ocellar furrow and between epicranial arm and ocellar furrow (fig. 89) ..... *caliginosus*

6.—With one seta on dorsum of 1st segment of labial palpus; lacinia with a seta on apex; head width of fullgrown larva around 2.4 mm. ..... *erythropus*

With two or three setae on dorsum of 1st segment of labial

palpus; lacinia with a seta on side; head width of fullgrown larva about 2.6 to 3.3 mm. 7

7.—With three mandibular teeth; head width of fullgrown larva about 3.3 mm. ..... *compar*

With two mandibular teeth; head width of fullgrown larva about 2.6 mm. ..... *vagans*

Species Key to Agonoderus

1.—Seven pairs of long setae on frontoclypeal area (fig. 88); three pairs of long setae on the cephalic margin of protergum (fig. 53); femur not longer than tarsus and tibia together. *pallipes*

Eight pairs of long setae on frontoclypeal area (fig. 92); more than three pairs of long setae on the cephalic margin of protergum (fig. 52); femur longer than tarsus and tibia together ..... *lineola*

IX. DESCRIPTIONS OF SPECIES

Chlaenius pennsylvanicus Say. (Figs. 5, 8, 14, 17, 18.)

Three lots of specimens in the U. S. National Museum collection:

1. One exuviae and one reared adult, Hamilton collection no. 48;
2. One exuviae and one reared adult, Hamilton collection no. 485;
3. One exuviae and one reared adult, Hamilton collection no. 487.

Measurements.—Width of head 1.4 mm., width of prothorax 2.2 mm., length of body 11.7 mm., length of cercus 1.7 mm., length of ninth abdominal segment 0.3 mm., length of tenth abdominal segment 0.8 mm.

Color.—Head dark brown; sclerites of thorax and abdomen all dark brown; intersclerite membrane light brown; legs dark brown.

Head.—Antenna four-segmented, little longer than mandible, first segment longest, second as long as third, third curved mesad with a sensorial appendage laterad, fourth shortest; mandible slender, with two setae on the back, retinaculum basal, slender and curved meso-caudad, mandibular teeth wanting; labium elongate with a row of strong setae on each lateral margin, labial palpus two-segmented, bases of ligular setae contiguous; maxillary palpus four-segmented, with one seta on the venter of first segment, galea two-segmented, lacinia with a seta on apex; nasale with a large even median tooth and two lateral teeth on each side; six pairs of long setae on frontoclypeal area;

six ocelli present on each side, ocellar furrow wanting; cervical groove wanting; stem of epicranial suture very short.

Thorax.—Tergites marginated and broad, covering to pleura; prothorax much longer than meso- or metathorax; setae short; mesothoracic spiracle large and elliptical; legs short, tarsus slightly longer than tibia, tarsus and tibia together almost as long as femur; two claws subequal.

Abdomen.—Tergites with numerous short setae, praeterga present on first nine segments; nine epipleurites present, heavily sclerotized with many setae; first to eighth hypopleurites present, heavily sclerotized with many setae; anterior ventrite and postventrites distinct in first seven segments with many setae on each sclerite; the sternites of eighth and ninth, each fused into one piece with many setae; tenth segment tubulose with many setae as shown in figure 5; cercus fairly long with nodules bearing setae; eight pairs of abdominal spiracles present laterally, annular and small.

Remarks.—Identification was based on the reared adults and the description was made from the exuviae.

Chlaenius tricolor Dejean. (Figs. 4, 11, 13.)

One exuviae and one reared adult in the U. S. National Museum collection, labeled Hamilton collection no. 579.

Measurements.—Width of head 1.6 mm., width of prothorax 2.6 mm., length of body 16.0 mm., length of cercus 2.9 mm., length of ninth abdominal segment 0.5 mm., length of tenth abdominal segment 1.1 mm.

Color.—Head dark brown; sclerites of thorax and abdomen all dark brown; intersclerite membrane light brown; leg dark brown.

Head.—Antenna four-segmented, a little longer than mandible, first segment longer than second, second longer than third, third curved mesad with a sensorial appendage laterad, fourth missing; mandible slender with two setae on the back, retinaculum basal, slender and curved meso-cauded, mandibular teeth wanting; labium elongate with a row of long setae on each lateral margin, labial palpus two-segmented, bases of ligular setae contiguous; maxillary palpus four-segmented with one seta on the venter of first segment, galea two-segmented, lacinia with a seta on apex; nasale with twenty-four small teeth of fairly equal sized; five pairs of setae on frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove wanting; stem of epicranial suture very short.

Thorax.—Tergites broad and marginated, covering to pleura; prothorax much longer than meso- or metathorax; setae short; mesothoracic spiracle large and elliptical; leg short, tarsus a little longer than tibia, tarsus and tibia together longer than femur; two claws subequal.

Abdomen.—Tergites with numerous setae, praeterga present on first eight segments; nine epipleurites present, heavily sclerotized with many setae; first to eighth hypopleurites present, heavily sclerotized with many setae; anterior ventrites and postventrites distinct in first seven segments with many setae on each sclerite, the sternites of eighth and ninth each fused into one piece with many setae; tenth segment tubulose with many setae as shown in figure 4; cercus fairly long with nodules bearing setae; eight pairs of abdominal spiracles present, annular and small.

Remarks.—Identification was based on the reared adult and the description was from the exuviae which has lost some parts. There is only one leg left and it is not known to what thoracic segment it belongs.

Chlaenius prasinus Dejean. (Figs. 1, 7, 9.)

Seven larvae in the U. S. National Museum collection, collected in sand on the shore of Lake Monroe, Enterprise, Florida, at the end of May, 1876, by Schwarz.

Measurements.—Width of head 2.1 mm., width of prothorax 3.3 mm., length of body 24.8 mm., length of cercus 14.4 mm., length of ninth abdominal segment 0.5 mm., length of tenth abdominal segment 1.9 mm.

Color.—Head brown; prothorax brown, mesothorax brown, metathorax dark brown; dorsum of first four abdominal segments dark brown, fifth to tenth light brown, cerci dark brown, other sclerites brown; legs light brown.

Head.—Antenna four-segmented, a little longer than mandible, first segment longest, second almost as long as third, fourth shortest, third segment curved mesad with a sensorial appendage laterad; mandible slender with two setae on the back, retinaculum basal, slender, and curved meso-caudad, mandibular teeth wanting; labium elongate with a row of long setae on each lateral margin, labial palpus three segmented, bases of ligular setae contiguous; maxillary palpus four-segmented with one seta on the venter of first segment, galea two-segmented, lacinia with a seta on apex; nasale with a small sharp median

tooth and two larger lateral ones on each side; many pairs of setae on the frontoclypeal area; six ocelli present on each side; ocellar furrow wanting; cervical groove wanting; stem of epicranial suture very short.

Thorax.—Tergites broad and marginated, covering to pleura; prothorax much longer than meso- or metathorax; setae short; mesothoracic spiracles large and elliptical; legs fairly long, tarsus longer than tibia, tarsus and tibia together much longer than femur; two claws subequal.

Abdomen.—Tergites with numerous short setae, praeterga present on first nine segments; nine epipleurites present; heavily sclerotized with many short setae; first to eighth hypopleurites present, heavily sclerotized with many short setae; anterior ventrites and postventrites distinct in first seven segments with many setae on each sclerite; the sternites of eighth and ninth each fused into one piece with many setae; tenth segment tubulose with many setae as shown in figure 1; cercus tapering and very long with numerous short hairs; eight pairs of abdominal spiracles present, annular and small.

Remarks.—Identification and description were based on the larvae.

Chlaenius cumatilis LeConte. (Figs. 3, 10, 12.)

One larva in the U. S. National Museum collection, collected from the stream bed in Sabino Canyon, Arizona, May 16, 1897. Hubb. no. 831.

Measurements.—Width of head 2.1 mm., width of prothorax 2.6 mm., length of body 23.8 mm., length of cercus 10.8 mm., length of ninth abdominal segment 0.4 mm., length of tenth abdominal segment 1.1 mm.

Color.—Head and all the sclerites dark brown, legs, distal half of cercus and venter of abdomen lighter.

Head.—Antenna four-segmented, a little longer than mandible, first segment longer than second, second almost as long as third, fourth shortest, third segment curved mesad with a sensorial appendage laterad; mandible slender, with four setae on the back, retinaculum basal, slender, and curved mesocaudad, mandibular teeth wanting; labium elongate with a few long setae on each lateral margin, labial palpus three segmented, bases of ligular setae contiguous; maxillary palpus four-segmented with one seta on the venter of first segment, galea two-segmented, lacinia with a seta on apex; nasale with a large

median tooth and two large lateral teeth on each side, two tiny teeth in the space between the median and the lateral teeth; eleven pairs of setae in the frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove wanting; stem of epicranial suture very short.

Thorax.—Tergites broad and marginated, covering to pleura; prothorax much longer than meso- or metathorax; setae short; mesothoracic spiracle large and elliptical; legs fairly long, tarsus longer than tibia, tarsus and tibia together longer than femur; two claws subequal.

Abdomen.—Tergites with numerous setae, praeterga present on first eight segments; nine epipleurites present, heavily sclerotized with many short setae; anterior ventrites and postventrites distinct in first seven segments with many setae on each sclerite; the sternites of eighth and ninth, each fused into one piece with many setae; tenth segment tubulose with many setae as shown in figure 3; cercus very long and tapering with numerous short hairs; eight pairs of abdominal spiracles present, annular and small.

Remarks.—Identification and description were based on a single larva.

Chlaenius sericeus Forster. (Figs. 2, 15, 16, 47.)

Three lots of specimens in the U. S. National Museum collection: 1. Eleven larvae collected around margins of ponds of Chicago bays, July 28, 1917, Hamilton collection nos. 475–479; 2. An exuviae and a reared adult, Hamilton collection no. 478; 3. An exuviae and a reared adult, Hamilton collection no. 475.

Measurements.—Width of head 1.8 mm., width of prothorax 2.2 mm., length of body 23.2 mm., length of cercus 8.6 mm., length of ninth abdominal segment 0.6 mm., length of tenth abdominal segment 1.6 mm.

Color.—Head reddish brown; thorax dark brown, coxae dark brown and the rest of leg yellowish brown; dorsum of abdomen dark brown, venter light brown, ninth and tenth abdominal segments dark brown, cerci dark brown with a part near the proximal ends, light brown.

Head.—Antenna four-segmented, longer than mandible, first segment almost as long as second, third shorter, curved mesad with a sensorial appendage laterad, fourth shortest; mandible slender with five setae on the back, retinaculum basal, slender and curved meso-caudad, mandibular teeth wanting;

labium elongate with a row of long setae on each lateral margin, labial palpus three-segmented, bases of ligular setae contiguous; maxillary palpus four-segmented with one seta on the venter of first segment, galea two-segmented, lacinia with a seta on apex; nasale with a large median tooth and two large lateral teeth on each side, three tiny teeth in the space between the median and lateral teeth; seven pairs of setae in the frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove wanting; stem of epicranial suture very short.

Thorax.—Tergites broad and marginated, covering to pleura; prothorax much longer than meso- or metathorax; short setae scattered with few longer setae; mesothoracic spiracle large and elliptical; legs fairly long, tarsus as long as or longer than tibia, tarsus and tibia together longer than femur; two claws subequal.

Abdomen.—Tergites with numerous short setae scattered with few longer setae, praeterga present on first nine segments; nine epipleurites present, heavily sclerotized with many short setae; first to eighth hypopleurites distinct, heavily sclerotized with many short setae; two pairs of small sclerites present on each front margin of first eight sterna; anterior ventrites and postventrites distinct in first seven segments with many setae on each sclerite; the sternites of eighth and ninth, each fused into one piece with many setae; tenth segments tubulose with many setae as shown in figure 2; cercus very long and tapering with numerous short hairs; eight pairs of abdominal spiracles present, annular and small.

Remarks.—Identification was based on the reared adults, while the description was made from the larvae.

Oödes sp. (Figs. 6, 75, 79.)

Three lots of specimens in the U. S. National Museum collection: 1. A larva collected among *Harpalus* by Schwarz and Barber in Plummers Island, Maryland, August 9, 1919; 2. A larva collected by Schwarz and Barber in Plummers Island, Maryland, August 16, 1914; 3. A larva collected by J. L. Wrenn in Plummers Island, Maryland, July 9, 1914.

Measurements.—Width of head 1.8 mm., width of prothorax 2.9 mm., length of body 14.1 mm., length of cercus 2.4 mm., length of ninth abdominal segment 0.5 mm., length of tenth abdominal segment 1.5 mm.

Color.—Head reddish brown; dorsum of thorax and abdomen uniformly dark brown, cerci dark brown, venter of thorax and abdomen and also legs brown.

Head.—Width of head much smaller than thorax; antenna four-segmented, a litte longer than mandible; first three segments almost as long as each other, third curved mesad with a sensorial appendage laterad, fourth short with a sensorial organ on distal end; mandible slender with two setae on the back, retinaculum basal, slender, and curved meso-caudad, mandibular teeth wanting; labium elongate with two pairs of setae on the venter, labial palpus three-segmented, bases of ligular setae contiguous; maxillary palpus four-segmented with one seta on the venter of first segment, galea two-segmented, lacinia with a seta on apex; nasale with a group of fine teeth on the middle, two larger ones on each lateral side, and a tiny one between two laterals; six pairs of setae in the frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove wanting; stem of epicranial suture almost none.

Thorax.—Tergites broad and marginated, covering to pleura; prothorax much longer than meso- or metathorax; setae short, scattered on whole terga; mesothoracic spiracle large and elliptical; legs not long, tarsus as long as tibia, tarsus and tibia together as long as femur; two claws subequal.

Abdomen.—Tergites with numerous short setae, praeterga present on first eight segments; ninth epipleurite present, heavily sclerotized with many setae; first to eighth hypopleurites distinct, heavily sclerotized with many short setae; anterior ventrites and postventrites distinct in first seven segments with many strong setae on each sclerite; the sternites of eighth and ninth, each fused into one piece with many strong setae; tenth segment tubulose with many setae as shown in figure 6; cercus short with nodules bearing setae; eight pairs of abdominal spiracles present, annular and small.

Remarks.—The species was identified by Dr. A. G. Böving based on the larvae, but it does not fit van Emden's key. The description was also based on those three larvae.

Nothopus zabroides LeConte. (Figs. 35, 41, 42.)

Two lots of specimens in the U. S. National Museum collection; 1. One larva collected by L. D. Christenson from soil of a peach orchard in Bangs, Texas, August 18, 1937; 2. One exuviae and one reared adult collected by W. H. Anderson from soil in Bangs, Texas, October 26, 1937.

Measurements.—Width of head 3.4 mm., width of prothorax 3.2 mm., length of body 24.5 mm., length of cercus 0.4 mm., length of ninth abdominal segment 0.7 mm., length of tenth abdominal segment 1.1 mm.

Color.—Head brown; dorsum of thorax, abdomen and legs brown; venter and pleuron brownish white.

Head.—Head broader than thorax; antenna four-segmented, longer than mandible, first segment longest, second as long as third, fourth shortest, third segment curved mesad with a sensorial appendage laterad; mandible stout, with one seta in scrobe, retinaculum stout, located near middle and directed mesad, mandibular teeth wanting; labium elongate with rows of strong setae on each lateral margin, labial palpus two-segmented, bases of ligular setae separate; maxillary palpus four-segmented, galea two-segmented, lacinia with a seta on side; nasale with two lateral teeth on each side; six pairs of major setae and six pairs of minor setae on the frontoclypeal area; six ocelli present on each side, ocellar furrow absent but with a row of setae on that position (fig. 41) cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated and broad, but hardly covering to pleura; prothorax much longer and broader than meso- or metathorax; setae distinct, fifteen pairs on protergum, nine pairs on meso- and also on metatergum; one seta on meso-anepimeron, two setae on meta-anepimeron, two setae on epimeron, one seta on trochantin; mesothoracic spiracle very large, elliptical; legs short, tarsus and tibia both very short, femur longer than tarsus and tibia together, cephalic claw longer than caudal.

Abdomen.—Tergites narrow not covering laterally entire terga, with five to seven pairs of strong setae; praeterga present on first eight segments; nine epipleurites present, each with three to six setae; first to eight hypopleurites not well sclerotized, each with two setae; anterior ventrites and postventrites not well sclerotized, with two to three pairs of setae on the former and two pairs on the latter; the sternites of eighth and ninth segments each fused into one piece with four and five pairs of setae respectively; tenth segment tubulose with many setae as shown in figure 35; cercus very short, shorter than ninth abdominal segment, with a group of three setae on distal portion; eight pairs of abdominal spiracles small and annular.

Remarks.—The species was identified by W. H. Anderson based

on the reared adult. The description was made from both the larva and the exuviae.

Cratacanthus dubius (Beauvois). (Figs. 37, 48, 50.)

Two lots of specimens in the U. S. National Museum collection: 1. One exuviae and one reared adult, Hamilton collection no. 203; 2. One larva mixed together with five other *Harpalus* larvae identified by van Emden, Hamilton collection nos. 202 and 207.

Measurements.—Width of head 2.5 mm., width of prothorax 2.5 mm., length of body 13.8 mm., length of cercus 0.7 mm., length of ninth abdominal segment 0.4 mm., length of tenth abdominal segment 0.8 mm.

Color.—Head brown, the rest brownish white.

Head.—Head as wide as thorax; antenna four-segmented, a little longer than mandible; mandible stout, with two setae in scrobe, retinaculum stout, located near middle and directed mesad, mandibular teeth wanting; labium elongate with rows of strong setae on each lateral margin, labial palpus two-segmented, bases of ligular setae separate; maxillary palpus four-segmented with a seta on venter of first segment, galea two-segmented, lacinia with a seta on side; nasale with a large median tooth and two smaller lateral teeth on each side; seven pairs of strong setae on the frontoclypeal area; six ocelli present on each side, ocellar furrow broad, with one long and one short setae in it; cervical groove present; stem of epicranial suture quite long.

Thorax.—Tergites marginated and broad, but hardly covering to pleura; prothorax longer and broader than meso- or metathorax; setae distinct, seven large pairs on protergum, nine large pairs on meso- and metatergum each; each with two setae on episternum, epimeron and trochantin; mesothoracic spiracle very large, elliptical; legs short, tarsus and tibia both are very short, femur longer than tarsus and tibia together, cephalic claw longer than caudal, especially on the forelegs.

Abdomen.—Tergites narrow, not covering laterally to pleura, with eleven pairs of long setae on first three segments and more on the rest; praeterga absent; nine epipleurites present, with five setae on first seven, four on eighth, two on ninth; eight hypopleurites, each with three setae; two pairs of long setae on anterior ventrites, two pairs on mesal postventrites, one pair on each lateral postventrite; the sternites of eighth and ninth segments, each fused into one piece with three pairs

of major setae, tenth segment tubulose with many setae as shown in figure 37; cercus rather short, shorter than tenth segment, but longer than ninth, with a group of four setae on the distal portion; eight pairs of abdominal spiracles small and annular.

Remarks.—The identification was based on the reared adult. The description was made from the exuviae.

Cratacanthus sp. (Figs. 38, 43, 45, 46.)

Two lots of specimens in the U. S. National Museum collection: 1. One larva collected from soil of peach orchard in Scott County, Missouri by W. F. Turner, November 9, 1937; 2. Two larvae collected by C. J. Drake in Ames, Iowa, no date indicated.

Measurements.—Width of head 2.4 mm., width of prothorax 2.6 mm., length of body 10.5 mm., length of cercus 0.6 mm., length of ninth abdominal segment 0.4 mm., length of tenth abdominal segment 0.9 mm.

Color.—Head and prothorax brown; mesothorax, metathorax, and legs light brown; abdomen white.

Head.—Head a little narrower than thorax; antenna longer than mandible; mandible stout, with two setae in scrobe, retinaculum stout, located near middle and directed mesad, labium elongate with rows of strong setae on each lateral margin, labial palpus two-segmented, bases of ligular setae separate; maxillary palpus four-segmented with a seta on venter of first segment, galea two-segmented, lacinia with a seta on side; nasale with a large median tooth and two smaller lateral teeth on each side; seven pairs of strong setae and three pairs of minor ones on the frontoclypeal area; six ocelli present on each side, ocellar furrow present with two seta on the caudal end; cervical groove present; stem of epicranial suture quite long.

Thorax.—Tergites marginated and broad, but hardly covering to pleura; prothorax longer and broader than meso- and metathorax; setae distinct, eleven pairs on protergum, ten pairs on mesotergum, and nine pairs on metatergum; mesothoracic spiracle very large, elliptical; legs short, tarsus and tibia both are very short, femur longer than tarsus and tibia together, cephalic claw longer than caudal, especially on the forelegs.

Abdomen.—Tergites narrow, not covering laterally to pleura, with five or six pairs of setae in each cephalic and caudal row of first three segments, and more setae on the re-

maining tergites; praeterga absent; eight epipleurites distinct with four to five setae; eight hypopleurites present each with three setae; sternites weakly sclerotized, two pairs of setae on anterior ventrites, two pairs on mesal postventrites, three setae on lateral postventrites; eighth and ninth sternites very weakly scleroized, tenth segment tubulose with many setae as shown in figure 38; cercus rather short, shorter than tenth segment, but longer than ninth, with a group of four setae on the distal portion; eight pairs of abdominal spiracles small and annular.

Remarks.—The identification and description were based on the larvae. This species was reported as injuring corn at Ames, Iowa, by Prof. C. J. Drake.

Harpalus caliginosus ? (Fabricius). (Figs. 26, 89, 90.)

Two larval specimens in the U. S. National Museum collection. Hamilton collection nos. 221–225. The label reads "probably *Harpalus caliginosus.*"

Measurements.—Width of head 5.3 mm., width of prothorax 5.2 mm., length of body 27.0 mm., length of cercus 2.3 mm., length of ninth abdominal segment 1.0 mm., length of tenth abdominal segment 1.2 mm.

Color.—Head and thorax dark brown; abdomen and legs brown.

Head.—Head very large; antenna four-segmented, longer than mandible, first segment longer than second, second longer than third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with one seta on scrobe, retinaculum stout, located near middle and directed mesad, two mandibular teeth present; labium elongate with a row of strong setae on each lateral margin, labial palpus two-segmented, bases of ligular setae separate; maxillary plapus four-segmented, galea two-segmented, lacinia with a seta on apex; nasale with a row of about twenty-seven teeth, two lateral ones larger; seven pairs of strong setae on frontoclypeal area; six ocelli present on each side, ocellar furrow present with one long seta at the caudal end; another furrow present on the area between epicranial arm and ocellar furrow, with two setae close to it (fig. 89); cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated and broad, covering to pleura; tergum more than two times larger than meso- or metatergum; ten pairs of setae on protergum, seven pairs on meso-

and metatergum each; mesothoracic spiracle very large, elliptical; legs short, tarsus and tibia both very short, femur longer than tarsus and tibia together, cephalic claw longer than caudal, especially on the forelegs.

Abdomen.—Tergites narrow, not covering laterally to pleura, with many setae in cephalic and caudal rows of each tergum; praeterga only present on first two segments; nine epipleurites present, with six setae on second to eighth, first has eight and last has two setae; eight hypopleurites, with three setae on first seven; four setae on seven anterior ventrites, four setae on seven mesal postventrites, three setae on seven lateral postventrites; the eighth and ninth sternites, each fused into one piece with four and five pairs of setae respectively; tenth segment tubulose with many setae as shown in figure 26; cercus longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles, annular, the first one larger than rest.

Remarks.—The identification and description were based on the larvae. There were originally three lots of specimens from the U. S. Museum. One lot has been reidentified as *Scarites,* not belonging to this group. Another lot has been reidentified as *Harpalus sp.*

Harpalus sp. (Figs. 19, 28, 76.)

Nine larvae in the U. S. National Museum collection, collected in sandy field near Brownfield woods, Urbana, Illinois, October 24, 1914.

Measurements.—Width of head 3.5 mm., width of prothorax 3.0 mm., length of body 20.5 mm., length of cercus 1.4 mm., length of ninth abdominal segment 0.7 mm., length of tenth abdominal segment 1.5 mm.

Color.—Head, thoracic terga, abdominal terga, legs, and cerci are brown; other parts of the body white.

Head.—Head very large; antenna four-segmented, longer than mandible, first segment much longer than second, second longer than third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with one seta in the scrobe, retinaculum stout, located near middle and directed mesad, three mandibular teeth present; labium elongate with a row of strong setae on each lateral margin, labial palpus two-segmented; bases of ligular setae separate; maxillary palpus four-segmented with a seta on venter of first segment, galea two-segmented, lacinia with a seta on apex; nasale with a row

of about twenty-eight teeth, two lateral ones larger; five pairs of strong setae on frontoclypeal area, a row of twelve spinulae located along each epicranial arm in the caudal area of the front (fig. 76); six ocelli present on each side; ocellar furrow present with one long seta on the caudal end; cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated, protergum broad, meso- and metatergum narrow, not covering laterally to pleura. Protergum almost twice as large as meso- or metatergum; five pairs of setae on protergum, six pairs on meso- and metaterga each; mesothoracic spiracle very large, elliptical; legs short, tarsus shorter than tibia, femur longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites very narrow, exposing a large part of each tergum; setae very regular: three pairs on cephalic row and two pairs on caudal row of each tergum; praeterga only present in first two segments; nine epipleurites present, each with two setae; eight hypopleurites not well sclerotized, second to seventh each with two short setae, last with one seta, and first with only one brown spot; on the first seven segments, sternites not well sclerotized, a pair of setae on each anterior ventrite, a pair on each mesal postventrite, one long and one short setae on each lateral postventrite; tenth segment tubulose with seven pairs of long setae; cercus longer than tenth segment, with nodules bearing setae; eight pairs of abdominal spiracles, annular and small.

Remarks.—The identification and description were based on the larvae. According to the nasale teeth, it might be a young instar of *Harpalus caliginosus.*

Harpalus viridiaeneus Beauvois. (Figs. 25, 80, 83.)

One larva, one exuviae, and one reared adult in the U. S. National Museum collection, Hamilton collection no. 427.

Measurements.—Width of head 2.1 mm., width of prothorax 2.1 mm., length of body 12.4 mm., length of cercus 1.1 mm., length of ninth abdominal segment 0.5 mm., length of tenth abdominal segment 1.1 mm.

Color.—Head brown; the rest light brown.

Head.—Head as broad as thorax; antenna four-segmented, longer than mandible, first segment very long, second almost as long as third, third curved mesad, with a large sensorial appendage laterad, fourth short; mandible stout with three setae in scrobe, retinaculum stout, located near middle and

directed mesad; mandibular teeth wanting; labium elongate with strong setae on each lateral margin, labial palpus two-segmented with two setae on dorsum of first segment, bases of ligular setae separate; maxillary palpus four-segmented, galea two-segmented, lacinia with a seta on side; nasale with a large median tooth and two large lateral ones; seven pairs of strong setae on frontoclypeal area; six ocelli present on each side, ocellar furrow present; cervical groove present; stem of epicranial suture long.

Thorax.—Tergites marginated, fairly broad, protergum much larger than meso- or metatergum; many setae on the terga as shown in figure 25; mesothoracic spiracle very large, elliptical; legs short, tarsus and tibia both are very short, femur longer than tarsus and tibia together; claws unequal, cephalic claw longer than caudal, especially on forelegs.

Abdomen.—Tergites narrow, exposing a large part of each tergum; setae fairly regular; four pairs in cephalic row and four pairs in caudal row, sometimes one to four setae present on each lateral margin of third to seventh terga; praetergum wanting; nine epipleurites present, with three to seven setae; eight hypopleurites with two setae on the first seven; sternites not well sclerotized, two pairs of setae on each anterior ventrite, a pair on each mesal postventrite, a single seta on each lateral postventrite; eighth and ninth sternite each fused into one piece with three pairs of long setae, tenth segment tubulose with many short and long setae as shown in figure 25; cercus longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles annular, first pair larger.

Remarks.—Identification was based on the reared adult and the description based on the exuviae and the larva.

Harpalus vagans LeConte. (Figs. 20, 49, 85, 86.)

Seven lots of specimens in the U. S. National Museum collection: 1. One exuviae and one reared adult, Hamilton collection no. 287; 2. One larva, one exuviae, and one reared adult, Hamilton collection no. 159; 3. One exuviae and one reared adult, Hamilton collection no. 78; 4. One exuviae and one reared adult, Hamilton collection no. 358; 5. One exuviae and one reared adult, Hamilton collection no. 284; 6. Six larvae, Hamilton collection nos. 78–83; 7. Three larvae, one exuviae, and one reared adult, Hamilton collection no. 359.

Measurements.—Width of head 2.6 mm., width of prothorax 2.5 mm., length of body 14.5 mm., length of cercus 1.9 mm.,

length of ninth abdominal segment 0.5 mm., length of tenth abdominal segment 1.0 mm.

Color.—Head and dorsum of thorax and abdomen brown; legs and cerci light brown, the rest brownish white.

Head.—Head almost as broad as thorax; antenna four-segmented, longer than mandible, first segment long, second almost as long as third, third curved mesad, with a large sensorial appendage laterad, fourth short; mandible stout with one seta in scrobe, retinaculum stout, located near middle and directed mesad, two mandibular teeth present; labium elongate with strong setae on each lateral margin, labial palpus two-segmented with two or sometimes three setae on dorsum of first segment; bases of ligular setae separate, maxillary palpus four-segmented, galea two-segmented, lacinia with a seta on side; nasale with about thirty-six tiny teeth on an even level; seven pairs of strong setae on frontoclypeal area; six ocelli present on each side, ocellar furrow present; cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated, fairly broad, protergum much larger than meso- or metatergum; many setae on the terga as shown in figure 20; mesothoracic spiracle very large, elliptical; legs short, tarsus shorter than tibia, tarsus and tibia together much shorter than femur; claws unequal, cephalic claw longer than caudal.

Abdomen.—Tergites narrow, exposing a large part of each tergum; many setae arranged on the margins of tergum as shown in figure 20; praetergum present on first three terga; nine epipleurites present with many setae; eight hypopleurites each with many setae, sternites of first seven segments distinct, many setae on anterior ventrites, three or four pairs on mesal postventrites, five or six setae on lateral postventrites; seventh and eighth sternites fused into one piece with setae; tenth segment tubulose with setae as shown in figure 20; cercus longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The species was identified by C. A. Hart based on the reared adults and the description was made from the exuviae and larvae.

Harpalus erythropus Dejean. (Figs. 23, 27, 77, 78.)

Ten lots of specimens in the U. S. National Museum collection: 1. Fifty-seven larvae collected by C. C. Hamilton at Urbana, Illi-

nois, April 16, 1915, Hamilton collection nos. 260–269; 2. One exuviae and one reared adult, Hamilton collection no. 184; 3. Twenty-three larvae collected by C. C. Hamilton in Urbana, Illinois, April 15, 1915, Hamilton collection nos. 181–192; 4. Nineteen larvae, Hamilton collection nos. 260–269; 5. One larva, one exuviae, and one reared adult, Hamilton collection no. 353; 6. One larva, one exuviae and one reared adult collected by C. C. Hamilton in drain by Cemetery, Urbana, Illinois, 1916; 7. One exuviae and one reared adult, Hamilton collection no. 197; 8. One exuviae and one reared adult, Hamilton collection no. 263; 9. One exuviae and one reared adult, Hamilton collection no. 192; 10. One exuviae and one reared adult, Hamilton collection no. 357.

Measurements.—Width of head 2.4 mm., width of prothorax 2.3 mm., length of body 18.1 mm., length of cercus 1.4 mm., length of ninth abdominal segment 0.7 mm., length of tenth abdominal segment 1.2 mm.

Color.—Head, dorsum of thorax and abdomen brown, the rest, brownish white.

Head.—Head wider than prothorax; antenna four-segmented, longer than mandible, first segment long, second almost as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with one seta in scrobe, retinaculum stout, located near middle and directed mesad, three mandibular teeth present; labium elongated with strong setae on each lateral margin, labial palpus two-segmented with one seta on dorsum of first segment, bases of ligular setae separate; maxillary palpus four-segmented, galea two-segmented, lacinia with a seta on apex; nasale with more than thirty fine teeth extending to the adnasale region; seven pairs of strong setae on frontoclypeal area; six ocelli present on each side, ocellar furrow present; cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated, protergite broader and longer than meso- or metatergite; ten pairs of setae on protergite, seven long pairs on meso- and metatergites; mesothoracic spiracle large, elliptical; legs short, both tarsus and tibia short, femur much longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, exposing a large part of each tergum; setae fairly regular, each tergite with three pairs of major setae and two pairs of minor ones on cephalic row and two pairs of major setae and two pairs of minor setae on the

caudal row; praeterga present on first four segments; nine epipleurites present, each with three long setae and one or two short setae on first eight, on ninth only two setae; eight hypopleurites each with three setae; on the first seven sternites: a pair of long setae on anterior ventrites, with a pair of short setae on third to seventh ventrites; one long pair and one short pair on each mesal postventrite, three setae on lateral postventrites; eighth and ninth sternites each fused into one piece with setae; tenth segment tubulose with setae as shown in figure 23; cercus longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The specimens of lot 10 were identified by C. A. Hart. The rest by C. C. Hamilton based on both the larvae and reared adults. The description was made from the exuviae and larvae.

Harpalus compar LeConte. (Figs. 22, 73, 74.)

1. Eight lots of specimens in the U. S. National Museum collection: One exuviae and one reared adult, Hamilton collection no. 255; 2. Twenty-two larvae collected by C. C. Hamilton in Urbana, Illinois, April 16, 1915, Hamilton collection nos. 254–259; 3. One exuviae and one reared adult, Hamilton collection no. 180; 4. Two larvae, Hamilton collection nos. 118 and 123; 5. One exuviae and one adult, Hamilton collection no. 122; 6. One exuviae and one adult, Hamilton collection no. 178; 7. Thirteen larvae, Hamilton collection nos. 254–259; 8. Twelve larvae, Hamilton collection nos. 174–180.

Measurements.—Width of head 3.2 mm., width of prothorax 2.9 mm., length of body 18.8 mm., length of cercus 1.2 mm., length of ninth abdominal segment 0.7 mm., length of tenth abdominal segment 1.5 mm.

Color.—Head dark brown; dorsum of thorax and abdomen brown, the rest brownish white.

Head.—Head wider than prothorax; antenna four-segmented, a little longer than mandible, first segment long, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with one seta in scrobe, retinaculum subbasal, stout, and directed mesad, three mandibular teeth present; labium elongate with strong setae on each lateral margin, labial palpus two-segmented with three seta on dorsum of first segment, bases of ligular setae separate; maxillary palpus four-segmented, galea two-segmented, lacinia with a seta on side; nasale with about forty fine teeth on a level,

seven pairs of strong setae on frontoclypeal area; six ocelli present on each side, ocellar furrow present with a seta on the caudal end; cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated, protergite broader and longer than meso- or metatergite; many pairs of setae on each tergum (fig. 22); mesothoracic spiracle very large, elliptical; legs short, both tarsus and tibia are short, femur much longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, exposing a large part of each tergum; setae as shown in figure 22; praeterga present on first four segments; nine epipleurites distinct, with two to seven setae, eight hypopleurites each with four setae; sternites of first seven segments with two pairs of setae on anterior ventrites, two pairs on mesal ventrites, three setae on lateral postventrites; eighth and ninth sternites each fused into one piece with setae as shown in figure 22; tenth segment tubulose with setae as shown in figure 22; cercus almost as long as tenth segment, with nodules bearing setae, eight pairs of abdominal spiracles annular and small.

Remarks.—The identification was based on the reared adults by C. C. Hamilton and the description was from the larvae and exuviae.

Harpalus pennsylvanicus Say. (Figs. 21, 29, 30, 31, 33, 84.)

Six lots of specimens in the U. S. National Museum collection: 1. Nine larvae collected by F. C. Pratt in Washington, D. C., April 9, 1898; 2. One larva, one exuviae, and one reared adult, collected and reared by A. G. Böving, May 15, 1914, Washington, D. C.; 3. One larva collected in garden, Washington, D. C., May 27, 1912; 4. Three larvae collected in garden, East Fall Church, Virginia, by Weld., November 17, 1931; 5. Four larvae collected by F. C. Pratt in Washington, D. C., April 9, 1898; 6. One larva collected by L. O. Howard, labeled as "box 4/104 Dep't."

Measurements.—Width of head 3.2 mm., width of prothorax 3.4 mm., length of body 22.1 mm., length of cercus 1.7 mm., length of ninth abdominal segment 0.7 mm., length of tenth abdominal segment 1.5 mm.

Color.—Head light brown; the rest brownish white.

Head.—Head almost as broad as prothorax; antenna four-segmented, a little longer than mandible, first segment long,

second as long as third, third curved mesad with a sensorial appendage laterad, fourth short with a small sensorial organ on top; mandible stout, with one seta in scrobe, retinaculum stout, located near middle and directed mesad, one small mandibular tooth present; labium elongate, with strong setae on each lateral margin; labial palpus two-segmented with two setae on dorsum of first segment, bases of ligular setae separate; maxillary palpus four-segmented; galea two-segmented, lacinia with a seta on side; nasale with five or six tiny teeth on middle and two larger teeth on each side; nine pairs of long setae on frontoclypeal area; six ocelli present on each side, but not so prominent as other species, ocellar furrow present with three long and several short setae on the mesal side; cervical groove present; stem of epicranial suture long.

Thorax.—Tergites marginated, protergite much broader and longer than meso- or metatergite; thirteen pairs of long setae on protergite, sixteen pairs of long setae on meso- and metatergites; mesothoracic spiracle very large, elliptical; legs short, both tarsus and tibia short, femur much longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, exposing a large part of each tergum; setae as shown in figure 21; praeterga present on first two segments; nine epipleurites, each with four to seven setae; eight hypopleurites each with three seta; first seven sternites with two pairs of setae on anterior ventrites, two pairs on mesal postventrites, first lateral postventrite with three setae, the rest only two setae; eighth and ninth sternite fused into one piece with setae as shown in figure 21; tenth segment tubulose with setae as shown in figure 21; cercus longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The identification was based on the reared adult and the description was made from larvae and exuviae. The specimens of lot 2 were recorded by A. G. Böving as "larva collected on May 13, 1914, pupated on May 25, and a female adult emerged on June 6, 1914."

Harpalus dichrous Dejean. (Figs. 24, 81, 82.)

Two lots of specimens in the U. S. National Museum collection: 1. Eight larvae, no collection date recorded except "same as nos. 84–89"; 2. One exuviae and one reared adult, Hamilton collection no. 86.

Measurements.—Width of head 1.6 mm., width of prothorax 1.8 mm., length of body 13.1 mm., length of cercus 1.1 mm., length of ninth abdominal segment 0.5 mm., length of tenth abdominal segment 1.0 mm.

Color.—Head and dorsum of thorax and abdomen brown, the rest brownish white.

Head.—Head almost as broad as prothorax; antenna four-segmented, a little longer than mandible, first segment long, second as long as third, third curved mesad with a long sensorial appendage laterad, fourth short; mandible stout, with two setae in scrobe, retinaculum located near middle and stout, and directed mesad, mandibular teeth wanting; labium elongate, with strong setae on each lateral margin, labial palpus two-segmented, bare; bases of ligular setae contiguous; maxillary palpus three-segmented, the fourth is not prominent, galea two-segmented, lacinia with a seta on side; nasale with about thirty-two fine teeth on middle and two larger lateral teeth each side; four fine teeth on adnasale region; eight pairs of long setae on frontoclypeal area, six ocelli present on each side, ocellar furrow wanting; cervical groove present; stem of epicranial suture long.

Thorax.—Tergites marginated, protergite fairly broad; nine major pairs of setae on protergite, eight major pairs on meso- and metatergites; mesothoracic spiracle large, elliptical; legs fairly long, tarsus longer than tibia, tarsus and tibia together as long as femur; claws unequal, cephalic claw a little longer than caudal.

Abdomen.—Tergites narrow, not covering to pleura, setae as shown in figure 24; praeterga present on all segments; nine epipleurites, setae as shown in figure 24; eight hypopleurites, each with a pair of long setae; first seven sternites not well sclerotized, each anterior ventrite with two pairs of setae, mesal postventrite with two pairs of setae, lateral postventrites with a single long seta and two small ones, eighth and ninth sternites, each fused ino one piece with setae; tenth segment tubulose with setae as shown in figure 24; cercus longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The identification was based on the reared adult and the description was made from the exuviae and larvae.

Anisodactylus californicus Dejean. (Figs. 39, 65, 66.)

Nine larvae in the U. S. National Museum collection, collected in soil by C. C. Wilson, Sacramento, California, April 1, 1937.

Measurement.—Width of head 2.9 mm., width of prothorax 2.7 mm., length of body 17.2 mm., length of cercus 2.0 mm., length of ninth abdominal segment 0.6 mm., length of tenth abdominal segment 1.1 mm.

Color.—Head and prothorax dark brown, meso- and metathorax light brown, the rest brownish white.

Head.—Head broader than prothorax; antenna four-segmented, longer than mandible, first segment long, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout with one seta in scrobe, retinaculum subbasal, stout and directed mesad, one mandibular tooth present; labium elongate, with strong setae on each lateral margin, labial palpus two-segmented, with one seta on dorsum of first segment, bases of ligular setae separate; maxillary palpus four-segmented, galea two-segmented, lacinia with a seta on side; nasale with about ten small teeth on middle and two large lateral teeth on each side; seven pairs of long setae on frontoclypeal area; six ocelli present on each side, ocellar furrow broad and deep with one seta, cervical groove present, one swollen area with two long setae present between the epicranial arm and ocellar furrow (fig. 66); stem of epicranial suture long.

Thorax.—Tergites marginated, protergite fairly broad; nine pairs of setae on protergite, fourteen or fifteen pairs of setae on meso- and metatergites; mesothoracic spiracle large, elliptical; legs fairly long, both tarsus and tibia short, femur longer than tarsus and tibia together, claws unequal, cephalic claw longer than caudal.

Abdomen.—Tergites narrow, exposing a large part of each tergum; setae as shown in figure 39; praeterga present on first two segments, not very prominent in third and fourth segments; nine epipleurites each with setae as shown in figure 39; eight hypopleurties each with four small setae; sternites of first eight segments distinct; two pairs of setae on each anterior ventrite, two pairs on each mesal postventrite, four or five setae on each lateral postventrite; ninth sternite fused into one piece with seven pairs of setae; tenth segment tubulose with setae as shown in figure 39; cercus longer than tenth segment, with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The larvae were collected together with adults associated with grasshopper eggs, and suspected of being predators of the eggs. The adult was determined as *Anisodactylus californicus* by Buchanan. The description was based on the larvae.

Anisodactylus (or close) *sp.* (Figs. 40, 69, 70.)

One larva in the U. S. National Museum collection, collected in Nushagak, Alaska No. 91, April 22, 1882.

Measurements.—Width of head 1.6 mm., width of prothorax 1.9 mm,. length of body 14 mm., length of cercus 1.3 mm., length of ninth abdominal segment 0.6 mm., length of tenth abdominal segment 0.6 mm.

Color.—Head dark brown, dorsum of thorax, abdomen, legs, and cerci brown, the rest brownish white.

Head.—Head slightly narrower than prothorax; antenna four-segmented, longer than mandible, first segment long, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with three setae in scrobe, retinaculum stout, located near middle and directed mesad, mandibular teeth wanting; labium elongate, with strong setae on each lateral margin, labial palpus two-segmented, with a seta on dorsum of first segment; bases of ligular setae separate; maxillary palpus four-segmented with a seta on venter of first segment, galea two-segmented, lacinia with a seta on side; nasale with six larger teeth on middle, three small teeth each side, seven pairs of long setae on frontoclypeal area; six ocelli present on each side, ocellar furrow absent; cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated, prothorax larger than meso- or metathorax; nine pairs of setae on protergite, eight pairs on meso- and metathorax; mesothoracic spiracle fairly large, elliptical; legs short, tarsus and tibia short, femur slightly longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, not covering to pleura; setae fairly regular; four pairs on cephalic row and four pairs on caudal row of first eight tergites; praeterga present on all segments; nine epipleurites with three to six setae; eight hypopleurites with two or three setae; first eight sternites not well sclerotized, two pairs of setae on anterior ventrite, two pairs on mesal postventrite, two setae on lateral postventrite; ninth sternite fused into one piece with setae; tenth segment tubulose,

with setae as shown in figure 40; cercus longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The species was identified by A. G. Böving as *Anisodactylus* or close. Since it has no ocellar groove it does not fit van Emden's ('42) key. The description was made from the larva.

Amphasia interstitialis (Say). (Figs. 36, 67, 68.)

Seven incomplete larvae and two complete larvae in the U. S. National Museum collection, collected in Ithaca, New York, September 8, 1917, Hamilton collection no. 572.

Measurements.—Width of head 1.6 mm., width of prothorax 1.8 mm., length of body 14.5 mm., length of cercus 1.2 mm., length of ninth abdominal segment 0.4 mm., length of tenth abdominal segment 0.9 mm.

Color.—Head and dorsum of prothorax dark brown, dorsum of meso- and metathorax, abdomen, and legs, brown, the rest whitish brown.

Head.—Head slightly narrower than prothorax; antenna four-segmented, longer than mandible, first segment slightly longer than second, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with one seta in scrobe, retinaculum stout, located near middle and directed mesad, mandibular teeth wanting; labium elongate, with strong setae on each lateral margin, labial palpus two-segmented, bare; bases of ligular setae separate; maxillary palpus four-segmented with a seta on venter of first segment, galea two-segmented, lacinia with a seta on side; nasale with two pairs of large teeth, each tooth slightly serrated; seven pairs of setae on frontoclypeal area; six ocelli present on each side, ocellar furrow short; cervical groove present; stem of epicranial suture long.

Thorax.—Tergites marginated, prothorax larger than meso- or metathorax; setae separate; four pairs on protergite, four pairs on meso- and metatergites; mesothoracic spiracle very large, elliptical; legs short, tarsus as long as tibia, femur slightly longer than tarsus and tibia together; claws unequal, cephalic claw longer than caudal.

Abdomen.—Tergites narrow, exposing a large part of terga; setae quite few, four pairs on each tergite, praeterga present on all segments; first seven epipleurites each with four setae, eighth with three and ninth with two; first hypopleurite with

a single seta, the last seven each with two setae; first seven sternites not well sclerotized with a pair of setae on each sclerite, eighth and ninth sternites each fused into one piece, four pairs of setae on eighth and two pairs on ninth; tenth segment tubulose with six pairs of long setae and two pairs of short setae; cercus longer than tenth segment, with nodules bearing setae; eight pairs of abdominal spiracles annular, the first pair larger.

Remarks.—The species was identified by C. C. Hamilton. The description was based on the larvae.

Anisotarsus sayi (Blatchley). (Figs. 32, 44, 51, 71, 72.)

Two lots of specimens in the U. S. National Museum collection: 1. Thirty-eight larvae, Hamilton collection nos. 344–353; 2. Seventy-two larvae collected by C. C. Hamilton in Urbana, Illinois, April 16, 1915.

Measurements.—Width of head 1.6 mm., width of prothorax 1.8 mm., length of body 16.1 mm., length of cercus 1.6 mm., length of ninth abdominal segment 0.8 mm.

Color.—Head and dorsum of prothorax brown, dorsum of mesothorax, metathorax, and abdomen light brown, the rest brownish white.

Head.—Head slightly narrower than thorax; antenna four-segmented, longer than mandible, first segment, long, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short, mandible stout, scrobe present, but short, with a seta in it, retinaculum stout, located near middle and directed mesad, mandibular teeth wanting, labium elongate, with strong setae on each lateral margin; bases of ligular setae separate; labial palpus two-segmented, bare; maxillary palpus four-segmented with a seta on venter of first segment, galea two-segmented, lacinia fused with stipes, lobe-like with a seta on side (fig. 44); nasale with seven or eight small fine teeth in middle, and one pair of larger teeth on each side, another three small fine teeth on side; six pairs of long setae on frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated, prothorax larger than meso- or metathorax; twelve pairs of setae on protergite, eight major pairs and several minor pairs of setae on meso- and metatergites; mesothoracic spiracle large, elliptical; legs short, tarsus slightly longer than tibia, femur longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, exposing a large part of terga; setae as shown in figure 51; praeterga present on all the segments; first seven epipleurites each with five setae, eighth with four and last with two; eight hypopleurites each with three setae; first seven sternites: with two pairs of long and one pair short setae on anterior ventrite, two pairs of mesal postventrite, one long and three short setae on lateral postventrite; eighth and ninth sternites each fused into one piece with setae; tenth segment tubulose with five pairs of long setae; cercus longer than tenth segment, with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The identification and description were based on the larvae.

Stenocellus rupestris (Say). (Figs. 56, 58, 60.)

One exuviae and one reared adult in the U. S. National Museum collection, the larva was collected in soil of peach orchard, Anna, Illinois, by W. H. Anderson, June 3, 1937.

Measurements.—Width of head 0.6 mm., width of prothorax 0.7 mm., length of body 4.3 mm., length of cercus 0.5 mm., length of ninth abdominal segment 0.2 mm., length of tenth abdominal segment 0.4 mm.

Color.—Head deep brown, body light brown.

Head.—Head slightly narrower than thorax; antenna four-segmented, slightly longer than mandible, first segment long, second shorter than third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout with a seta on back, scrobe absent, retinaculum stout, located near middle and directed mesad, mandibular teeth wanting; labium elongate, with few setae on each lateral margin, labial palpus two-segmented, bare, bases of ligular setae contiguous; maxillary palpus four-segmented with a seta on venter of first segment, galea two-segmented, lacinia with a seta on apex; nasale with four shorter teeth on middle and three longer teeth each side; seven pairs of long setae on frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove present; stem of epicranial suture long.

Thorax.—Tergites marginated, prothorax larger than meso- or metathorax; six pairs of long setae on protergite, eight pairs of long setae on mesotergite, nine pairs of long setae on metatergite; mesothoracic spiracle large, elliptical; legs short, tarsus as long as tibia, femur slightly longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, exposing a large part of terga, each tergite with three pairs of long setae on cephalic row and two pairs of long setae on caudal row; praeterga wanting on all segments; first epipleurite with three setae, second to eighth with four setae, ninth with two setae; eighth hypopleurites each with three setae; first seven sternites with two pairs of long setae on anterior ventrite, two pairs of long setae on mesal postventrite, two setae on lateral postventrite; eighth and ninth sternites each fused into one piece, with four pairs of setae on eighth and two pairs on ninth; tenth segment tubulose with four pairs of setae; cercus longer than tenth segment, with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The species was identified by L. L. Buchanan based on the adult which was reared by W. H. Anderson and emerged on June 22, 1937. The description was made from the exuviae.

Stenolophus conjunctus (Say). (Figs. 54, 63, 64.)

One incomplete exuviae and one reared adult in the U. S. National Museum collection, collected by W. H. Anderson as a larva in soil of peach orchard, May 31, 1937, Sikeston, Missouri.

Measurements.—Width of head about 0.8 mm., width of prothorax about 0.7 mm., length of body about 4.5 mm., length of cercus about 0.5 mm., length of ninth abdominal segment about 0.2 mm., length of tenth abdominal segment about 0.3 mm.

Color.—Light brown.

Head.—Head slightly broader than thorax; appendages missing; frontoclypeal piece missing; ocellar furrow wanting; cervical groove wanting; stem of epicranial suture fairly long.

Thorax.—Protergite marginated, with nine pairs of setae; meso- and metathorax incomplete; mesothoracic spiracle large, elliptical; legs short, tarsus as long as tibia, femur slightly longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, not covering to pleura, with five pairs of long setae on each; praeterga wanting on all segments; eight epipleurites each with three setae, ninth with two setae; eight hypopleurites each with two setae; first seven sternites with two pairs of setae on anterior ventrite, one pair on mesal postventrite, a single seta on lateral postventrite; eighth and ninth sternites each fused into a single piece with setae; tenth

segment tubulose with seven pairs of setae; cercus slightly longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The species was identified by L. L. Buchanan based on the adult which was reared by W. H. Anderson. The description was made from the exuviae.

Stenolophus sp. (Figs. 55, 61, 62.)

One larva in the U. S. National Museum collection, collected by R. L. Post in alfalfa field, Monroe, Oregon, June 24, 1941.

Measurements.—Width of head 0.6 mm., width of prothorax 0.7 mm., length of body 5.8 mm., length of cercus 0.6 mm., length of ninth abdominal segment 0.2 mm., length of tenth abdominal segment 0.3 mm.

Color.—Head deep brown, body light brown.

Head.—Head slightly narrower than thorax; antenna four-segmented, longer than mandible, first segment long, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with two setae in scrobe, retinaculum stout, located near middle, and directed mesad, mandibular teeth wanting; labium elongate, only a pair of setae on dorsum, bases of ligular setae contiguous; labial palpus two-segmented; maxillary palpus three-segmented with a seta on venter of first segment, galea two-segmented, lacinia with a seta on side; nasale with eight teeth in middle and one tooth on each side; six pairs of long setae on frontoclypeal area; six ocelli present on each side, ocellar furrow absent; cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated, prothorax larger than meso- or metathorax, setae as shown in figure 55; mesothoracic spiracle large, elliptical; legs short, tarsus as long as tibia, femur slightly longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, not covering to pleura, each with three pairs of long setae on cephalic row and two pairs of long setae on caudal row; praetergite wanting on all segments; first epipleurite with three setae, second to eighth each with five setae, ninth with two setae; eight hypopleurites each with three setae; first eight sternites: two pairs of setae on anterior ventrites, one pair on mesal postventrite, a single seta on lateral postventrite; ninth sternite fused into one piece with four pairs of setae; tenth segment tubulose with five pairs of

setae; cercus longer than tenth segment, with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The species was identified by W. H. Anderson based on the larva. It seems not to agree with van Emden's key. The description was made from the larva.

Agonoderus lineola (Fabricius). (Figs. 52, 91, 92.)

Three lots of specimens in the U. S. National Museum collection: 1. Five larvae collected by H. S. Barber in golf greens at Chevy Chase Lake, Maryland, June 13, 1922; 2. Seven larvae and three adults collected by H. S. Barber in golf greens at Chevy Chase Lake, Maryland, August 12, 1921; 3. Eighteen larvae and two adults collected by H. S. Barber in golf putting greens at Chevy Chase Lake, Maryland, July 30, 1921.

Measurements.—Width of head 1.8 mm., width of prothorax 1.8 mm., length of body 13.1 mm., length of cercus 0.9 mm., length of ninth abdominal segment 0.4 mm., length of tenth abdominal segment 0.7 mm.

Color.—Head brown, dorsum of thorax and abdomen brown, the rest brownish white.

Head.—Head as wide as thorax; antenna four-segmented, longer than mandible, first segment long, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with one seta in scrobe and another seta on the dorsum, retinaculum stout, located near middle, and directed mesad, mandibular teeth wanting; labium elongate, with strong setae on each lateral margin, ligula larger than usual, well sclerotized on proximal end, bases of ligular setae contiguous; labial palpus two-segmented, bare; maxillary palpus four-segmented with a seta on venter of first segment, galea two-segmented, lacinia with a seta on side; nasale with one large median tooth and two lateral teeth on each side; eight pairs of long setae on frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove present; stem of epicranial suture long.

Thorax.—Tergites marginated; prothorax larger than meso- or metathorax; many setae on terga as shown in figure 52; mesothoracic spiracle large, elliptical; legs short, tarsus and tibia short, femur longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, exposing a large part of terga, with many setae as shown in figure 52; praeterga wanting on all

segments; nine epipleurites with setae as shown in figure 52; eight hypopleurites with setae as shown in figure 52; first eight sternites not well sclerotized, setae shown in figure 52; ninth sternites fused into one piece, with setae; tenth segment tubulose with many setae as shown in figure 52; cercus longer than tenth segment, with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The species was identified by H. S. Barber based on adults and larvae. The description was made from the larvae.

Agonoderus pallipes (Fabricius). (Figs. 53, 87, 88.)

Thirteen larvae in the U. S. National Museum collection, collected by H. Strong in sod at Rosslyn, Long Island, New York, July 28, 1919.

Measurements.—Width of head 1.5 mm., width of prothorax 1.5 mm., length of body 12.5 mm., length of cercus 0.9 mm., length of ninth abdominal segment 0.4 mm., length of tenth abdominal segment 0.8 mm.

Color.—Head and prothorax deep brown, dorsum of mesothorax, metathorax and abdomen brown, the rest whitish brown.

Head.—Head as wide as thorax, antenna four-segmented, longer than mandible, first segment long, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with one seta in scrobe and another seta on the dorsum, retinaculum very large, located near middle and directed mesad, mandibular teeth wanting; labium elongate, with strong setae on each lateral margin, bases of ligular setae contiguous, labial palpus two-segmented, maxillary palpus four-segmented, with a seta on venter of first segment, galea two-segmented, lacinia with a seta on side; nasale with a large median tooth and two smaller teeth on each side; six pairs of long setae on frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove present; stem of epicranial suture long.

Thorax.—Tergites marginated; prothorax larger than meso- or metathorax; many setae on terga as shown in figure 53; mesothoracic spiracle large, elliptical; legs short, tarsus and tibia short, femur short, as long as tarsus and tibia together, claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, exposing a large part of terga, with many setae as shown in figure 53; praeterga wanting; nine epipleurites with setae as shown in figure 53; eight hypopleu-

rites with four setae except third and fourth each with five setae; first to seventh sternites distinct with setae as shown in figure 53; eighth and ninth sternites each fused into one piece with setae; tenth segment tubulose with many setae as shown in figure 53; cercus longer than tenth segment with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The species was identified by H. Strong based on the reared adult. The description was made from the larvae.

Cratocara capitata Chaudoir. (Figs. 34, 57, 59.)

One larva in the U. S. National Museum collection, collected at Tucson, Arizona, Hubb. collection no. 765.

Measurements.—Width of head 1.2 mm., width of prothorax 1.3 mm., length of body 13.7 mm., length of cercus 0.55 mm., length of ninth abdominal segment 0.32 mm., length of tenth abdominal segment 0.6 mm.

Color.—Head deep brown, the rest light brown.

Head.—Head wider than thorax; antenna four-segmented, longer than mandible, first segment long, second as long as third, third curved mesad with a sensorial appendage laterad, fourth short; mandible stout, with one seta in scrobe, retinaculum stout, located near middle and directed mesad, mandibular teeth wanting; labium elongate, with strong setae on each lateral margin; bases of ligular setae separate; labial palpus two-segmented, maxillary palpus four-segmented, with a seta on venter of first segment, galea two-segmented, lacinia with a seta on side; nasale with a large median tooth and two lateral teeth and another pair of small teeth on each side; seven pairs of long setae on frontoclypeal area; six ocelli present on each side, ocellar furrow wanting; cervical groove present; stem of epicranial suture fairly long.

Thorax.—Tergites marginated; prothorax much larger than meso- or metathorax; many setae on terga as shown in figure 34; mesothoracic spiracle very large, elliptical, legs short, both tarsus and tibia short, femur longer than tarsus and tibia together; claws unequal, cephalic claw longer.

Abdomen.—Tergites narrow, not covering to pleura, with setae as shown in figure 34; nine epipleurites with setae as shown in figure 34; first hypopleurite with two setae, second to eighth each with four setae; first seven sternites with three pairs of setae on anterior ventrite, two pairs on mesal postventrite;

two or three setae on lateral postventrites; eighth and ninth sternites each fused into one piece with setae; tenth segment tubulose with many setae as shown in figure 34; cercus very short, even shorter than ninth segment, with nodules bearing setae; eight pairs of abdominal spiracles annular and small.

Remarks.—The identification and description were based on the larva.

X. SUMMARY

1. The present paper is the result of a study of the larvae of Harpalinae Unisetosae in the United States National Museum collection. The Unisetosae is a section belonging to the Harpalinae, Carabidae, Coleoptera. A total of twenty-seven species belonging to twelve genera and three tribes has been studied.

2. Besides the external morphology, biology and habits, and geographical distribution, generic and species keys have been prepared. The literature has also been reviewed.

3. The external morphology is the basis of classification. The diagnostic characters used have been discussed such as the mandibular scrobe, mandibular teeth, ligula, lacinia, nasale, ocellar furrow, cervical groove, praetergum, comparative length of tarsus, tibia, and femur, claws, and cerci. These are considered as important characters in the classification of the larvae. Setal arrangement is of considerable systematic importance; however, little of it has been used in the key.

4. Because of the lack of knowledge of relationships of the larvae, the systematic arrangement of Leng's catalogue has been followed although it is based upon adult characters.

5. The species were identified by different specialists mostly based upon the reared adults as indicated in the paper. The writer has checked the identification of all the species and made pertinent remarks at the end of each description. Van Emden's ('42) key was found most useful in identification of genera.

XI. GLOSSARY

Adnasale (fig. 30, ANS).—At the cephalic margin of the frontoclypeal area, there are three lobe-like parts, the two lateral lobes are called the adnasales.

Anepimeron (fig. 51, AEM).—A sclerite situated on the posterior margin of the meso- or metapleuron, and above the epimeron.

Anepisternum (fig. 51, AES).—A sclerite situated on the anterior margin of the meso- or metapleuron and above the episternum.

Anterior ventrite (fig. 32, AV).—A transverse sclerite located on the abdominal sternum and cephalic of postventrites.

Cervical groove (fig. 30, C).—A transverse groove located on the gena and postgena behind the ocellar furrow.

Epipleurite (fig. 19, EPP).—A swollen area on the abdominal pleuron beneath the abdominal spiracle and above the hypopleurite.

Granular knob of cardo (fig. 29, GKC).—A knob with tiny teeth on the distal end of paracardo.

Hypopleurite (fig. 19, HPP).—A swollen area on the abdominal pleuron and beneath the epipleurite.

Ligular setae (fig. 27, LGS).—Two strong setae present on the distal end of ligula. The bases of these two setae are sometimes contiguous (fig. 7), and sometimes separate (fig. 27).

Lateral postventrite (fig. 32, LPV).—Four sclerites behind the anterior ventrite on the abdominal sternum, the two on the ectal sides of mesal postventrites are known as the lateral postventrites.

Mandibular scrobe (fig. 33, MS).—A longitudinal depression on the ectal aspect of the mandible.

Mandibular teeth (fig. 76, MDT).—The small teeth located on the cutting edge of mandible between the retinaculum and the apex of the mandible.

Mesal postventrite (fig. 32, MPV).—A pair of sclerites located on the abdominal sternum caudad to the anterior ventrite and mesad to the lateral postventrites.

Nasale (fig. 30, NS).—At the cephalic margin of the frontoclypeal area, there are three lobe-like parts, the middle lobe is called the nasale.

Ocellar furrow (fig. 30, OCF).—There is a furrow extending cephalo-cauded behind the ocelli and sometimes reaching almost to the cervical groove.

Penicillum (fig. 84, P).—A cluster of hairs at the base of the cutting edge of the mandible is known as the penicillum or penicillus.

Praetergum (fig. 19, PTG).—There is a keel on the tergum, the cephalic part of the keel is known as the praetergum.

Prosternum (fig. 47, PS).—A triangular sclerite on the cephalic margin of the sternum of prothorax.

Protrusible tube (fig. 6, PT).—The terminal end of the tubulose tenth abdominal segment often armed with a pair of protrusible tubes.

Retinaculum (fig. 84, R).—A large tooth located on the middle or subbasal portion of the cutting edge of the mandible.

Sensorial appendage (fig. 83, SO).—An appendage situated on the ectal aspect of the third antennal segment.

Tentorial rib (fig. 30, TR).—The anterior tentorial arms which can be seen through the surface of the front are known as the tentorial ribs.

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XIII. LIST OF ABBREVIATIONS

ABS	Abdominal spiracle.
AEM	Anepimeron.
AES	Anepisternum.
ANS	Adnasale.
ANT	Antenna.
AS	Antennal sclerite.
AV	Anterior ventrite.
CG	Cervical groove.
CR	Cercus.
CV	Cervicum.
CX	Coxa.
EC	Eucardo.
ECS	Epicranial suture.
EPM	Epimeron.
EPP	Epipleurite.
EPS	Episternum.
ET	Extensotendon.
FCL	Frontoclypeal area.
FM	Femur.
FP	Furcal pit.
G	Gena.
GA	Galea.
GKC	Granulose knob of cardo.
GUS	Gular suture.
HPP	Hypopleurite.
LA	Lacinia.
LB	Labium.
LBP	Labial palpus.
LG	Ligula.
LGS	Ligular seta.
LPV	Lateral postventrite.
MD	Mandible.
MDT	Mandibular teeth.
MPV	Mesal postventrite.
MS	Mandibular scrobe.
MT	Mentum.
MTS	Mesothoracic spiracle.
MX	Maxilla.
MXP	Maxillary palpus.
NS	Nasale.
OC	Ocelli.
OCF	Ocellar furrow.
OP	Occiput.
OPS	Occipital suture.
P	Penicillum.
PC	Paracardo.
PG	Postgena.
PM	Prementum.
POA	Postartis.
PRA	Preartis.
PS	Prosternum.
PT	Protrusible tube.
PTG	Praetergum.
R	Retinaculum.
RT	Rectotendon.
SAP	Sensorial appendage.
SO	Sensorial organ.
STP	Stipes.
TA	Posterior tentorial arm.
TB	Tibia.
TC	Trochanter.
TN	Trochantin.
TP	Tentorial pit.
TR	Tentorial rib.
TS	Tarsus.
V	Vertex.

Plate I

Fig. 1. Lateral aspect of *Chlaenius prasinus* Dejean.
Fig. 2. Lateral aspect of *Chlaenius sericeus* Forster.
Fig. 3. Lateral aspect of *Chlaenius cumatilis* LeConte.
Fig. 4. Lateral aspect of *Chlaenius tricolor* Dejean.
Fig. 5. Lateral aspect of *Chlaenius pennsylvanicus* Say.
Fig. 6. Lateral aspect of *Oödes sp.*
Fig. 7. Dorsal aspect of head, *Chlaenius prasinus* Dejean.
Fig. 8. Right maxilla, *Chlaenius pennsylvanicus* Say.
Fig. 9. Ventral aspect of head, *Chlaenius prasinus* Dejean.
Fig. 10. Ventral aspect of head, *Chlaenius cumatilis* LeConte.
Fig. 11. Ventral aspect of head, *Chlaenius tricolor* Dejean.
Fig. 12. Dorsal aspect of head, *Chlaenius cumatilis* LeConte.
Fig. 13. Dorsal aspect of head, *Chlaenius tricolor* Dejean.
Fig. 14. Right mandible, *Chlaenius pennsylvanicus* Say.
Fig. 15. Dorsal aspect of head, *Chlaenius sericeus* Forster.
Fig. 16. Ventral aspect of head, *Chlaenius sericeus* Forster.
Fig. 17. Dorsal aspect of head, *Chlaenius pennsylvanicus* Say.
Fig. 18. Ventral aspect of head, *Chlaenius pennsylvanicus* Say.

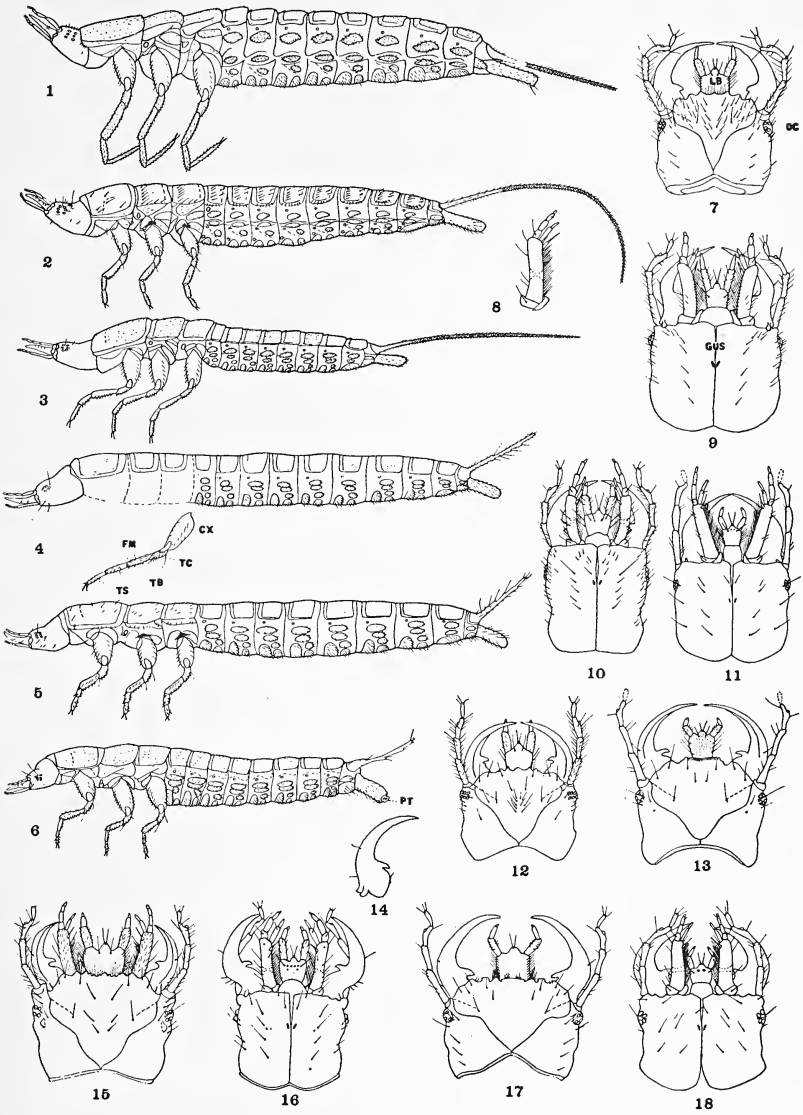
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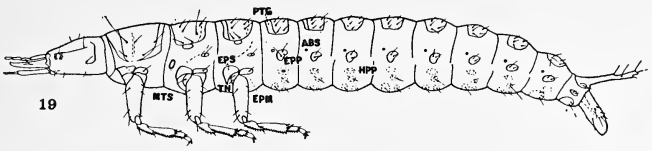
Plate II

Fig. 19. Lateral aspect of *Harpalus sp.*
Fig. 20. Lateral aspect of *Harpalus vagans* LeConte.
Fig. 21. Lateral aspect of *Harpalus pennsylvanicus* Say.
Fig. 22. Lateral aspect of *Harpalus compar* LeConte.
Fig. 23. Lateral aspect of *Harpalus erythropus* Dejean.
Fig. 24. Lateral aspect of *Harpalus dichrous* Dejean.
Fig. 25. Lateral aspect of *Harpalus viridiaeneus* Beauvois.
Fig. 26. Lateral aspect of *Harpalus caliginosus* ? (Fabricius).
Fig. 27. Dorsal aspect of labium, *Harpalus erythropus* Dejean.
Fig. 28. Left maxilla, *Harpalus sp.*
Fig. 29. Left maxilla, *Harpalus pennsylvanicus* Say.
Fig. 30. Dorsal aspect of head, *Harpalus pennsylvanicus* Say.
Fig. 31. Ventral aspect of head, *Harpalus pennsylvanicus* Say.
Fig. 32. Ventral aspect of thorax and first three abdominal segments, *Anisotarsus sayi* (Blatchley).
Fig. 33. Lateral aspect of head, *Harpalus pennsylvanicus* Say.



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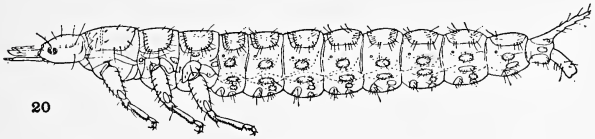

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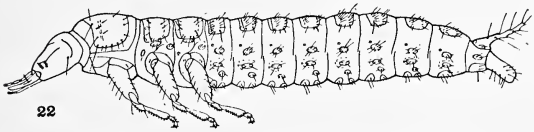

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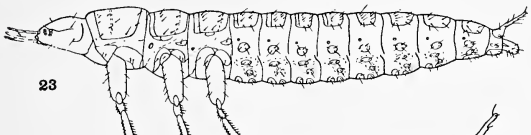

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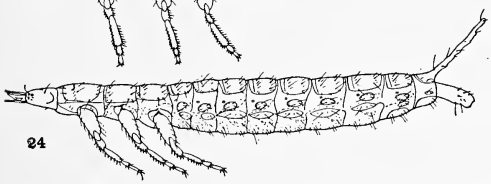

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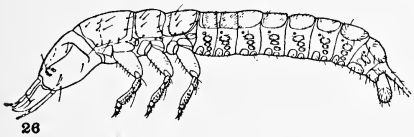

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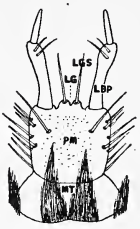

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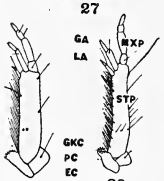

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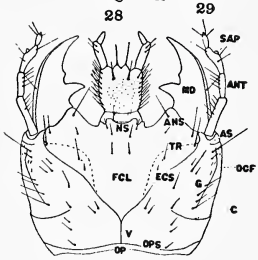

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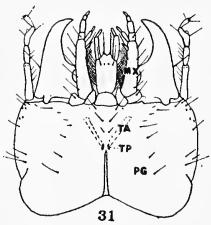

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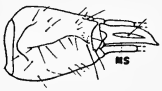
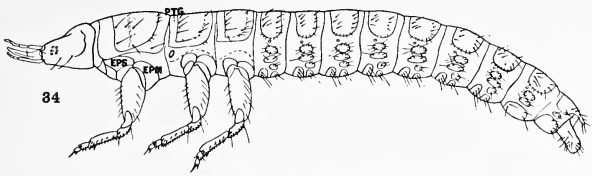


33

Plate III

Fig. 34. Lateral aspect of *Cratocara capitata* Chaudoir.
Fig. 35. Lateral aspect of *Nothopus zabroides* LeConte.
Fig. 36. Lateral aspect of *Amphasia interstitialis* (Say).
Fig. 37. Lateral aspect of *Cratacanthus dubius* (Beauvois).
Fig. 38. Lateral aspect of *Cratacanthus sp.*
Fig. 39. Lateral aspect of *Anisodactylus californicus* Dejean.
Fig. 40. Lateral aspect of *Anisodactylus* (or close) *sp.*
Fig. 41. Dorsal aspect of head, *Nothopus zabroides* LeConte.
Fig. 42. Ventral aspect of head, *Nothopus zabroides* LeConte.
Fig. 43. Dorsal aspect of head, *Cratacanthus sp.*
Fig. 44. Left maxilla, *Anisotarsus sayi* (Blatchley).
Fig. 45. Ventral aspect of head, *Cratacanthus sp.*
Fig. 46. Lateral aspect of eighth to tenth abdominal segments, *Cratacanthus sp.*
Fig. 47. Ventral aspect of thorax, *Chlaenius sericeus* Forster.
Fig. 48. Dorsal aspect of head, *Cratacanthus dubius* (Beauvois).
Fig. 49. Ventral aspect of thorax, *Harpalus vagans* LeConte.
Fig. 50. Ventral aspect of head, *Cratacanthus dubius* (Beauvois).



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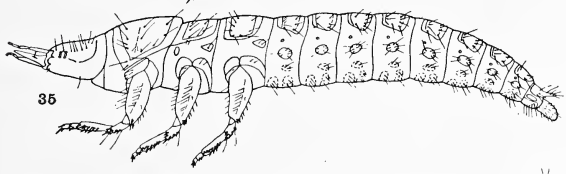
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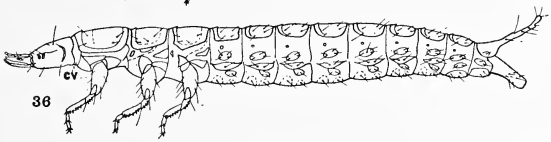

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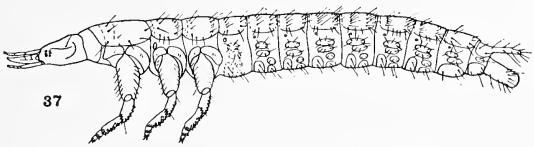
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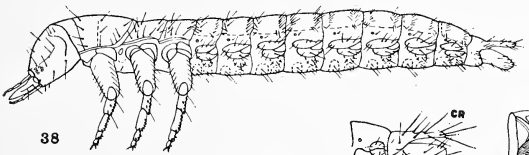
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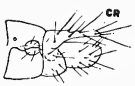

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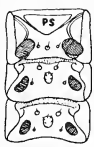

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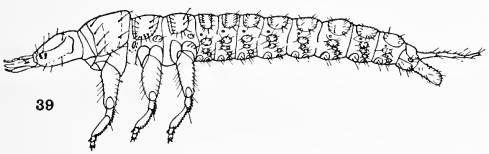
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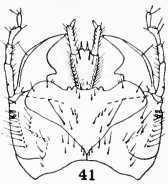
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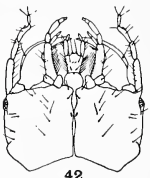
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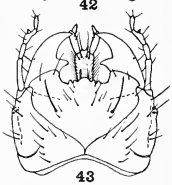
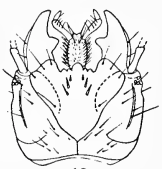

43


45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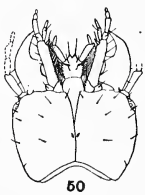
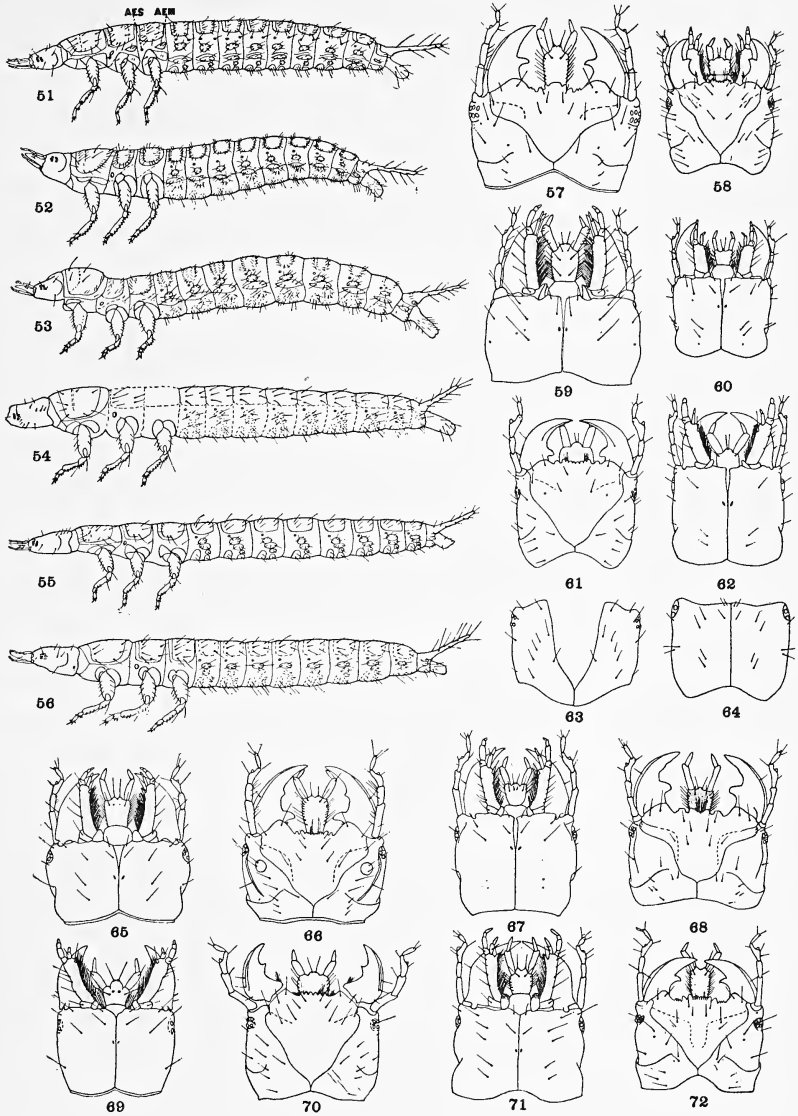

50

Plate IV

Fig. 51. Lateral aspect of *Anisotarsus sayi* (Blatchley).
Fig. 52. Lateral aspect of *Agonoderus lineola* (Fabricius).
Fig. 53. Lateral aspect of *Agonoderus pallipes* (Fabricius).
Fig. 54. Lateral aspect of *Stenolophus conjunctus* (Say).
Fig. 55. Lateral aspect of *Stenolophus sp.*
Fig. 56. Lateral aspect of *Stenocellus rupestris* (Say).
Fig. 57. Dorsal aspect of head, *Cratocara capitata* Chaudoir.
Fig. 58. Dorsal aspect of head, *Stenocellus rupestris* (Say).
Fig. 59. Ventral aspect of head, *Cratocara capitata* Chaudoir.
Fig. 60. Ventral aspect of head, *Stenocellus rupestris* (Say).
Fig. 61. Dorsal aspect of head, *Stenolophus sp.*
Fig. 62. Ventral aspect of head, *Stenolophus sp.*
Fig. 63. Dorsal aspect of head (incomplete), *Stenolophus conjunctus* (Say).
Fig. 64. Ventral aspect of head (incomplete), *Stenolophus conjunctus* (Say).
Fig. 65. Ventral aspect of head, *Anisodactylus californicus* Dejean.
Fig. 66. Dorsal aspect of head, *Anisodactylus californicus* Dejean.
Fig. 67. Ventral aspect of head, *Amphasia interstitialis* (Say).
Fig. 68. Dorsal aspect of head, *Amphasia interstitialis* (Say).
Fig. 69. Ventral aspect of head, *Anisodactylus sp.*
Fig. 70. Dorsal aspect of head, *Anisodactylus sp.*
Fig. 71. Ventral aspect of head, *Anisotarsus sayi* (Blatchley).
Fig. 72. Dorsal aspect of head, *Anisotarsus sayi* (Blatchley).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57
58
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62
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64
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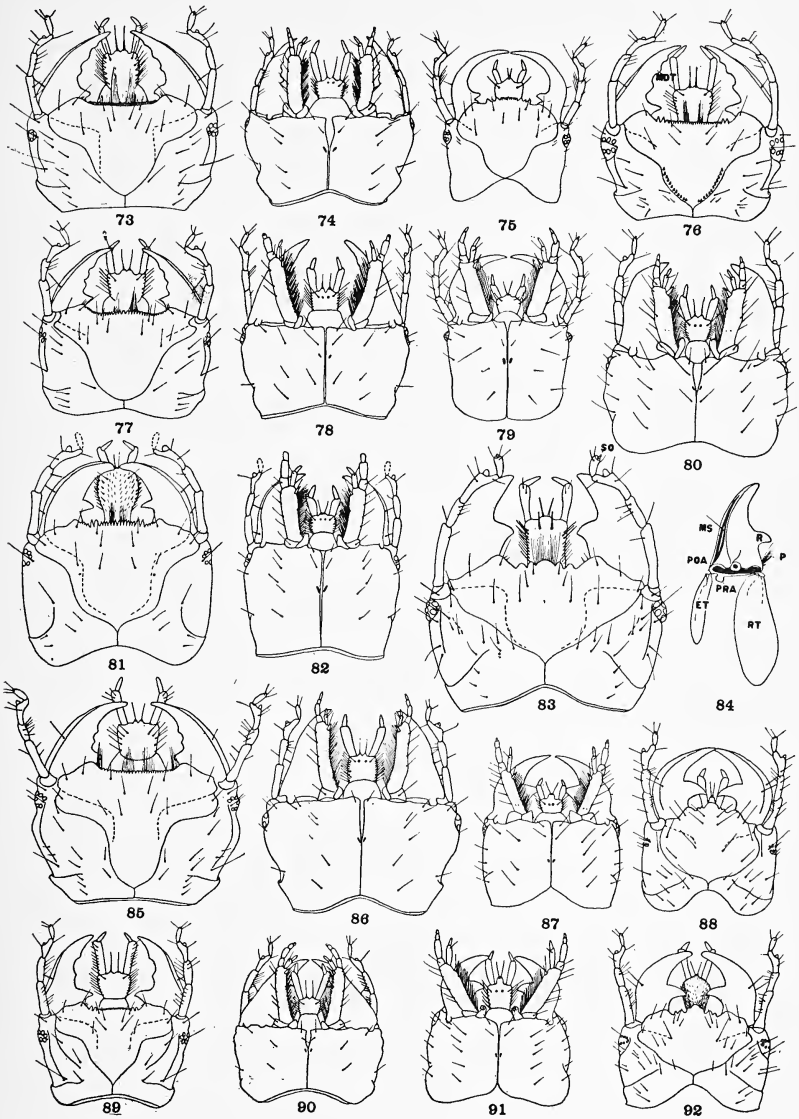
68
69
70
71
72

Plate V

Fig. 73. Dorsal aspect of head, *Harpalus compar* LeConte.
Fig. 74. Ventral aspect of head, *Harpalus compar* LeConte.
Fig. 75. Dorsal aspect of head, *Oödes sp.*
Fig. 76. Dorsal aspect of head, *Harpalus sp.*
Fig. 77. Dorsal aspect of head, *Harpalus erythropus* Dejean.
Fig. 78. Ventral aspect of head, *Harpalus erythropus* Dejean.
Fig. 79. Ventral aspect of head, *Oödes sp.*
Fig. 80. Ventral aspect of head, *Harpalus viridiaeneus* Beauvois.
Fig. 81. Dorsal aspect of head, *Harpalus dichrous* Dejean.
Fig. 82. Ventral aspect of head, *Harpalus dichrous* Dejean.
Fig. 83. Dorsal aspect of head, *Harpalus viridiaeneus* Beauvois.
Fig. 84. Left mandible, *Harpalus pennsylvanicus* Say.
Fig. 85. Dorsal aspect of head, *Harpalus vagans* LeConte.
Fig. 86. Ventral aspect of head, *Harpalus vagans* LeConte.
Fig. 87. Ventral aspect of head, *Agonoderus pallipes* (Fabricius).
Fig. 88. Dorsal aspect of head, *Agonoderus pallipes* (Fabricius).
Fig. 89. Dorsal aspect of head, *Harpalus caliginosus* ? (Fabricius).
Fig. 90. Ventral aspect of head, *Harpalus caliginosus* ? (Fabricius).
Fig. 91. Ventral aspect of head, *Agonoderus lineola* (Fabricius).
Fig. 92. Dorsal aspect of head, *Agonoderus lineola* (Fabricius).



73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92

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THE TICKS, OR IXODOIDEA, OF THE NORTHEASTERN UNITED STATES AND EASTERN CANADA

BY JOSEPH C. BEQUAERT*

TABLE OF CONTENTS

Preface

Until the latter part of the Nineteenth Century, ticks were usually thought to be merely annoying parasites of domestic animals and occasionally of man. It was known that in certain limited areas their bite caused a peculiar illness to which natives were apparently immune, while strangers seldom escaped. Nevertheless, ticks attracted little attention until, in 1889–1890, Theobald Smith and F. L. Kilborne showed that they play an essential rôle in the transmission of Texas or southern cattle fever. Many similar discoveries followed, concerning tick-borne diseases in man as well as in animals. These arthropods rank now, with mosquitoes, lice and fleas, among the most dangerous foes of mankind. For a long time it was believed that the northeastern United States and eastern Canada were free of tick-borne human diseases; but in recent years three of these, tick paralysis, spotted fever and tularemia, were found to extend much farther north and east than had been suspected. Two of these diseases occur sometimes even in New England, a section of the country where arthropod-borne diseases are unusually scarce.

An intelligent and effective control of the diseases transmitted by ticks is based on the same two premises as the control of other arthropod-borne affections: first, the correct recognition of the particular species of ticks involved in natural transmission, so that no effort be wasted on those that are innocuous or unimportant; next, a thorough knowledge of the life-history and habits of the species to be controlled, so that they might be fought efficiently when and where they are most vulnerable. I have gathered all available information bearing on these two topics, insofar as they affect the northeastern United States and eastern Canada, namely, the New England States, New York, New Jersey, Pennsylvania, Ohio, West Virginia, Maryland and Delaware, as well as Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, Quebec, Labrador and eastern Ontario (as far west as the 85th meridian). In the present paper, the term "our territory" refers to that area only.

I have discussed all species either truly indigenous or well established, merely mentioning some of the accidental importations on man or on animals. Such importations are particularly common in Zoological Gardens. H. L. Stecher (1933, Proc. Staten Id. Inst.

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* From the Department of Comparative Pathology and Tropical Medicine, Harvard Medical School and School of Public Health, Boston, Mass.

Arts Sci., 6, pp. 180 and 183) reports finding ticks, presumably *Amblyomma dissimile* Koch, on imported Central American boa and king snake. In one case the boa was said to have been brought in by a ship carrying bananas.

Being intended as a guide to the study of the distribution, habits and host relations of the ticks and of the diseases they transmit, the paper includes generic and specific keys to all stages, so far as possible at present. The early stages of some of our local ticks are as yet imperfectly studied and even the males of some species have never been described. Our knowledge in both respects should be completed by the breeding of adults from eggs, larvae or nymphs kept in captivity, and by a thorough investigation of the burrows or nests of the hosts. Useful hints for the rearing of ticks are given by W. L. Jellison and C. B. Philip (1933), G. M. Kohls (1937) and W. A. Hooker (1908), among others. The true breeding range of most species should be defined more accurately and the list of known hosts might be considerably extended. Moreover, we need to understand more correctly the host specificity of the several species, a factor of much importance for the perpetuation and spread of tick-borne diseases. Some of our ticks, such as *Ornithodoros kelleyi, Ixodes uriae, I. brunneus, Rhipicephalus sanguineus, Dermacentor erraticus,* and *Haemaphysalis leporis-palustris,* have a rather narrow range of hosts; but this applies sometimes only to the adult stage, the larvae and nymphs of some of these species being found on different types of animals. *Dermacentor erraticus* is our only indigenous true one-host tick. All stages of *Rhipicephalus sanguineus* have been found on domestic dogs only in our territory, but they drop off for moulting. It is remarkable that in North America this imported dog tick rarely if ever attaches to man, whereas in some parts of the Old World it readily does so and is then sometimes a vector of human disease. Our most common ticks attack a variety of animals, even as adults, as shown by their extensive host lists. Yet it is possible that even these omnipresent species may prefer certain hosts to others, or may have few true *breeding hosts,* whose presence is needed for the perpetuation of the species in a given area. Other animals might then be no more than stray or accidental hosts. It should be emphasized that, within the limits of our territory at any rate, man is always an accidental host only for ticks. A female tick will scarcely ever be able to engorge fully on a human and then be allowed to drop off for oviposition in a suitable spot. Furthermore, in our tick-borne human diseases, man never acts as the source

of the infection, but the original reservoir is always some wild animal on which the ticks become infected.[1]

Relatively little has been written thus far on the rather scant tick fauna of northeastern North America, a large proportion of the articles listed in the appended bibliography referring to cases of tick-borne diseases only. N. Banks (1908*a;* 1908*b*) mentioned six species for New England, but gave few localities for any and the hosts of none. H. S. Peters (1933; 1936) added some records of bird ticks for that area. F. C. Bishopp and C. N. Smith (1937) described a new *Ixodes* from Massachusetts and added another to the New England list; while more recently (1938) they discussed the distribution of *Dermacentor variabilis* in New England. On Martha's Vineyard, C. N. Smith (1940; 1942) worked out the life history of *Ixodes dentatus* and, in collaboration with M. M. Cole (1941), studied the behavior of *Dermacentor variabilis.* C. M. Herman (1938) dealt with *Haemaphysalis leporis-palustris* on Cape Cod. The species found in New York State do not appear to have been enumerated, although some were first noticed by P. Kalm (1754), and others were mentioned by A. Fitch (1872) and R. Matheson (1931; 1937). H. B. Weiss (1915) included five ticks in his list of the Acarina of New Jersey, but gave definite localities for one only. The same five species were listed from New Jersey by T. J. Headlee (1938; 1940). A. E. Miller (1925) included six ticks in his account of the Acarina of Ohio, but had records for four only and one of these was probably misidentified; while J. S. Katz (1941), more recently, listed five species from that State (his *Ixodes diversifossus* is what is here called *I. dentatus*). D. McCreary (1939; 1940) recorded six species from Delaware. The Canadian species were studied by C. G. Hewitt (1915) and T. D. Jarvis (1910), and there are a few records by A. O. Gross (1930), C. H. D. Clarke (1936; 1937), and D. A. MacLulich (1937). Additional records for our territory are given by R. A. Cooley (1938), R. A. Cooley and G. M. Kohls (1944 *a;* 1944*b;* 1946), and F. C. Bishopp and H. L. Trembley (1945).

Under each species references are given to the original description, recent revisions, useful figures, and all published records for our territory. Every reference has been checked with the original and critically examined. Locality and host records listed as "Seen"

[1] This statement does not apply to the so-called recurrent or spirochaetal fevers of other parts of the world, where both man and animals may act as reservoirs.

are based upon material examined by myself, even though sometimes recorded also by some previous author. Published records and others received from correspondents, but which I was unable to check with specimens, are included under "Recorded."

It is to be regretted that the conditions under which this paper was prepared and is now published, made it impossible to include illustrations.

Acknowledgments

Relatively little of the material is of my own collecting. I am indebted for specimens or records to the following Institutions: Academy of Natural Sciences of Philadelphia (Ac.N.S.Phila.), American Museum of Natural History (Am.M.N.H.), Carnegie Museum, Pittsburgh (Carn.M.; through Mr. G. E. Wallace), New England Museum of Natural History (Bost.M.), Connecticut Agricultural Experiment Station (Conn.A.E.S.; through the late Dr. W. E. Britton), Delaware Agricultural Experiment Station (Del.A.E.S.; through Mr. D. MacCreary), Department of Agriculture (Entomological Branch) of Ottawa (Ent.Br.Ott.; through Mr. G. Walley, Mr. C. R. Twinn and Mr. A. Gibson), Ontario Agricultural College of Guelph (Ont.A.C.; through Mr. A. W. Baker), Department of Entomology of Cornell University (Corn.Un.; through Prof. R. Matheson), Maryland State Horticultural Department (Md.S.H.D.; through Dr. E. N. Cory), Museum of Comparative Zoölogy (M.C.Z.), New Jersey Agricultural Experiment Station (N.J.A.E.S.; through Mr. John B. Schmitt), Field Museum of Natural History (F.M.N.H.; through Mr. W. J. Gerhard), Department of Zoology and Entomology of Ohio State University (through Mr. J. N. Knull), New York State Conservation Department (C.Dept.N.Y; through Dr. E. K. Le Dune and Dr. F. C. Goble), New York State Museum (N.Y.Mus.; through the late Dr. Dayton Stoner and Dr. R. D. Glasgow), United States Bureau of Animal Industry, Dept. of Agriculture (Bur.An.Ind.), and Rocky Mountain Laboratory, Hamilton, Montana (through Mr. R. A. Cooley). I have also received specimens from several private collectors: G. Chagnon, the late Wm. T. Davis, P. F. English, H. S. Fuller, E. J. Gerberg, C. M. Herman, J. H. Hughes, Edwin A. Mason, W. P. Wharton, L. W. Wilson, M. Wood, and others. I am under particular obligation to Dr. F. C. Bishopp, Mr. R. A. Cooley, Prof. R. Matheson, Mr. A. McIntosh, Dr. C. B. Philip, and Dr. C. N. Smith for helpful suggestions, criticism, and other favors. Mr. C. R. Twinn has very generously allowed the use of information which

he has accumulated for some years past on the ticks of eastern Canada. The help received from several Provincial and State Departments of Health is acknowledged in the discussion of the tick-borne diseases. Mr. James L. Peters, Mrs. W. E. Schevill (Barbara Lawrence), and the late Dr. Glover M. Allen, my colleagues at the Museum of Comparative Zoölogy, have assisted with the identification and nomenclature of the hosts.

Economic and Medical Importance of Ticks

Ticks are among the arthropods most important to man. The following pages deal with their relations to human health, to the welfare of domestic animals, and to the preservation of wild life in our territory. Some of the statements in this discussion do not necessarily apply to other sections of North America, where conditions may be different.

1. *Ticks and Human Welfare*

Few species of ticks attack man in our territory, only three being known to do so to any extent: *Dermacentor variabilis, Ixodes cookei* and *Amblyomma americanum.* Even these are only accidental human parasites, as none of our ticks could use man alone for a normal or permanent breeding host.

In tick bite, the purely mechanical injury, caused by the action of the chelicerae and the introduction of the hypostome, is usually followed by an inflammatory reaction of the skin tissues. In common with other blood-sucking arthropods, ticks inject in the bite a certain amount of saliva, containing an anti-coagulant which enables a continued flow of blood into the hypostome. The various skin reactions are probably caused mainly by the saliva. As all ixodid ticks remain for several days attached to the same spot, the inflammation often results in pathological tissues and sometimes in an indurated sheet around the hypostome. Exceptionally the tick may become imbedded in the skin, if the edematous swelling near the point of attachment is unusually pronounced. G. H. F. Nuttall (1914) and P. Schulze (1921) collected a number of records of ticks found under the skin of man and animals. In Pennsylvania, J. F. Bell and W. S. Chalgren (1943) observed a massive subcutaneous infestation of a cottontail rabbit by *Ixodes dentatus* (see under that species). The amount of blood taken up by engorging ticks is often considerable. When several hundreds of them are feeding at the same time, this no doubt results sometimes in "tick anemia," in-

duced by the mere loss of blood. Female adult ticks swell up not only by engorging, but also by the development of the eggs, so that they grow several times their original size. When attached to humans, these very large ticks may be mistaken for warts or pedunculated tumors (R. Friedman, 1940; K. Wiener, 1939).

In their study of the tissue reactions following the bite of *Dermacentor variabilis,* L. H. Winer and E. A. Strakosch (1941) distinguish three stages. In the acute stage, the predominant features are the intense epidermal and subepidermal edema and the outpouring of eosinophils. The subacute stage is characterized by the excessive numbers of mast cells and the diminution of elastic tissue. In the chronic stage, there is a massive increase in fibrous tissue, with sporadic presence of giant cells and complete obliteration of elastic tissue.

The subjective symptoms of tick bite vary with the species of tick. They are relatively mild and of short duration for *Dermacentor variabilis.* In my own experience, the bite of *Amblyomma americanum* is much more severe than that of any other local species. It induces intense itching, which, moreover, persists for several days or even weeks after removing the tick. Certain individuals appear to be more sensitive than others, an observation which applies to the bite of all types of blood-sucking arthropods. In these persons tick bite may cause a variety of graver symptoms, simulating allergy and ranging all the way from general discomfort to pronounced fever. I. A. Feder (1944) has recently discussed a number of such cases, for which he proposes the name "tick bite pyrexia." It is not impossible that so-called "tick paralysis," to be discussed presently, is an extreme case of sensitiveness to tick bite.

Until recent years there was no fully reliable evidence that our local ticks carried specific diseases to man, as they do frequently elsewhere. At present, however, three or possibly four tick-borne human diseases have been reported from our territory, some of the cases being clearly autochthonous. It should be emphasized at the outset that the two important ones, *viz.,* Rocky Mountain spotted fever and tularemia, are primarily diseases of wild animals, from which man may acquire the infection.[2] In the species of ticks that attack man, the early stages and both sexes of the adult may act as

[2] Toxoplasmosis, a disease of certain animals and birds, and occasionally of man, has recently been suspected of being tick-borne; but there is as yet no evidence in support of this view (D. Weinman, 1944).

vectors once they have become infected from an animal reservoir. In addition, an infected female may sometimes transmit the infection through the eggs to part of her progeny.

Tick Paralysis.—A dangerous form of paralysis in man and animals, particularly sheep and dogs, is induced by the bite of certain species of ticks. The causative agent is disputed, being either (and more probably) a neurotropic toxin proper to the tick and which it injects by the mouthparts, or a specific organism or virus, as yet unrecognized. The various theories as to the cause of the disease are discussed by K. H. Abbott (1943) and by J. D. Gregson (1943). Children are more commonly affected than adults, perhaps because ticks are not as readily detected on them. As a rule, the disease starts with lassitude, listlessness, convulsions and locomotory disturbances, followed by flaccid ascending paralysis, which progresses rapidly and may end fatally. In children the symptoms often simulate those of polio-encephalitis. However, if the tick drops off early enough or is discovered and removed in time, recovery is very rapid and complete, all symptoms disappearing in 24 to 48 hours. In this disease, it is of the utmost importance to search the body most carefully for ticks, so that they may be removed as soon as possible after the onset of symptoms.

Tick paralysis appears to have been first clearly recognized in Australia, but it is known to occur in many parts of the world. In North America it is most common in the western United States and western Canada, where it is usually caused by *Dermacentor venustus* (= *andersoni*). In the eastern United States a few cases, due to *Dermacentor variabilis,* have been reported since 1938 from South Carolina, Georgia and Texas. In our territory, a case was observed in 1942 by A. G. De Sanctis and P. A. di Sant'Agnese (1943) in New York City, in a 3-year-old child. A female *D. variabilis,* apparently acquired on Long Island, was removed from the scalp of the patient more than a week after the onset of the disease, the removal being followed by rapid recovery.

Rocky Mountain Spotted Fever.—This is a grave typhus-like disease, often with high mortality in man, who acquires it exclusively through infected ticks. A prominent rash over part or most of the body is one of the most common and striking diagnostic signs. The causative agent is an intracellular microörganism of the group of the rickettsiae, *Dermacentroxenus rickettsi* Wolbach. It is normally inoculated to man or a receptive animal by the bite (mouthparts) of an infected tick. However, the disease may also be contracted either by rubbing in infected tick feces or by merely handling or

crushing infected ticks, as the organism may enter by a slight abrasion of the skin or perhaps even through the intact mucous membranes of nose, lips and eyes. Most human cases are acquired outdoors; but in a few instances infection was reported as occurring indoors, by ticks straying onto people from undressed hides or furs. The incubation period in man usually lasts from 2 to 5 days. Recovery from the disease is followed by a lasting immunity. Infection from man to man is unknown.

The spotted fever organism has a natural animal reservoir, on which all the several stages of the tick may become infected with the rickettsia, the microörganism persisting through the successive moults. In addition, an infected female tick transmits the rickettsia through the eggs to a certain percentage of her offspring. In the tick the microörganism multiplies in the gut and goes through cyclical changes which eventually produce intracellular forms in the epithelial cells of the digestive tract. The duration of the incubation period, before the tick becomes infective for a healthy animal or man, is not definitely known. It is well established, however, that once a tick is infected it may inoculate the disease to healthy animals, as well as to man, for the remainder of its life. The bite of a single infective tick suffices, but as a rule it must be attached and feed for some time (2 to 8 hours or more) in order to produce infection. According to R. R. Parker (1933) hibernating infected ticks are usually not infective early in the spring, but become so later, the rickettsia being reactivated by warmer weather or by prolonged feeding.

Several North American ticks can act as vectors in experiments and some of these have been found infected in nature. It should be noted, however, that even in areas where the disease is prevalent, the infection rate of the ticks is usually very low, not over one in 300 being infected. The species of *Dermacentor* are particularly important for human infection; while the rabbit tick, *Haemaphysalis leporis-palustris,* seems to be instrumental only in perpetuating the disease among wild rabbits and hares. Possibly, in addition, the rabbit ticks may be responsible for sporadic outbursts of spotted fever outside areas where it is well established, owing to the fact that the early stages commonly attach to many species of migratory birds, returning to rabbits at a later stage (R. R. Parker, 1938). Only species of ticks that frequently attach to man, however, can act as vectors to humans, and this eliminates *H. leporis-palustris* as the source of human cases. In the western United States *Dermacentor venustus* Banks (Syn.: *D. andersoni* Stiles) is the chief transmitter

to man; while in the eastern States the allied American dog tick, *Dermacentor variabilis,* plays the same rôle. M. B. Maver (1911) infected guinea pigs experimentally by means of nymphs and adults of *D. variabilis* (see also R. E. Dyer, L. F. Badger, and A. Rumreich, 1931). The rickettsia was recovered from wild *D. variabilis* collected in Virginia, on a farm where a human case had occurred (L. F. Badger, 1932), and from wild ticks of the same species in Iowa (C. F. Jordan, 1938). W. P. Havens, C. G. Whitbeck and C. G. Kramer (1940) found rickettsiae in one out of 18 lots of ticks (probably *Dermacentor variabilis*), collected in nature near Philadelphia. M. B. Maver (1911) also transmitted the disease in the laboratory by *Amblyomma americanum,* a tick which was later found infected under natural conditions in Oklahoma (R. R. Parker, G. W. Kohls and E. A. Steinhaus, 1943). No doubt where this tick is a common pest, it is responsible for some of the human cases, as shown in Texas and Oklahoma by L. Anigstein and M. Bader (1942, 1943). *Amblyomma maculatum* also was found spontaneously infected in Texas (R. R. Parker, G. M. Kohls, G. W. Cox and G. E. Davis, 1939).

In our territory, cases of Rocky Mountain spotted fever (at one time called tick-bite fever) have now been reported from 11 states (New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Ohio, West Virginia, Delaware, and Maryland). From the point of view of local epidemiology and measures of control, it is essential to distinguish between truly autochthonous cases, acquired on the spot, and those imported from other parts of the country. With the present rapid means of travel, people may show clinical signs of the disease in a locality far distant from where they contracted the infection. Such cases, of course, are no evidence that the disease is endemic in the local tick or rodent population; nor does the abundance or scarcity of ticks in a given locality have any direct bearing on the incidence of the disease, unless the ticks are shown to be infected in nature. Thus far the occurrence of the spotted fever organism in local ticks or in wild native fauna has been little investigated in our territory. H. D. Chadwick (1938) states that a tick survey of the Cape Cod area was conducted by the Massachusetts state authorities in 1933 and 1937, but that no ticks infected with Rocky Mountain spotted fever were found in the samples studied.

As many people seem to have become unduly alarmed over tick-borne diseases in the northeastern United States, I am reviewing critically all available evidence bearing on the prevalence of Rocky

Mountain spotted fever in this area. It has been claimed that the disease is on the increase and becoming more widespread in the eastern United States. More probably, however, the larger number of cases reported since 1930 is merely due to more attention being paid to the disease than formerly and to better methods of diagnosis.

Canada.—Although Rocky Mountain spotted fever is by no means rare in certain districts of the western Provinces of the Dominion, I was unable to find any evidence of its occurrence in the eastern Provinces. A letter recently received (December, 1944) from the Ministry of Health and Social Welfare of Quebec, definitely states that there is no record of the disease having ever been diagnosed in the Province.

Maine.—Rocky Mountain spotted fever has not been reported from this state, according to Dr. R. L. Mitchell, Director of the State Department of Health and Welfare (1944).

Vermont.—No case of the disease has been reported, according to information received from Dr. C. F. Dalton, of the State Department of Public Health (1944).

New Hampshire.—According to information supplied by Dr. E. W. Colby, of the State Department of Health (1944), the only two cases of Rocky Mountain spotted fever known thus far occurred in 1942. One was traced definitely as having been acquired in South Carolina. The exact place of origin of the other is not known, but may have been Massachusetts. Both cases recovered.

Massachusetts.—Information was received from Dr. R. F. Feemster, Dr. V. A. Getting, and Dr. M. Champion, of the State Department of Public Health, on nine cases reported up to 1945; eight of them coming from the Cape Cod area. In some of the cases the diagnosis is uncertain. One of the first known cases was contracted out of the state, as the patient had picked ticks from a dog while on a visit in Washington, D. C., between June 5 and 15, 1938, and, returning to Massachusetts on June 15, developed Rocky Mountain spotted fever on June 18. A second possible case, acquired in 1937, was described by L. S. Pilcher (1938); but the diagnosis is not clear and, moreover, infection may likewise have occurred outside the state. This person had traveled through Indiana, Ohio, and Washington, D. C., and developed symptoms 2 to 3 days after arriving in Massachusetts and 2 days after having been bitten by some arthropod on Cape Cod. The next two cases concern two members of a family residing in Rhode Island, who became ill in 1937 after visiting in East Brewster, where they appear to have acquired the infection (E. A. McLaughlin and M. L. Grover, 1937).

A fifth case developed in June, 1938, at Dennis, in an 8-year-old native child, who became severely ill after being bitten by ticks, but eventually recovered (H. D. Chadwick, 1938). This is the only case from this state in which the causative agent was isolated from the blood and maintained by serial passage in guinea pigs (A. D. Rubenstein and H. F. Rowley, 1943). In June, 1939, another well-defined case, also followed by recovery, occurred in a 4-year-old child, who had been bitten by several ticks on Cape Cod sometime during the three previous weeks (A. D. Rubenstein and H. F. Rowley, 1943). Three unpublished cases occurred in 1944 and 1945. One non-fatal case was contracted in June, 1944, at Chatham. A non-fatal case occurred in July-August, 1944, at Oak Bluffs, on Martha's Vineyard in a summer visitor from New Jersey; the patient recalled pulling a tick off the back of his neck about two weeks before the onset. In July–August, 1945, another case, ending in death, was contracted at Oak Bluffs by a man from Newton Center, Massachusetts, who had been exposed to many tick bites. In both the Martha's Vineyard cases the diagnosis of Rocky Mountain spotted fever was made by complement fixation tests on the blood.

Rhode Island.—The only two cases known thus far, according to Dr. H. J. Connor (1944), of the State Department of Health, were in two residents who became ill after having been summer visitors in East Brewster, Massachusetts, as mentioned above (McLaughlin and Grover, 1937).

Connecticut.—According to information received from Dr. M. Knowlton (1944), of the State Department of Health, of four reported cases, one (1942) was incorrectly diagnosed, as it proved to be meningococcus meningitis. A case in 1935 was somewhat questionable, but as no change in diagnosis was reported, it is carried in the records as Rocky Mountain spotted fever. There is no information as to where it might have been acquired. The third case is based on a newspaper report of a woman who developed a fatal illness, diagnosed as Rocky Mountain spotted fever, 6 days after arriving in New London from Texas in May, 1943. The last case, followed by recovery, concerns a 7-year-old child who became ill at Enfield, Connecticut, on May 5, 1942, after having visited in Media, Pennsylvania, from April 22 to May 3. Sometime between April 24 and 26 a tick was removed from the child, after playing outdoors. The detailed clinical and laboratory findings leave no doubt that this was genuine Rocky Mountain spotted fever; but it was obviously acquired outside the state. Whether the disease is endemic anywhere in Connecticut seems open to question.

Summarizing the evidence for New England, it would appear that the disease is endemic only on Cape Cod and on at least one of the neighboring islands, where *Dermacentor variabilis* is more plentiful than elsewhere. Even there, however, in view of the abundance of ticks in certain localities, it is difficult to understand why so few cases develop every year among the many summer visitors and campers. Possibly the disease has only become established in recent years at a few points, either through infected ticks dropped from dogs brought in from outside the state or through some of the rabbits which have been imported from time to time for hunting purposes. No serious attempt has as yet been made to determine the incidence of the disease in the native tick population and among the wild animal reservoirs in the infected area.

New York.—Rocky Mountain spotted fever seems to have been first recognized in 1912, when two cases occurred on Gardiner's Island, at the eastern tip of Long Island, a third case occurring in the same locality in 1913 (Anonymous, 1945). The disease became officially reportable in September, 1932. Meanwhile, R. Gilbert and M. B. Coleman (1925) described an illness, contracted at East Hampton in July, 1925, following the removal of a tick; the diagnosis was uncertain at the time, but it was no doubt Rocky Mountain spotted fever (R. E. Dyer, 1933; E. R. Maillard and E. L. Hazen, 1935). According to the latest comprehensive report issued by the New York State Department of Health (Anonymous, 1945), a total of 85 native cases, 16 of them fatal, occurred up to the end of 1944, all of them acquired in rural districts of Long Island (82 in Suffolk Co. and 3 in Nassau Co.). In addition, a case was contracted accidentally in a laboratory in Rockland Co., in 1943. The number of cases in successive years was as follows: 7 in 1912–1932; 3 in 1933; 4 in 1934; 2 in 1935; 1 in 1936; 2 in 1937; 5 in 1938; 12 in 1939; 0 in 1940; 8 in 1941; 9 in 1942; 16 in 1943; and 17 in 1944. East Hampton has had the most cases (26), Brookhaven coming next (15). The 17 cases contracted in 1944 were fairly evenly distributed among all ages and both sexes, and confined to the period May through September (6 in May, 3 in June, 3 in July, 4 in August, and 1 in September). In 7 of the cases there was a definite history of tick bite, in 6 others evidence of contact with ticks, and in 8 others contact with domestic animals infested with ticks (7 with dogs and 1 with cats). Additional information may be found in a number of publications (Anonymous, 1937, 1939*a*, 1939*b*, 1945; Jackson, 1943; E. R. Maillard and E. L. Hazen, 1935, 1942, 1944). The only known endemic area, on Long Island, is evidently more heavily infected

than that of Cape Cod; but, here as there, there is no definite information as to the prevalence of the causative rickettsia in either the native ticks or in the wild rodent reservoirs.

New Jersey.—From information supplied by Dr. L. Snegiroff, it appears that Rocky Mountain spotted fever was first reported in 1931. Up to early in 1936 the State Department of Health had records of 9 apparently well-defined cases. L. S. Carey and G. G. Duncan (1938) described a case with recovery at Blue Anchor, in June, 1936, of a 16-year-old boy, who had picked ticks from a dog and crushed them with the fingers, but did not recall being bitten. C. A. Pons, S. C. DePons and W. A. Sweet (1938) studied 7 cases (3 fatal) contracted in 1938 in Monmouth Co., but eliminated on laboratory findings 6 additional suspected cases.

Pennsylvania.—First reported by A. Rumreich, R. E. Dyer and L. F. Badger (1931), Rocky Mountain spotted fever appears to be endemic, though relatively rare, in some of the eastern counties of the state. Three cases were diagnosed in 1930, 1932 and 1934, respectively, from Franklin Co., Delaware Co., and Chester Co., according to H. F. Flippin (1936). He described a fourth case, with recovery, acquired in 1935 by a woman who had resided in Delaware Co. for several months previously. Two weeks before the onset, she removed several ticks from her dog, but denied being bitten by them. The U. S. Public Health Service lists 7 cases for the state in the years 1931–1935 (1 in 1931, 2 in 1933, 1 in 1934, and 3 in 1935), but some might have been acquired elsewhere. An unusual case occurred early in December, 1939, in York Co., long after the tick season was ended, under circumstances suggesting that the victim became infected by handling undressed furs about a week before the onset of the illness (M. H. Cohen, 1940). W. P. Havens, C. G. Whitbeck and C. G. Kramer (1940) found that of 18 lots of ticks (species not stated, but probably *Dermacentor variabilis*), collected in as many localities from dogs roaming the woods and fields in the environs of Philadelphia, only one showed infection with rickettsiae.

Ohio.—The first 2 cases of Rocky Mountain spotted fever were recognized in 1937 (M. L. Cooper, M. A. Kurzner, A. T. Wilson and R. E. Dyer, 1938). One was a fatal case in a 9-year-old child who became infected on a farm near Marathon, where several ticks were picked from her skin. One engorged specimen was removed from the lobe of her right ear the morning after she returned from the farm to her home in Lebanon. Illness developed 3 days later. A strain of the disease was isolated from the blood of this patient and

maintained for 10 months in guinea pigs. The second case, in Cincinnati, was in a 2½-year-old child, who recovered. This patient had a pet dog infested with ticks, some of which had been picked at various times from the child's neck. Evidently the disease is indigenous in certain localities of southern Ohio, where *Dermacentor variabilis* is abundant.

West Virginia.—Rocky Mountain spotted fever was first recognized positively in 1933, when three cases occurred in the same family near Lewisburg (D. G. Preston, 1934). There may have been, however, some cases earlier. In 1939, there were two fatal cases in Huntington (J. S. Pearson, 1940). According to a map published by H. H. Henderson and K. A. Walke (1944), the disease has been reported from the following counties: Jefferson, Berkeley, Hampshire, Preston, Wood, Mason, Kanawha, Roane, Fayette, Greenbrier, and Monroe.

Delaware.—The first case of Rocky Mountain spotted fever was recognized in 1931 by A. Rumreich, R. E. Dyer and L. F. Badger (1931). In 1933, three more cases occurred in Kent Co., according to E. Cameron (in S. Worden, 1945). E. Cameron (1943) also states that there were 13 known cases in 1943, up to August; 2 of these were from Cedar Creek and Little Creek townships (1943, Jl. Amer. Med. Assoc., 122, p. 820).

Maryland.—First recognized in 1929, Rocky Mountain spotted fever now ranks as one of the important diseases of Maryland. It is endemic and fairly prevalent in the summer throughout most of the State, Garrett Co. being the only section remaining immune thus far. The mortality rate is nearly 20 per cent. N. H. Topping (1941) states that of 330 cases occurring from 1931 to 1936, inclusive, 66 were fatal. Of the total number of patients, 155 were under 15 years of age, 85 were 15 to 39 years old, and 90 were 40 years old or more. It is strictly a rural disease, occurring either in country dwellers or in city people who were exposed to ticks during visits in the country. A total of 463 cases was reported from the counties (exclusive of Baltimore City) from 1930 to 1940, divided as follows: 29 in 1930, 40 in 1931, 35 in 1932, 53 in 1933, 38 in 1934, 42 in 1935, 31 in 1936, 32 in 1937, 39 in 1938, 71 in 1939, and 53 in 1940. In addition, 43 cases were reported from the whole of the state in 1941.[3] The seasonal distribution of the 463 cases of 1930 to 1940 was as follows: 4 in January, 0 in February, 0 in March, 3 in April, 40 in

[3] These figures are taken from the Annual Reports of the State Board of Health.

May, 110 in June, 130 in July, 141 in August, 27 in September, 4 in October, 1 in November, and 3 in December. Many of the cases gave a definite history of tick bite within two weeks before the onset of the illness. In one case the disease seemed to have been acquired by removing and crushing ticks from a dog.[4] In this state also, the incidence of the disease in the ticks and its occurrence in the animal reservoirs have not been investigated.

TULAREMIA.—Tularemia, or rabbit fever, is a bacterial, plague-like disease primarily of certain rabbit-like mammals (Order Lagomorpha) and occasionally of certain rodents (Order Rodentia) and other wild mammals (shrew, opossum, beaver, coyote, red fox, gray fox, etc.) and game birds (sage hen, quail, and grouse),[5] due to *Pasteurella tularensis*. Although it is readily transmissible to man, causing a severe illness with acute fever and a variety of symptoms, and often ending fatally, human infections are only accidental. After recovery one attack confers life-long immunity. In North America it appears to be enzoötic among wild life over most of the United States, parts of Canada, and Alaska. It is also known from several European countries, northern and central Asia, and Japan.

There is no definite record of the transfer of the infection directly from sick to healthy man. Human infection may be acquired from three main sources (E. Francis, 1937). The most common method, in eastern North America at any rate, is by contact with a diseased animal. The bacterium may enter the human skin, either abrased or possibly even intact, or the mucous membrane (particularly of the eyes), during the skinning and dressing of infected wild animals or while merely handling their skins. Although thorough cooking kills the organism, infection may occur from eating raw or improperly cooked infected meat (H. L. Amoss and D. H. Sprunt, 1936). Sometimes also animals convey the disease to people by the

[4] The following articles of the appended bibliography refer to cases of Rocky Mountain spotted fever contracted in Maryland: A. L. Florman and J. Hafkenschiel, 1940; C. H. Halliday, 1936*b*; H. H. Henderson and K. A. Walke, 1944; H. A. Ong and J. F. Raffetto, 1940; M. C. Pincoffs and C. C. Shaw, 1933; A. Rumreich, R. E. Dyer and L. F. Badger, 1931; P. G. Shipley, 1932; N. H. Topping, 1941; and N. A. Welch and P. J. Jakmauh, 1939.

[5] A recently published list of Vertebrates known to be naturally infected with tularemia includes, for the United States and Canada, 6 species of birds and 28 species of mammals (A. L. Burroughs, R. Holdenried, D. S. Longanecker and K. F. Meyer, 1945).

bite or by scratching. Self-inoculation by contact is prevalent among hunters, cooks, and butchers, and there are often cases in large cities where so-called "market fever" is well known among market men. As infection by contact is the usual method in our territory, it explains the seasonal incidence, cases being most frequent with us from November to January, during the hunting season and when cottontail rabbits particularly are for sale. Dogs and cats are susceptible and have been known to contract the disease by eating raw meat of sick wild rabbits. In dogs *Pasteurella tularensis* may persist for many days apparently without outward symptoms (H. N. Johnson, 1944). It may be well to note that, although the domestic rabbit is susceptible to experimental tularemia, rabbits raised in rabbitries have very rarely been found infected in this country and may therefore be handled and eaten with safety (E. Francis, 1925; W. L. Jellison and R. R. Parker, 1945).[6]

Tularemia is usually transmitted among wild mammals and birds by infected ticks, either by the bite or, more probably, by the feces which the ticks void while engorging on the host. Several species of ticks are known as natural or potential vectors. The rabbit tick, *Haemaphysalis leporis-palustris,* one of our most common ticks, was found infected in nature (G. E. Davis, C. B. Philip and R. R. Parker, 1934) and transmits the disease in the laboratory (R. R. Parker and R. R. Spencer, 1925). Infected female ticks also pass on the bacterium to their eggs and larvae (R. R. Parker, 1934). *H. leporis-palustris* is a particularly active transmitter, as all stages, larvae, nymphs and adults, occur often in unbelievable numbers on wild Lagomorpha, the adults being restricted to this type of host. Larvae and nymphs, however, often attach also to migratory and game birds, which may thus carry infected ticks over long distances and into new territory. It seems probable that *Pasteurella tularensis* survives the winter chiefly in infected *H. leporis-palustris* which have dropped off from cottontail rabbits dying of the disease (L. E. Hicks, 1942). All stages of this tick hibernate away from the host. The rabbit tick is not known to attack man and is therefore not instrumental in the transmission of tularemia from infected animals to humans. The related bird tick, *Haemaphysalis chordeilis* (= *cinnabarina* of many writers), was found infected in nature in Montana (R. R. Parker, C. B. Philip, and G. E. Davis, 1932). The Rocky Mountain wood tick, *Dermacentor venustus* Banks (= *D.*

[6] The rather intricate relationship between the presence of tularemia in the wild fauna and outbreaks among humans in the same locality, is discussed in a later chapter on "Ticks and Wild Life."

andersoni Stiles), is infected in nature in Montana (R. R. Parker, R. R. Spencer and E. Francis, 1924; G. E. Davis, C. B. Philip and R. R. Parker, 1934). It was also proved that this tick is a true biological host of *P. tularensis,* which it harbors, not only in its feces, but also in the epithelial cells of the digestive tract and Malpighian tubes and in the coelomic fluid. Furthermore, an infected female *D. venustus* will transmit *P. tularensis* to a certain percentage of its eggs, larvae and nymphs (R. R. Parker and R. R. Spencer, 1926). The presence of tularemia in the Pacific Coast wood tick, *Dermacentor occidentalis* Curtice, was demonstrated in California (R. R. Parker, C. S. Brooks and H. Marsh, 1929). Our eastern wood tick, *Dermacentor variabilis,* was found infected with the disease in nature, notably in Minnesota by R. G. Green (1931). According to C. B. Philip and W. L. Jellison (1934), in this tick also the bacterium may be carried by an infected female to part of the progeny, through the eggs. However, in later investigations by J. F. Bell (1945) no "hereditary" infection could be obtained and it was concluded that such transmission appears to be of no significance for *D. variabilis* and may be the exception rather than the rule in nature. Bell points out that the lack or difficulty of "hereditary" infection of the tick may be a most important limiting factor in the epizoötic course of tularemia. He also demonstrated that infected *D. variabilis* feeding on immune or normal hosts lose their infection, presumably owing to the stimulating effect of the blood meal upon a normal bactericidal function of the tick's gut. Before losing their infection as a result of feeding, such infected ticks may nevertheless inoculate a normal host, which will later be a source of infection to other ticks feeding upon it. On the other hand, when fed on an immune host, infected ticks will not infect it, so that such an animal will not transmit the disease further to clean ticks. The number of animals which have become immune by a previous mild or a chronic infection in a given area, may also be of importance in limiting the spread of tularemia. In our territory, some human cases seen to have been caused by adults of *Dermacentor variabilis,* which must have become infected in the immature stages on wild life; but tick-borne infection of man is possible only when wood ticks are active, particularly from March to August.

The third method of transmission involves a variety of blood-sucking insects, such as the squirrel flea (*Ceratophyllus montanus* Baker), the rabbit louse (*Haemodipsus ventricosus* Denny),[7] the

[7] Probably a misidentification of the native North American rabbit louse, *Haemodipsus setoni* Ewing.

squirrel louse (*Neohaematopinus laeviusculus* Grube), the mouse louse (*Polyplax serrata* Burmeister), the bedbug (*Cimex lectularius* Linné), two western species of deer-flies (*Chrysops discalis* Williston and *C. noctifer* Osten Sacken), some western species of horse-flies (*Tabanus*), the stable-fly (*Stomoxys calcitrans* Linné), a species of blackfly (*Simulium katmai* Dyar and Shannon), and several species of mosquitoes (*Aëdes aegypti* Linné, *Aëdes cinereus* Meigen, and others). With all of these, transmission has been effected under laboratory conditions from sick to healthy animals, either mechanically by the bite (interrupted feeding) or by the feces (E. Francis, 1929; R. R. Parker, 1934). Such experiments do not, however, necessarily incriminate all these insects as effective transmitters of the disease to man under natural conditions. The bite of *Chrysops discalis* has been blamed for many of the human cases in Utah and adjoining states; hence the name "deer-fly fever" sometimes applied to the disease.[8] In our territory, although several species of *Chrysops* are abundant and often attack people during the summer, they have been seldom incriminated in human cases of tularemia and there seems to be no definite proof that they act as vectors in northeastern North America.

In recent years a fourth possible source of infection has come to light; namely through drinking water contaminated by infected animals, particularly by muskrats and beavers (S. K. Karpoff and N. J. Antonoff, 1936; W. L. Jellison, G. M. Kohls, W. J. Butler and J. A. Weaver, 1942; R. R. Parker, E. A. Steinhaus and G. M. Kohls, 1943). It is doubtful whether this method of infection is of practical importance in our territory.

From published accounts and from information kindly furnished by the several State Departments of Public Health, I am reviewing the local incidence of the disease as known at present. Particular attention has been given to the reported mode of infection, as this is of foremost practical importance.[9]

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[8] Before being able to infect man, the *Chrysops* must acquire *P. tularensis* from an infected animal. I know of no published observations of species of *Chrysops* biting Lagomorpha or other small mammals in nature. Moreover, thus far natural infection of *Chrysops* has not been proved by examination of flies caught in areas where tularemia is prevalent. True deer-flies should not be confused with deer-keds (*Lipoptena*) nor with deer bot-flies (*Cephenomyia*), as was done by some writers.

[9] I have not included in my discussion cases of tularemia con-

Nova Scotia.—There appears to be at least one endemic focus of tularemia. According to H. G. Grant and A. L. McLean (1935), two Indians, near St. Peters, Cape Breton, became ill in 1930 after touching a wild rabbit found dead. Both recovered and their two companions, who did not touch the animal, did not contract the disease. W. L. Jellison and R. R. Parker (1945) point out that Nova Scotia is the only section of North America reporting tularemia in man, yet not known to have cottontail rabbits in the wild fauna.

Ontario.—A. L. McNabb (1930) and H. D. L. Hudson (1930) reported the first known, non-fatal case of tularemia in the Dominion of Canada. It occurred at Timmins in December, 1929, following the skinning of a wild rabbit. In 1931, another non-fatal case was reported from Woodville. So far as could be ascertained, this patient had handled a mouse at Bancroft, 4 days previous to the illness (J. B. Cramer, 1931). Five non-fatal cases were reported in 1931 and 1932 from the vicinity of London, by E. P. Johns (1933). The three cases of 1932 appear to have been acquired by skinning muskrats. The mode of infection of the two cases of 1931 was not determined. The foregoing seven cases are all from the southeastern part of the province, where there are evidently some endemic foci of the disease. This area is within the very limited range of the cottontail in Canada (W. L. Jellison and R. R. Parker, 1945). According to information recently received from Mr. J. T. Marshall, Chief of the Vital Statistics Branch, Dominion Bureau of Statistics, Ottawa (*in litt.*, 1944), the cases of tularemia reported to the Provincial Health Department of Ontario numbered 8 in 1931, 9 in 1932, 9 in 1933, 8 in 1934, 7 in 1935, 0 in 1936, 1 in 1937, 1 in 1938, 2 in 1939, 3 in 1940, 4 in 1941, 0 in 1942, 3 in 1943, and 2 in 1944 (up to November 18), a total of 57 for the past 14 years.

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tracted by laboratory workers or clearly acquired outside our territory. One of these is the very first case ever observed in New England (P. R. Withington, 1929). It concerned a man who became ill while visiting an island off the coast of Georgia and returned to his home in Massachusetts to be treated. Another case, reported to the Department of Public Health of Massachusetts in 1934, was contracted on a ranch in Colorado, presumably by eating a wild rabbit (F. D. Moore, C. S. Sawyer and S. G. Blount, Jr., 1944). A case which occurred in New Hampshire in May, 1942, was traced to its point of origin at Bulls Island, off the coast of Charleston, South Carolina, according to information supplied by the State Department of Health (*in litt.*, 1944).

Quebec.—There is as yet no definite evidence that tularemia is endemic in this province. Information supplied (*in litt.*, 1944) by Dr. Jean Grégoire, Deputy of Health and Social Welfare, mentions three supposed cases of the disease. Two of these occurred some five years ago at Levis, on the St. Lawrence River facing Quebec, and were ascribed to the wearing of a white rabbit fur coat, the primary lesions being at the back of the neck. The third incident was only hearsay and cannot be relied upon. The disease was first reported from Quebec by R. B. Jenkins (1942).

No human cases of tularemia are reported thus far from Newfoundland, New Brunswick, Prince Edward Island, and Labrador. It would seem that tularemia is at present of little importance as a Public Health problem in eastern Canada.

Maine.—The only case on record at the State Department of Health and Welfare, according to Dr. R. L. Mitchell (*in litt.*, 1944), is of unusual interest. It occurred, in late 1933, in an elderly trapper who lived in a remote cabin in the woods on Kokadjo Lake, north of Moosehead Lake. It was learned that he had skinned recently two red foxes, a raccoon and some muskrats. This case, which ended fatally, called attention to the possibility of red foxes acting as reservoirs for *P. tularensis*. In the fall of 1934, some of these animals, killed in Maine several miles from Moosehead Lake, were found to be infected. Later, healthy red foxes were successfully inoculated with tularemia at the U. S. National Institute of Health. The case has been discussed by E. Francis (1937), T. L. Badger (1939), A. W. Eckstein (1941), and F. D. Moore, C. S. Sawyer and S. G. Blount, Jr. (1944). It shows that the disease is endemic in at least one area of the state. It is, however, not prevalent, as it is not known to occur in native rabbits and hares. J. H. Severaid (1942) reports that no evidence of tularemia was noted in 132 adult Maine snowshoe hares which he autopsied in 1938.

Vermont.—No case of tularemia has been reported thus far, according to information received from Dr. C. F. Dalton, of the State Department of Public Health (*in litt.*, 1944).

New Hampshire.—The earliest known case of tularemia occurred at Claremont, in 1931, when a person became ill after dressing two wild rabbits killed near by (E. Francis, 1937; T. L. Badger, 1939; A. W. Eckstein, 1941; F. D. Moore, C. S. Sawyer and S. G. Blount, Jr., 1944). According to Dr. E. W. Colby (*in litt.*, 1944), the State Department of Health has on record one supposed case in 1935 and two supposed cases in 1936, but no further information is available. Another case occurred in July, 1943, in the western portion of the

state. Its exact place of origin is not known; but as the patient was in Massachusetts a short time before he became ill, he might have acquired the disease there. All 5 cases recovered. It seems somewhat doubtful whether tularemia is truly endemic in the state.

Massachusetts.—Up to the end of 1944, the following cases of tularemia are known to have been acquired in the state, according to published data and information supplied by Dr. R. F. Feemster and Dr. V. A. Getting, of the State Department of Public Health (*in litt.*, 1939 and 1944). (1) The first case occurred in 1929 in Boston, a man becoming ill after dressing a cold-storage wild rabbit imported from Illinois and kept frozen for 30 days before being offered for sale (H. F. R. Watts, 1930). (2) In July, 1937, a 10-year-old child contracted the disease at West Falmouth, on Cape Cod, apparently through close association with a puppy that had been very ill with fever and cough for 3 days before the onset of the child's illness. Blood from both child and dog was found positive for tularemia. The source of the dog's infection was not traced (T. L. Badger, 1939). (3) Another child contracted the disease in 1938 in the Falmouth area, probably after being bitten by a tick (F. D. Moore, C. S. Sawyer and S. G. Blount, Jr., 1944). (4) In 1939, a Boston resident became ill after spending the summer in Falmouth, where she appears to have been bitten by a tick (R. E. Moss and L. R. Evans, 1940). (5) In 1941, a case in Lawrence gave a history of having shot and dressed wild rabbits shortly before becoming ill (F. D. Moore, C. S. Sawyer and S. G. Blount, Jr., 1944). (6) A case occurred in 1943 in the Falmouth district, following a tick bite (F. D. Moore, C. S. Sawyer and S. G. Blount, Jr., 1944). (7) A case at Waltham in 1943 was possibly contracted from the bite of a tick, as there was no history of contact with rabbits or other rodents (F. D. Moore, C. S. Sawyer and S. G. Blount, Jr., 1944). All these cases were followed by recovery.

Rhode Island.—A. G. Randall (1929) reported the first case of tularemia in 1929 at North Scituate, in a man who had torn up three wild rabbits found dead on his farm. A cat that ate one of the dead rabbits also contracted the disease and died; but the patient recovered. Two cases were acquired near Providence, according to information supplied by Dr. H. J. Connor (*in litt.*, 1944), of the State Department of Health, the patient recovering in both. One occurred in November, 1940, after skinning a wild rabbit (case discussed by A. W. Eckstein, 1941); the other in November, 1943, a few days after skinning and dressing several wild rabbits. This patient did not eat any of the rabbits; but his wife and son, who consumed some

of the prepared meat, suffered no ill effects (cases reported by F. D. Moore, C. S. Sawyer and S. G. Blount, Jr., 1944). The foregoing evidence points to the existence of at least one endemic focus of tularemia in the state.

Connecticut.—Dr. M. Knowlton, of the State Department of Health (*in litt.*, 1944), informs me that only 3 cases of tularemia had been recognized up to the end of 1944. The first was a fatal case, reported by E. H. Gibbons, E. L. Lamoureux and H. A. Arkless (1941). It occurred in December, 1940, at Colchester, after killing and dressing three wild rabbits. The second case, also fatal, was contracted in September, 1941, at Columbia, only 10 miles from Colchester, from the bite of a cat which was later shown by laboratory tests to have had tularemia (E. Jungherr, 1942). A third case, followed by recovery, was contracted at Stamford, in November, 1941, by handling a dressed wild rabbit, the origin of which is not known. Tularemia is probably endemic in wild life in at least one area of the state, although bacteriological investigations have failed thus far to find the causative agent in nature. In 1936–38, 342 cottontail rabbits were examined by C. F. Clancy, E. Jungherr and P. R. Sime (1940), but without attempting to determine the occurrence of tularemia. In 1940, 19 wild rabbits were examined in the Colchester area; and in 1941, 6 wild rabbits, 23 mice, 9 rats, 1 hawk, 2 grouse and 24 cats in the Columbia area, more especially for *P. tularensis* (E. Jungherr, 1942). All these animals gave negative results.

So far as the available evidence goes, New England remains relatively little affected by tularemia. No doubt some unrecognized cases occur every year, as the diagnosis of the disease is not always easy. Nevertheless, it would seem that if *P. tularensis* were prevalent in native wild life, hunters would become infected more often. As thus far only 4 main endemic foci are known, it seems worth while to take every precaution against a further spread of the disease. Of the 19 cases discussed in the foregoing summary, 3 ended in death. One of the cases was clearly acquired from handling imported game and 18 were contracted from local sources (8 through contact with wild animals; 1 from a dog; 1 from a cat bite, 4 reportedly from ticks, and 4 of doubtful or unknown origin). There are known endemic foci in Maine, Massachusetts, Rhode Island and Connecticut; possibly also in New Hampshire. Otherwise, little is known of the natural incidence of tularemia in wild life, as only the red fox in Maine was found infected thus far.

The most important endemic focus is in the Cape Cod area of

Massachusetts, where at least 4 cases have originated since 1937. It has been suggested that the disease was introduced in that area with western wild rabbits (T. L. Badger, 1939). Although difficult of proof, this theory cannot be dismissed lightly. From March to June, 1937, 33 cottontail and 90 jack rabbits, imported from mid-western states, were released at Harwich, Truro, Wellfleet, Barnstable, Falmouth, Provincetown, and Dennis. In the Falmouth area 8 cottontail rabbits were released, and it seems noteworthy that 4 months later a case of tularemia appeared in the town of Falmouth, where the disease had not been known before. Moreover, D. L. Belding and B. Merrill (1941) demonstrated *P. tularensis* in a cottontail rabbit imported in April, 1940, from Missouri to Massachusetts, and again in November, 1940, in a rabbit from Arkansas. Since 1937, 24,689 imported rabbits have been liberated in various parts of Massachusetts for the benefit of sportsmen. This practice endangers not only human welfare, but also the health of native wild life. Fortunately, it has been discontinued in recent years. Certification at the shipping source that the rabbits are from tularemia-free districts does not guarantee freedom from the disease.

New York.—The first case recognized was non-fatal and occurred in 1927 in the steward of a club in Buffalo (J. A. Murphy, 1928). In December, 1928, another case was contracted in New York City, following the cleaning of rabbits bought in a store (Anonymous, 1928*b*). In later years, according to published accounts and information kindly supplied by Dr. F. C. Goble, Pathologist of the State Bureau of Game (*in litt.*, 1945), the majority of cases occurred in New York City, being attributed to infection from market rabbits imported from the Middle West (42 cases between 1929 and 1942, 3 of them fatal). In addition, Dr. Goble lists the following upstate cases by years: 0 in 1929; 1 in 1930 (supposedly from deer); 1 in 1931 (source questionable); 6 in 1932 (from imported market rabbits); 0 in 1933; 1 in 1934 (from a Kansas rabbit); 1 in 1935 (from a Missouri rabbit); 3 in 1936 (2 from Maryland rabbits; 1 in Ontario Co. from a rabbit, the source questionable); 0 in 1937; 2 in 1938 (1 from an Illinois rabbit; 1 from a rabbit in Wayne Co.); 6 in 1939 (2 from muskrats in Oswego Co.; 1 from rabbit in Jefferson Co.; 1 from rabbit on Long Island; 1 from fox in St. Lawrence Co.; 1 supposedly from deer-fly in Broome Co.); 0 in 1940; 1 in 1941 (at Rochester, from a Missouri rabbit); and 2 in 1942 (from muskrats in Wayne Co.). The case of 1930 is particularly interesting, as it is believed to have been contracted from a wild deer shot at Willsboro. That this animal was actually the source of the infection is perhaps

open to question, as the patient was seemingly in the habit of skinning various animals. There is as yet no other evidence of native American deer being infected with tularemia. Although most of the cases were attributed to out-of-state rabbits, it is evident that the disease is endemic in the wild fauna of at least six counties (Wayne, Oswego, Jefferson, Suffolk, St. Lawrence, and Broome), where human cases have been traced to contact with local wild rabbit, muskrat, and fox. The most instructive cases occurred in November, 1943, when two persons became ill after handling wild rabbits shot near Quogue, Suffolk Co. Several people who ate cooked meat of the infected rabbits, were not affected (Anonymous, 1944). Nevertheless, tularemia is at present of relatively little public health importance in the state and does not seem to be on the increase.[10]

New Jersey.—The first case of tularemia was recognized in November, 1927, in a resident of Wildwood, Cape May Co., together with another probable case, both reportedly contracted from local wild rabbits (Anonymous, 1928*a;* R. A. Kilduffe and C. F. Dandois, 1928). In succeeding years the number of cases was as follows, according to the annual Reports of the State Department of Health: 0 in 1928, 0 in 1929, 1 in 1930, 1 in 1931, 3 in 1932, 1 in 1933, 1 in 1934, 4 in 1935, 5 in 1936, 5 in 1937, 8 in 1938, 4 in 1939, 2 in 1940, and 1 in 1941, a total of 37 in 15 years. Tularemia is still a rare disease in the state, although it appears to be endemic in wild life in Cumberland Co., Cape May Co., and Monmouth Co. C. A. Pons, S. C. DePons and W. A. Sweet (1938) state that a case occurred in Monmouth Co. in May, 1936, in a man who had handled a wild rabbit caught by the family dog.

Pennsylvania.—The first known cases of tularemia were nonfatal and occurred at Pittsburgh, in 1925, in two market men who had handled imported dead rabbits. In one case the infected rabbits came from Ohio (W. W. G. Maclachlan, W. J. Fetter and A. R. Cratty, 1926). It has been recognized since that the disease is common and is, moreover, endemic in the wild life of certain sections. H. L. Baer (1934) states that in Pittsburgh alone there were

[10] The following articles of the appended bibliography deal with cases of tularemia in New York: Anonymous, 1928*b*, 1928*c*, 1928*d*, 1928*e*, 1931*a*, 1931*b*, 1931*c*, 1931*d*, 1931*e*, 1932*a*, 1932*b*, 1932*c*, 1932*d*, 1932*e*, 1932*f*, 1933*a*, 1933*d*, 1939*b*, 1939*c*, 1939*d*, 1940, 1942*a*, 1942*b*, 1944; J. G. Dwyer, 1933; Ruth Gilbert and Marion B. Coleman, 1932; S. M. Kaufman, 1931; E. R. Maillard, 1943; and J. A. Murphy, 1928*a*, 1928*b*.

21 cases in 1932 and 69 in 1933; 16 of the 1933 cases being caused by local wild rabbits, while the remainder were traced to dead rabbits imported from Illinois, Kansas, and Missouri. On the other hand, J. L. Farmer and G. G. Duncan (1938) report that, in the period 1924–1935, 91 cases occurred in the state, of which 25 were acquired from wild rabbits killed in the western counties (mostly in Lancaster, Adams, Franklin, and Fayette Counties). A rather unusual case occurred in 1939 near Burgettstown in a man who was pecked on a finger by a wounded chicken hawk that had been feeding on a dead rabbit (J. M. Johnston, 1940).[11]

Delaware.—Not much is known as yet of the occurrence of tularemia in this state. According to T. G. Hull (1941, p. 267), the first case occurred in 1930. Two other cases, reported by L. B. Flinn (1935), were contracted near Wilmington from the same wild rabbit rescued from a dog while hunting. The hunter had noticed that the rabbit had sores behind the ears.

Maryland.—Tularemia is prevalent in this state, where in recent years it is being most carefully studied by Dr. C. H. Halliday, Epidemiologist of the State Department of Health. In addition to his publications on the subject, Dr. Halliday (*in litt.*, 1945) has kindly given me much useful information, completing the annual Reports of his Department. The first reported case was fatal and was contracted in some obscure way at Mount Rainier in 1923 (J. R. Verbrycke, Jr., 1924). Two other, non-fatal cases occurred in 1925, at Girdle Tree, from handling a local wild rabbit (J. B. Flick, 1926). Many cases have been recognized since, J. C. Ransmeier and C. L. Ewing (1941) studying 87 non-fatal and 10 fatal cases in the period 1928–1940, in Baltimore alone. Dr. Halliday has supplemented the data he published (1936*a*, 1938) with some unpublished information, giving the following yearly figures. For the entire state: 11 in 1928 (5 of them in Baltimore), 23 in 1929 (10 in Baltimore), 15 in 1930 (8 in Baltimore), 20 in 1931 (10 in Baltimore), 26 in 1932 (11 in Baltimore), 25 in 1933 (11 in Baltimore), 33 in 1934 (17 in Baltimore), 30 in 1935 (13 in Baltimore), 31 in 1936 (14 in Balti-

[11] Cases of tularemia from Pennsylvania are discussed in the following papers of the appended bibliography: H. L. Baer, 1933, 1934; J. L. Farmer and G. G. Duncan, 1938; G. H. Fetterman and H. Lerner, 1936; E. Francis and G. R. Callender, 1927; J. M. Johnston, 1940; W. W. G. Maclachlan, W. J. Fetter and A. R. Cratty, 1926; H. H. Permar and W. W. G. Maclachlan, 1931; and H. H. Permar and G. C. Weil, 1926.

more), 23 in 1937 (13 in Baltimore), 32 in 1938 (13 in Baltimore), 49 in 1939 (31 in Baltimore), 22 in 1940 (9 in Baltimore), 16 in 1941 (1 in Baltimore), 12 in 1942 (0 in Baltimore), 16 in 1943 (1 in Baltimore), and at least 14 in 1944 (0 in Baltimore). Of the 398 cases reported during the past 17 years, 35 were fatal and 167 occurred in the city of Baltimore. All counties except two (Cecil Co. and Garrett Co.) have had cases, mostly contracted from handling local wild rabbits. One case, in 1935, was attributed to the bite of *Dermacentor variabilis* and another is said to have been contracted from one of the biting flies. Several of the city cases were traced to imported rabbits bought in the market.[12]

Ohio.—Tularemia is very prevalent and widespread, occurring as well among people in the large cities (Cincinnati, Dayton, Cleveland) who handle dead wild rabbits offered for sale, as among hunters and farmers in rural districts. Although there seems to be some reason to believe that an unrecognized case had occurred as early as 1908, the first definite evidence was a case contracted in Cincinnati in 1913 (D. T. Vail, Sr., 1914). This was also the first case recognized in our territory and, moreover, the first human case on record to be diagnosed by bacteriological methods. The second case occurred in 1916, also in Cincinnati (F. W. Lamb, 1917).[13] Cases have become so numerous since, that it seems pointless to discuss them in detail. Up to the close of 1929, W. M. Simpson (1930) had recognized 60 cases in and near Dayton alone. E. Francis (1942*b*) states that 1,109 cases had been reported for the entire state up to 1942, only Illinois having more cases on record.[14] Although from the available data it is not possible to determine the proportion of rural and city cases, there is sufficient evidence that there are several endemic foci of tularemia in the wild fauna. For

[12] The following titles in the appended bibliography deal with Maryland cases: Anonymous, 1932*g*; A. Bernstein, 1935; D. P. Bowe and D. C. Wakeman, 1936; J. B. Flick, 1926; E. Francis, 1942; L. P. Gundry and C. G. Warner, 1934; C. H. Halliday, 1936*a* and 1938; L. Hamman, 1933; E. L. LeCompte, 1941; J. C. Ransmeier and C. L. Ewing, 1941; J. C. Ransmeier and I. G. Schaub, 1941; J. R. Verbrycke, Jr., 1924; F. C. Warring and V. F. Cullen, 1936; A. Weinzirl and C. H. Halliday, 1937; and M. M. Whitehurst, 1940.

[13] A case observed in Cincinnati in 1914 (R. Sattler, 1915) was contracted in a nearby county in Indiana.

[14] L. E. Hicks (1942) gives a much larger number of Ohio cases: 1,275 for the period 1930 to 1941, 112 of them fatal.

instance, a case was contracted in 1928 near Dayton by skinning a woodchuck (*Marmota monax*) (W. M. Simpson, 1930; the animal is here called *Marmota flaviventer,* a name properly applied to the Western species, which does not occur in Ohio). A non-fatal case was acquired in 1921 near Tippecanoe by hunting rabbits (W. L. Brosius, 1928). In November, 1940, a fatal case occurred at Alliance after cutting up a wild rabbit found dead. Three dogs, who ate some of the raw meat of this rabbit, also became ill, but recovered (L. F. Ey and R. E. Daniels, 1941).[15] F. W. Lamb (1917) states that wild rabbits were dying in large numbers in the country around Cincinnati in 1914 and that W. B. Wherry isolated *Pasteurella tularensis* from some of the dying animals. In recent years, the yearly recurrence of tularemia in cottontails has been generally recognized in Ohio, so much so that the disease is now accepted as one of the major hazards of rabbit hunting. In the course of field work by the Ohio Wildlife Research Station, evidence of tularemia was present in most cottontails found dead or dying during September, October, and November, but none was detected later, although large numbers of rabbits were examined during December and January (L. E. Hicks, 1942).

West Virginia.—The first known cases of tularemia, all followed by recovery, were contracted at Huntington in 1923 and 1924, from handling local wild rabbits (F. C. Hodges, 1925). At Charleston, a fatal case followed the dressing of rabbits in a store, while a second case was acquired from a native wild rabbit (B. S. Preston, 1931*a* and 1931*b*). West Virginia cases are also discussed by R. D. Roller (1931) and by F. E. Brammer (1931), the latter stating that there had been only 7 cases in the state up to May, 1929.

Equine Encephalomyelitis and St. Louis Encephalitis.—A

[15] The following papers, listed in the appended bibliography, cover cases of tularemia contracted in Ohio: F. Berry, 1928; W. L. Brosius, 1928; I. I. Cramer, 1938; L. F. Ey and R. E. Daniels, 1941; L. Foshay, 1932*a*, 1932*b*, 1933, 1934*a*, 1934*b*, 1935, 1937, 1938, 1940; E. Francis, 1942; E. Francis and G. R. Callender, 1927; S. O. Freedlander and M. H. Grossberg, 1927; J. O. Haizlip and A. E. O'Neil, 1931; K. V. Kitzmiller, 1939; F. W. Lamb, 1917; E. W. Netherton, 1927; M. Oosting, 1939; C. C. Pinkerton and R. H. Markwith, 1927; W. M. Simpson, 1928*a*, 1928*b*, 1928*c*, 1928*d*, 1928*e*, 1928*f*, 1929*a*, 1929*b*, 1930, 1931, 1933; L. L. Terry and H. S. Reichle, 1940; D. T. Vail, Sr., 1914; D. T. Vail, Jr., 1926, 1929, 1930; W. B. Wherry, 1914; W. B. Wherry and B. H. Lamb, 1924*a*; and W. J. Zeiter, 1939.

brief mention should be made of these diseases because of the possibility that ticks might play a rôle in their epidemiology.

Equine encephalomyelitis is a disease of great economic importance among horses and mules in the United States and Canada. It is caused by a filtrable virus, which seems to occur in a "western" and an "eastern" type, differing in immunology and virulence. The eastern type is known in the United States only east of the Appalachian mountain range. Both the western and the eastern types can be transmitted to man, in whom they cause a severe and sometimes fatal illness. In our territory, human cases occurred in Massachusetts in 1938. It is well established that several species of Culicine mosquitoes of the genus *Aëdes* transmit the disease experimentally and these insects are probably the usual vectors to equines and man. J. T. Syverton and G. P. Berry (1936, 1937, 1941) have shown, however, that under experimental conditions the western type of the disease can also be transmitted among guinea pigs by the bite of the western wood tick, *Dermacentor venustus,* in which the virus is inherited for two successive generations. Whether ticks are of practical importance for natural transmission is as yet unknown. Attempts to transmit the western type by the eastern wood tick, *Dermacentor variabilis,* were unsuccessful (A. W. Grundmann, C. M. Kitselman, L. M. Roderick and R. C. Smith, 1943).

St. Louis encephalitis is in many respects similar to the foregoing disease, being likewise caused by a filtrable virus. At present it is known chiefly from human cases, although the virus has also been traced in horses. Cases strictly referable to this disease are as yet unknown from our territory. Like equine encephalomyelitis, it has been transmitted experimentally by several species of mosquitoes and its natural occurrence in *Culex tarsalis* has been demonstrated. R. J. Blattner and F. M. Heys (1941, 1944), in Missouri, were able to transmit the virus of St. Louis encephalitis by *Dermacentor variabilis* in small laboratory animals. They also showed that the virus is hereditary in the tick, an infected female transmitting it to her offspring and, through all stages of the second generation, to the third generation. They do not believe, however, that *D. variabilis* is the vector responsible in the known human cases; but they suggest that the tick may play a part in the natural epidemiology of the disease by maintaining the virus.

2. *Ticks and Domestic Animals*

In our territory the larger domestic animals, cattle, horses, mules, and donkeys, are seldom attacked by ticks, particularly in the

northern areas. Apart from infestations on freshly imported animals, there are only a few records of *Dermacentor erraticus* (both the typical form and the var. *albipictus*) being taken apparently off local cattle in Pennsylvania, Nova Scotia, and New Brunswick. R. H. Riley and C. H. Halliday found *Dermacentor variabilis* on horses and cattle in Maryland in the course of a tick survey during the summer of 1931.[16] *Ixodes cookei* was taken on one occasion off domestic pig in New York State. No ticks seem to occur in our territory on sheep and goats. The domestic cat also is relatively free from them, there being only a few records of *Ixodes cookei* from this host. The domestic dog, on the other hand, is often attacked by *Dermacentor variabilis* and more rarely by *Ixodes cookei* and a few other species. In addition, the introduced European dog tick, *Rhipicephalus sanguineus,* has become a serious household pest in certain localities and seems to be spreading steadily. In North America it seems to be restricted thus far to dogs, although in the Old World it has a very wide range of hosts. Our domestic birds are relatively free of ticks. There is no reliable evidence that the argasid pigeon tick occurs in our territory; while the fowl tick, *Argas persicus,* has been recorded only once from Maryland. The two species of *Haemaphysalis* often found on our wild birds, *H. leporis-palustris* and *H. chordeilis,* have been taken occasionally on domestic turkey.

The scarcity of ticks on domestic mammals and birds explains why most of these animals are practically free from tick-borne diseases in our territory. Such diseases as Texas fever (piroplasmosis of cattle), canine piroplasmosis, anaplasmosis of cattle, and tick-fever (spirochetosis) of fowl, which occur in some other parts of North America, are unknown with us.

The chief animal reservoirs of the North American types of Rocky Mountain spotted fever appear to be wild mammals (particularly rodents) and birds. Sheep and dogs can acquire the disease, although it does not seem to do them much harm. These animals may be involved in perpetuating it or in introducing it into new territory, particularly in view of the hereditary transmission of the rickettsiae to part of the offspring of an infected female tick. Interstate transportation of dogs from areas known to be foci of the disease should be prohibited, at least during the tick season. It

[16] From an unpublished report on rickettsial diseases read in 1932 before the Western Branch, American Public Health Association.

should also be noted that, in southern Europe, the dog is a frequent reservoir of an eruptive human fever, known as "fièvre boutonneuse" or "Marseilles fever," and now generally regarded as a type of Rocky Mountain spotted fever. This European disease is regularly transmitted from dog to dog and to man by the brown dog tick, *Rhipicephalus sanguineus*. It is not impossible, therefore, that in localities where *R. sanguineus* has become well established some American strain of Rocky Mountain spotted fever may eventually become an endemic disease of dogs, which then would be a potential source of human infection.

Dogs and cats are not only highly susceptible to tularemia, which they usually acquire from catching or eating sick rabbits, but they have also communicated the disease to humans in a few cases. L. F. Ey and R. E. Daniels (1941), in connection with a human case in Ohio, report that three dogs which had eaten a wild rabbit, became ill with tularemia. R. E. Green and E. M. Wade (1928*a*) infected two cats with *Pasteurella tularensis* by feeding them infected meat; one of the animals developed a fatal illness, while the disease was very mild in the other. No human case of tularemia has thus far been traced to the introduced domestic rabbit (*Oryctolagus cuniculus* Linnaeus) in our territory; but two cases appear to have been acquired from this source in Michigan and New Mexico (W. L. Jellison and R. R. Parker, 1945).

Argas persicus is a serious pest of poultry, as it weakens the birds through loss of blood and rest, the ticks attacking at night and remaining hidden in the cracks of the walls and floor of the chicken houses during the day. It is the vector of avian spirochetosis, a grave disease of poultry in the Old World and tropical America. It is also said to transmit or produce a type of fowl paralysis in Texas and Florida (J. C. Brown and J. C. Cross, 1941; M. W. Emmel, 1945). In parts of Asia Minor it attacks man commonly and transmits there a form of human spirochetosis or tick-borne relapsing fever. Thus far this tick has been reported in our territory only from one locality in Maryland.

3. *Ticks and Wild Life*

Two main aspects of the host-parasite relations between ticks and the wild fauna deserve our attention. It is, of course, important to know which wild mammals and birds may serve as natural reservoirs of tick-borne human diseases or act as natural breeding hosts for the species of ticks that stray onto man and domestic animals. However, we should also be concerned with ticks as they affect the well-

being of wild life itself, if we are at all interested in its conservation either for purely recreational purposes or for profit as game and fur animals.

It is now recognized that the population of many mammals and birds in North America varies widely from season to season. These natural fluctuations occur in a regular periodic cycle, the peaks of greatest abundance being some 7 to 14 years apart (9 or 10 years on the average), although not necessarily occurring at the same time for all species or in all areas. The factors underlying these cycles are evidently complex and as yet the subject of much speculation. Nevertheless it is fairly certain that the large-scale dying off following the peak years is greatly hastened, if not actually caused, by epizoötic diseases, among which tularemia may be of outstanding importance.

Elsewhere in this paper I have listed our species of ticks according to their mammal and bird hosts. Some of these records, however, are based on stray occurrences. In the discussion of the several species, I have attempted to determine their true *breeding hosts* in nature, that is, the hosts without which the species might be unable to survive. It seems reasonable to believe that the great changes brought about in the American wild fauna, since the arrival of Europeans, have resulted in the disappearance or greater scarcity of certain species of ticks in our territory, as well as in the introduction or greater prevalence of others. At present most of our ticks are too rare to be of much consequence, either as pests or as disease vectors. Only *Ixodes cookei, I. scapularis, Dermacentor variabilis, D. erraticus* (and its var. *albipictus*), *Haemaphysalis leporis-palustris,* and *H. chordeilis* are occasionally found in abundance on their native hosts and might therefore be at times effective disease vectors.

Mammals.—Deer (generally distributed), moose (in Canada, Maine, and northern New York only), and caribou (in Canada and Maine only) are our remaining large game. Ticks are usually not abundant on these animals. There is no record of their occurrence on caribou. Moose sometimes harbor fair numbers of *Dermacentor erraticus* var. *albipictus,* as discussed under that tick. Deer is our usual host of typical *Dermacentor erraticus* and of *Ixodes scapularis,* and, in addition, one of our few native hosts for the adults of *Dermacentor variabilis.* These large animals are not definitely known as reservoirs of either Rocky Mountain spotted fever or tularemia. A human case of tularemia was claimed to have been acquired at Willsboro, New York, from handling a dead wild deer (R. Gilbert and

M. B. Coleman, 1932). But the evidence is far from conclusive, particularly as there are no other reports of deer carrying tularemia elsewhere in North America. In Minnesota and southern Ontario, moose suffer from a peculiar disease resulting in death in some cases. G. I. Wallace, A. R. Cahn, and L. J. Thomas (1933) have presented evidence which strongly points to this disease being caused by a bacterium, *Klebsiella paralytica*. They cultured this organism repeatedly from the intestinal contents of *Dermacentor erraticus* var. *albipictus* taken off diseased moose. Inoculated into experimental animals, it produced symptoms similar to those of the moose disease. The same symptoms also appeared in guinea-pigs and rabbits exposed to the bites of *D. e.* var. *albipictus* taken from diseased moose.

Fur animals commonly trapped in our territory include the native Carnivora (gray fox, red fox, mink, skunk, weasel, raccoon, lynx, otter, etc.), beaver and muskrat. Their importance in the epidemiology of tularemia was ably discussed, particularly as it affects western Canada, in a recent article by J. D. Brown (1944). Laboratory experiments have shown that gray fox, red fox, beaver and muskrat are highly susceptible to the disease (R. D. Lillie and E. Francis, 1937; R. G. Green, E. M. Wade, and E. T. Dewey, 1929). The natural occurrence of *Pasteurella tularensis* was reported in beaver by J. W. Scott (1940) and by E. R. Quortrup and R. L. Sudheimer (1944), in gray fox by C. F. Schlotthauer, C. Olson, and L. Thompson (1934), in skunk by W. L. Jellison, G. M. Kohls, W. J. Butler, and J. A. Weaver (1942), and in muskrat by R. R. Parker (in J. H. Brown, 1944) and by E. R. Quortrup and R. L. Sudheimer (1944). In our territory, however, natural infection was demonstrated thus far only for the red fox in the Moosehead Lake area of Maine. Some human cases in Canada appear to have been contracted from trapped muskrats. Probably fur animals do not contract tularemia from tick bites. Beaver and muskrat may be contaminated by infected water and the Carnivora by catching or eating diseased rabbits, hares, and smaller rodents. In any case, our fur animals are relatively free from ticks, none having been taken thus far on our muskrat and beaver. *Ixodes cookei* is found rather frequently on wild Carnivora and is one of the ticks which occasionally stray onto man, particularly in Maine and Canada. No ticks have as yet been taken on bear.

Wild rabbits and hares (Lagomorpha) and their ticks are one of our most serious health problems, these animals being often infected with tularemia. As many of them are handled every year by hunters, farmers, marketmen, and consumers, they are our main

source of human infection. All Lagomorpha are susceptible to the disease (W. B. Wherry and B. H. Lamb, 1914*d;* E. Francis, 1925; W. L. Jellison and R. R. Parker, 1945). The snowshoe hare (*Lepus americanus*), the jack rabbit (races of *Lepus californicus*), and the cottontail rabbit (*Sylvilagus floridanus*) have all been found infected in nature. Certain species, however, are more important natural reservoirs than others. J. F. Bell and R. G. Green (1939), in Minnesota, found that the snowshoe hare often has chronic tularemia of a rather mild type, many animals recovering from the disease. Probably few human cases are acquired from this source. On the other hand, from the point of view of the permanence of a focus, the snowshoe hare might be a more effective wild reservoir than the cottontail, which, although very susceptible, usually dies from the disease in nature (R. G. Green, 1943). J. F. Bell and W. S. Chalgren (1943) go so far as to state that, as "chronic tularemia occurs rarely if at all in cottontails, it is quite unlikely that animals of this species will introduce tularemia into an area stocked with them in winter, because the principal vectors (ticks) are not present in any numbers at that season, and if several days are consumed in handling the animals, those few which may be infected will die and be discarded." All species of wild Lagomorpha in North America are subject to periodic epizoötics with great mortality, apparently caused by several distinct diseases. While *Pasteurella tularensis* is one of the chief causative agents of these epizoötics in cottontails, it is rather doubtful whether this is true for the snowshoe hare.

There is dire need for further investigation in our territory of the complex relations between human tularemia, the disease in wild rabbits and hares, and the incidence of ticks. The available evidence is extremely scanty and obscured by the difficulty of distinguishing between cases acquired from local wild animals and those caused by handling game imported from elsewhere. In most areas we can only infer the presence of enzoötic or epizoötic tularemia from human cases being contracted by handling local animals. Some valuable observations were made particularly by the Ohio Wildlife Research Station. It was found that in Ohio tularemia prevails among the cottontails only during September, October, and November; it was not found in rabbits observed or caught during December and January (L. E. Hicks, 1942). Some years earlier, W. M. Simpson (1929, p. 41) stated that 6 rabbits found in the woods near Dayton, Ohio, had died of tularemia. E. L. Wickliff (1933) did not detect the disease in 50 rabbits caught during November and December, 1930, in 16 counties of southern and southwestern Ohio. In

1931, however, of 105 rabbits examined from 51 of the 88 Ohio counties, 8 showed symptoms; but only 2 proved positive for tularemia by laboratory animal tests (1 from Noble Co. and 1 from Gallia Co.). After a most careful study of the rabbit-tularemia problem in North America, W. L. Jellison and R. R. Parker (1945) reach the conclusion that the cottontails (species of *Sylvilagus*), and particularly the eastern species (races of *Sylvilagus floridanus*) are the direct source of over seventy per cent of all human cases. They point out that the area of greatest incidence of the human disease coincides with the territory where *Sylvilagus* is the only genus of wild Lagomorpha present.

Up to now the natural occurrence of Rocky Mountain spotted fever in wild Lagomorpha has not been demonstrated directly; but it can be inferred from the occurrence of spotted fever rickettsiae in the rabbit tick, *Haemaphysalis leporis-palustris*. This species of tick has no other known mammalian breeding host, although it is often found on birds. We do not know what the course of this disease is in the Lagomorpha and whether or not the snowshoe hare and the cottontail react differently to it.

Among the Lagomorpha, tularemia and probably also Rocky Mountain spotted fever are transmitted almost exclusively by *Haemaphysalis leporis-palustris;* although the possibility should be investigated that *Ixodes dentatus* may sometimes act as the vector. Rabbits and hares are the only efficient breeding hosts of *Haemaphysalis leporis-palustris* and the snowshoe hare (*Lepus americanus*) seems to be the preferred host. As this tick is not known to attack man, it is not responsible for human cases. R. G. Green, C. A. Evans, and C. L. Larson (1943) made a most careful study of the rabbit tick population in an area of Minnesota about 6.5 square miles in extent. They found that smaller mammals, such as meadow mice, deer mice, jumping mice and red-backed mice, were of practically no significance as hosts of *H. leporis-palustris*. Song birds also appeared to be unimportant in maintaining the tick population, although the relatively few specimens these birds carry may spread the tick to new areas. Ruffed grouse, however, are an important host, although rarely as heavily attacked as the snowshoe hare. Snowshoe hares carry an average of 4 times as many ticks as do cottontail rabbits and about twice as many ticks as do ruffed grouse. In September–October, 1932, 8 cottontails carried an average each of 425 ticks, with a maximum of 1,166; whereas 19 snowshoe hares carried an average each of 1,537, with a maximum of 4,739. Ten ruffed grouse examined about that time had an average

each of 905 ticks, with a maximum of 1,546. Such heavy tick infestation throughout the summer months must weaken the host through the mere loss of blood. It has been suggested that an unusual increase in the tick population, induced by particularly favorable weather, may be the prime cause of the heavy mortality which sometimes overtakes snowshoe hares and grouse in Wisconsin and Minnesota (W. T. Cox, 1936). Perhaps it may cause in nature a secondary anemia similar to that produced in domestic rabbits (W. J. Jellison and G. M. Kohls, 1938) by heavy experimental infestation with *Dermacentor venustus*. R. H. Smith and E. L. Cheatum (1944) attribute an unusually high mortality among cottontails on Fishers Island, New York (in Long Island Sound), to heavy infestation with *Ixodes dentatus* and *Haemaphysalis leporis-palustris*. They believe death was caused either by tick-induced anemia or by bacterial infections at the points of tick attachment. Counts on 34 rabbits showed a total of 1,377 ticks (661 adults and 716 nymphs). Of the 571 specimens identified, 397 were *I. dentatus* and 174 *H. leporis-palustris*.

The chief importance of *Haemaphysalis leporis-palustris* lies in its relation to the maintenance and spread of Rocky Mountain spotted fever and tularemia in nature. According to R. R. Parker (1938), it consistently carries an extremely mild type of Rocky Mountain spotted fever and the rickettsia has been demonstrated in it far north of any known occurrence of the disease in man and far beyond the northern distributional limits of *Dermacentor venustus* and *D. variabilis*. The rickettsia can therefore persist in it independently of the two species of *Dermacentor*. In the western United States the early stages of *D. venustus* occur on rabbits, which are then a medium through which infection could be passed back and forth between this *Dermacentor* and *H. leporis-palustris*. The extent to which the larvae and nymphs of *D. variabilis* infest rabbits and hares in eastern North America is imperfectly known, the problem needing further investigation in our territory.

Tick bites are perhaps sometimes the portals of entry for various secondary skin infections of rabbits, although the available evidence is not conclusive. J. F. Bell and W. S. Chalgren (1943) observed wild cottontails in Pennsylvania with large abscesses, mostly filled with thick white pus, from which pure cultures of staphylococci were consistently isolated. Some of their observations suggested that ticks (especially *Ixodes dentatus*) played an essential mechanical rôle in these infections.

Most ticks found on our smaller mammals, of the orders

Rodentia, Insectivora, and Marsupialia, are restricted at all stages to this type of host, hence of no practical importance. In addition, however, some rodents are the chief hosts of the larvae and nymphs of *Dermacentor variabilis.* Outstanding among these is the vole or meadow mouse, *Microtus pennsylvanicus,* the abundance of which is often closely correlated with the prevalence of *D. variabilis* in a given locality. Nothing much is known as yet concerning the natural occurrence of tick-borne diseases in our small mammals. W. M. Simpson (1930) reported a case of tularemia acquired from skinning a woodchuck in Ohio. A human case in Ontario was attributed to handling a mouse (J. B. Cramer, 1931). No direct examination of small rodents for the presence of tularemia seems to have been made anywhere in our territory.

Birds.—Ruffed grouse (*Bonasa umbellus*, of several races) and spruce grouse (*Canachites canadensis;* in the northern sections only) are at present our most interesting native game birds. They are often attacked by the bird tick, *Haemaphysalis chordeilis,* and, in some areas at any rate, occasionally by the rabbit tick, *H. leporis-palustris.* Both ticks have been taken off ruffed grouse in our territory. However, I have seen myself from this host all stages (larvae, nymphs, and adults) of *H. chordeilis*, but only larvae and nymphs of *H. leporis-palustris.* On the other hand, I have never seen any of the stages of *H. chordeilis* from rabbits or hares in our territory. There are a few published records to the contrary, but I am inclined to regard them as erroneous.

It is at present impossible to gain a clear idea of the exact relations in nature between the two species of *Haemaphysalis* and their bird and mammal hosts. Published accounts give the impression that certain investigators regarded all their ticks on grouse as *H. leporis-palustris,* while others called them all *H. chordeilis* (= *cinnabarina*). In some cases they seem to have relied on the identification by a specialist of a small part only of the tick populations. Some writers admit that only adult ticks were named, the larvae and nymphs being neglected. C. H. D. Clarke (1936), in Ontario, called all his grouse ticks *H. chordeilis,* although recognizing that some larvae and nymphs might have been *H. leporis-palustris.* In Minnesota, R. G. Green, C. A. Evans and C. L. Larson (1943) referred all ticks found on rabbits, hares and grouse to *H. leporis-palustris;* but most probably some of the grouse ticks were *H. chordeilis.* No essential progress can be expected on the rabbit-grouse-tick problem until all ticks, at all stages, taken off the hosts are correctly identified and records kept of their numbers. If such

investigations were carried out systematically over a number of years in different sections, some interesting questions might be answered, such as: the relative abundance of the two species of *Haemaphysalis* at their several stages on snowshoe hare, cottontail rabbits and ruffed grouse; the correlation between the number of ticks of each species and the fluctuations of the host population as well as the incidence of tick-borne diseases; and the seasonal prevalence at each stage of the two species on different hosts. The specific identification of our *Haemaphysalis* is by no means difficult at all stages with the keys given in the present paper. It should, however, be done in the laboratory, not in the field, and with the proper magnification. As this type of tick tends to drop off after the host is dead, it is essential that the mammal or bird be put in a paper or cotton bag as soon as possible after death. The whole matter may be of some practical importance in connection with tularemia. If it were shown that *H. chordeilis* scarcely ever or never attacks rabbits and hares, but is at the same time the dominant tick on grouse, these game birds might be relatively negligible as natural reservoirs of tularemia and offer very little danger to hunters. Infection of grouse with the disease would then be exceptional and due to the straying onto a bird of early stages of *H. leporis-palustris* previously infected on a rabbit or hare.

With the fragmentary information available, it can only be stated that *H. chordeilis* is the tick most commonly found on ruffed grouse, although the incidence differs greatly from one area to another. Dr. Frans C. Goble (*in litt.*, 1945) sent me some pertinent data based on accurate counts of ticks in different parts of New York State. *H. chordeilis* occurred on 26 per cent of juvenile grouse taken in the Adirondacks during June, July, and August. The greatest number found on a bird was 300, the average 38. On the juvenile grouse taken in the rest of the state during the same season, ticks were found on 6 per cent of 510 birds; the maximum was 26, the average 5. Dr. Goble is inclined to believe that they were more abundant on grouse in the Adirondack region because the general environment or ecological conditions are unusually favorable to ticks in this area.[17]

The grouse population also varies widely from year to year,

[17] The information sent by Dr. Goble is part of a chapter by himself and Dr. R. P. Levine, on "Parasitism and Disease in Ruffed Grouse," to be included in a book reporting the New York State Grouse Investigation. It is given here with Dr. Goble's permission.

rising and falling in a periodic cycle. It has been suggested that several diseases, possibly including tularemia, are involved in the mass dying-off which concludes the cycle. R. G. Green and E. M. Wade (1928) found ruffed grouse very susceptible to experimental tularemia, always with fatal results. Later, R. G. Green and J. E. Shillinger (1932 and 1933) reported isolating *Pasteurella tularensis* from a ruffed grouse shot in St. Louis Co., Minnesota, and also found one sharp-tailed grouse (*Pedioecetes phasianellus* Linné) infected in nature. R. R. Parker, C. B. Philip, and G. E. Davis (1932), who demonstrated tularemia in wild sage grouse or sage hen (*Centrocercus urophasianus* Bonaparte) in Montana, also found *Haemaphysalis chordeilis* naturally infected with *Pasteurella tularensis.* It is nevertheless doubtful that so-called "grouse disease" is tularemia (A. A. Allen, 1928). C. H. D. Clarke (1936) concluded from his study of mass dying-off of grouse in Ontario, in 1933–1934, that it was due to a blood parasite, *Leucocytozoon bonasae,* not known to be transmitted by ticks. The relations in nature between the strains of tularemia attacking mammals and game birds, respectively, appear to be complex. Endemic tularemia often occurs in nature with low virulence, R. G. Green and J. E. Shillinger being of the opinion that tularemia adapted to mammals has low virulence for birds, while tularemia adapted to birds has low virulence for mammals.[18]

Quail (*Colinus virginianus*) is susceptible to tularemia and was found naturally infected near Minneapolis, Minnesota, in 1929 (R. G. Green and E. M. Wade, 1929). On the other hand, the imported domestic pigeon and ring-necked pheasant are relatively resistant to this disease (R. G. Green and E. M. Wade, 1928*b*, 1928*c*, 1929; R. G. Green, E. M. Wade, and W. Kelley, 1928). R. R. Parker (1934) has shown that among our wild ducks, the green-winged teal (*Nettion carolinense* Gmelin) and the mallard (*Anas platyrhynchos* Linnaeus) are susceptible. It seems fairly certain, however, that the epizoötics occurring sometimes among ducks are not due to tularemia. Ticks are very rare on ducks and none has been taken on this

[18] The tick mentioned by W. Brewster (1925) as attacking young *Bonasa umbellus* in the Lake Umbagog region of Maine may have been either *Haemaphysalis leporis-palustris* or *H. chordeilis.* He states that it often kills them "probably by piercing their tender skulls." No other observer has confirmed this and it seems improbable in view of the structure and size of the hypostome of *Haemaphysalis.*

type of host in our territory. These birds might conceivably contract the disease directly from infected water. Ticks are also scarcely ever found on our wading birds and birds of prey.

The Hungarian partridge (*Perdix perdix* Linnaeus), introduced as a game bird in certain areas, is very susceptible to experimental tularemia (R. G. Green and E. M. Wade, 1928*b*). It has not yet been found naturally infected. No ticks have been recorded from this bird in our territory.

Our smaller migratory song-birds are occasionally attacked by ticks, particularly by all stages of *Haemaphysalis chordeilis* and *Ixodes brunneus,* and by larvae and nymphs of *Haemaphysalis leporis-palustris.* There are also a few bird records for larvae of *Dermacentor variabilis* and *Amblyomma americanum* and for some other species (see the list of ticks according to hosts). No specific disease is known to be transmitted by ticks to this type of bird. Small birds nevertheless may be of importance in the epidemiology of tularemia and Rocky Mountain spotted fever. In connection with the spread of Rocky Mountain spotted fever, R. R. Parker (1938) notes that fully as high a percentage of spotted fever-infected *H. leporis-palustris* is met with among those taken from birds as among those taken from rabbits. Since migratory birds move about considerably, it is easily understood that this tick and its bird hosts form an excellent means for intensive local distribution of the disease and possibly in some instances for its transportation over longer distances. Somewhat similar conditions obtain in the case of tularemia.

In addition, there is some evidence that *Ixodes brunneus* occasionally has a markedly adverse effect upon its bird host. R. H. Thomas (1941) and C. B. Worth (1942) reported cases of ticks found attached to birds' eyelids and impairing their eyesight. F. C. Bishopp and H. L. Trembley mention birds being found dead or unable to fly, with an engorged female *I. brunneus* attached to the neck or head. They suggest that the ill effects were due to a toxin introduced by the tick, the condition being similar to so-called tick paralysis of man and mammals, which I have discussed before.

Control of Ticks and Tick-Borne Diseases

Several of our local ticks are of little or no practical importance, being either too few in numbers or restricted to certain definite types of wild hosts. The exceptions are: *Argas persicus,* possibly a dangerous parasite of fowl in parts of Maryland; two species of *Ixodes* (*I. scapularis* and *I. cookei*), sometimes found on dogs and

cats, more rarely on man, but not known to transmit disease; *Ixodes dentatus,* a common parasite of wild rabbits; *Amblyomma americanum,* in the southern part of our territory only, occasionally on man, possibly on cattle and horses; *Rhipicephalus sanguineus,* the imported brown tick of dog, sometimes a household pest; *Dermacentor variabilis,* our most serious tick problem; and the two species of *Haemaphysalis* (*H. chordeilis* and *H. leporis-palustris*), owing to their rôle in the perpetuation and spread of tick-borne diseases.

1. *Control by Destruction of the Ticks.*—A direct attack upon the tick is most successful for species which feed on domestic animals at all stages. Dipping of cattle with arsenicals, carried out for several years in the southern United States, has eradicated the cattle tick, *Boophilus annulatus,* from most of the area it formerly occupied. Ticks are, however, so rare on cattle in our territory, that dipping of these animals is scarcely ever needed.

In discussing the control of *Argas persicus,* F. C. Bishopp (1919 and 1942) emphasized the difficulties involved. The fowl tick is secretive and its flat body enables it to hide in very narrow cracks. It is, moreover, extremely hardy, resistant not only to the usual insecticides, but also to drought and prolonged fasting. The poultry houses and their furnishings should be treated with crude petroleum, pure carbolineums (or anthracene oils), or creosote oil containing 8 to 20 per cent tar acids. It is unnecessary and even dangerous to apply these chemicals to the birds. Treating the cracks of stone walls and of tarred woodwork with the flame of a properly constructed blow-lamp is sometimes very effective (C. du Plessis, 1932). When feasible, poultry houses should be built or made tick-proof; while roosts and nests should be constructed so as to offer few hiding places and to be easily treated for tick infestation. Care should be taken not to introduce ticks with birds from outside sources.

Rhipicephalus sanguineus, the brown dog tick introduced from the Old World, is thus far restricted in our territory to domestic dogs and almost entirely a household problem. The ticks are rather readily destroyed on dogs with arsenical, carbolic or derris dips. H. K. Gouck and C. N. Smith (1944*b*) obtained satisfactory control of all stages with emulsions containing 5 per cent of DDT[19] applied as a wash to the dog. It is, however, much more difficult to deal with this tick away from the host, either with the newly hatched larvae or with later stages that have dropped off. Even repeated fumigation with hydrocyanide sometimes fails to eliminate them

[19] Abbreviation for dichloro-diphenyl-trichloroethane.

permanently from buildings. W. O. Nietz (1943) recommends spraying the premises with a solution of 6.6 per cent pyagra (a British trade name of a pyrethrum preparation) in kerosene or in a mixture of 1 part of kerosene and 4 parts of crankcase oil. After applying 8 gallons of this solution to 6,500 square feet of an infected kennel surface, a few live ticks were found three months after treatment; but a second treatment cleared up the infestation completely. Where the tick has become a regular house pest, routine spraying every six months is indicated. G. H. Plump (1944) found that a dust containing 5 grams "lethane 384 special," 2 grams $MgCO_3$ and 100 grams Pyrax ABB, was toxic to *R. sanguineus* away from the host; but this substance has not been tested on dogs or in infested quarters.

Dipping or spraying with insecticides will effectively destroy ticks picked up by dogs in the woods, such as *Dermacentor variabilis* and *Amblyomma americanum;* but as these species have several wild hosts, control on the dogs will scarcely affect their prevalence in a given locality for any length of time.

Several insecticides have recently been advocated for the purpose of killing ticks in nature, during the period when they are away from the host. F. C. Bishopp and C. N. Smith (1938) noted that the numbers of *Dermacentor variabilis* could be appreciably reduced by spraying an infested area with a solution of nicotine sulfate (1 part nicotine sulfate, 1 part soap, 288 parts water). C. N. Smith and H. K. Gouck (1944*a*) suggest increasing the amount of nicotine sulfate in this mixture to 1 part in 200. The method may be recommended for the temporary reduction of the tick population, for instance, at an overnight camp site and in the close vicinity of a house. For more permanent control, Smith and Gouck found a spray containing 1.5 per cent sodium fluoride and 0.5 per cent nicotine sulfate very effective, not only against *D. variabilis,* but also against *Amblyomma americanum* and *Ixodes scapularis;* but this mixture is injurious to vegetation. Some preparations of dinitro-orthocyclo-hexylphenol were found to be almost as effective against *D. variabilis* as sodium fluoride, but equally injurious to plants. A spray containing 2.6 ml. of purified pyrethrum extract in 1 gallon of water is effective only with an activator, when it readily kills *Amblyomma americanum* and *Ixodes scapularis* and does not injure the vegetation. C. N. Smith and H. K. Gouck (1944*b*) state that adults of *A. americanum* and *I. scapularis* are readily killed by DDT in the laboratory, provided the proper solvent and emulsifier are used. Fairly satisfactory results were also obtained in nature

against *I. scapularis,* with sprays containing 0.1 per cent DDT and with dusts containing 1 and 0.5 per cent DDT. The same investigators (1945) obtained excellent control of nymphs and adults of *Amblyomma americanum* in woodland plots, in Georgia, by spraying with DDT dissolved in soluble pine oil and emulsified in water, at the rate of one pound of DDT per acre. *Dermacentor variabilis* they found to be more resistant; although similar sprays, at the rate of 9, 7 and 3 pounds of DDT per acre, controlled the adults effectively in roadside plots at West Tisbury, Massachusetts.

2. *Control by Destruction of the Wild Hosts and Disease Reservoirs.*—In the sections of our territory where *Dermacentor variabilis* is a serious problem, its larvae and nymphs occur abundantly on small wild rodents, meadow mice (*Microtus pennsylvanicus* and related species of *Microtus*) being particularly favored. In the Cape Cod area and the neighboring islands, *M. pennsylvanicus* is the main breeding host. The abundance of *D. variabilis* is in direct relation to that of the meadow mouse, other rodents, such as the deer mouse (*Peromyscus*), harboring only insignificant numbers of the tick (F. Larrousse, A. G. King, and S. B. Wolbach, 1928; M. Hertig and D. Smiley, 1937; C. N. Smith and M. M. Cole, 1941). D. MacCreary (1940) found that this is also true in Maryland. From these observations it would seem that the eradication of meadow mice may be one of the most valuable means of controlling *D. variabilis.*

M. Hertig and D. Smiley (1937) studied with great care the ecology and habits of the meadow mouse on Martha's Vineyard, with a view to their control. This rodent, sometimes also called the field mouse or vole, does not invade houses, but lives in or close to areas covered mainly with grass. Its chief food is grass or other green vegetation, occasionally also fruit and, in winter, the bark of shrubs or trees. In foraging, it follows tunnel-like runways in the grass, where it is protected against hawks, owls, and predaceous Carnivora. The presence or absence of suitable protective cover regulates to a large extent the spotted distribution of meadow mice and of their ticks. If the grass is kept short, either by repeated mowing (as on lawns) or by grazing, very few mice can survive. On Martha's Vineyard, the best "mouse and tick country," was found in either ungrazed grassland, dotted with thickets of rose and poison ivy or in strips of beach grass. Sometimes mice were also fairly abundant in open grassy patches in otherwise dense woodland. Intensive and constant grazing, particularly by sheep, appears to be one of the most efficient methods of dealing with field mice, by removing both their food and their protective cover. Hogs pasturing in meadows

in addition kill and devour the mice, soon eliminating them completely. Various direct control measures have also been advocated against meadow mice. Persistent trapping will no doubt reduce their numbers, but is difficult to apply to large areas. An appropriate poison bait, placed in the runways, is much more effective. Such a bait, made of steam-crushed oats treated with strychnine, is obtainable through the U. S. Department of Agriculture, with instructions for its proper use (J. Silver, 1930).

In Rocky Mountain spotted fever, man does not act as a reservoir for new human infections, but animal carriers are involved. As pointed out in the discussion of the disease, we are as yet completely in the dark as to these natural carriers in the eastern United States. Domestic animals, particularly dogs, seem to be ruled out or could at most act in isolated cases, without being able to perpetuate the disease in the district. They themselves must first acquire it from some wild source. Outside our territory certain rodents and wild rabbits and hares are known to be infected in nature. As the immature stages of *Dermacentor variabilis* are almost restricted in the East to meadow mice, these rodents may conceivably be the chief reservoir from which Rocky Mountain spotted fever is transmitted to man. The control of meadow mice, either through grazing or poisoning, should therefore also tend to check or eradicate this disease.

The animal reservoirs of tularemia present an entirely different problem. They are well known, but, unfortunately, so numerous and varied, both among mammals and birds, that in most cases it would seem impossible to eliminate them from a given area. Moreover, some of them are valuable, either as fur bearers or as game. Perhaps the best one might attempt would be either to prohibit or to regulate most carefully the importation for release of some of the most dangerous carriers, particularly wild rabbits or hares. Even such a measure might be too unpopular for effective enforcement.

3. *Biological Control by Means of Insect Parasites.*—Certain minute species of winged insects, belonging to the group of the chalcid flies in the order Hymenoptera, sometimes attack ticks, of which they are specific parasites, never breeding in any other type of host. The female lays a number of eggs in a living tick, most often selecting a nymph. The larvae hatching from the eggs feed on the tissues of the tick, eventually killing it. After a pupal resting period, the winged adult chalcids emerge from the dead tick through a neatly cut, circular opening. Parasitized dead ticks may be recognized as such, before the chalcids hatch, by their mottled and somewhat puffed-up appearance.

Only two species of chalcids are known at present to parasitize ticks: *Ixodiphagus texanus* Howard and *Hunterellus hookeri* Howard (synonym: *Ixodiphagus caucurtei* R. du Buysson), both of the family Encyrtidae (A. B. Gahan, 1934). In North America, *I. texanus* has been bred in nature with certainty from *Haemaphysalis leporis-palustris* and *Ixodes dentatus,* and somewhat doubtfully from *Ixodes cookei;* while *H. hookeri* was obtained in nature from *Rhipicephalus sanguineus, Dermacentor variabilis, D. parumapertus,* and *Ixodes scapularis.*

Hunterellus hookeri is the most widely distributed of the two chalcids. It is easily reared in captivity, so that large numbers are obtainable for release in areas where ticks are not known to have native parasites. If the chalcid became well established, it could conceivably do its share to reduce the tick population by killing a certain percentage of the nymphs. An attempt to introduce *H. hookeri* on Naushon Island (Cape Cod) was made by F. Larrousse during the summer of 1926, at the suggestion of Dr. S. B. Wolbach. Field work done the following year by A. G. King showed that descendants of the released parasites had survived the winter, as they were recovered from nymphs of *Dermacentor variabilis* and *Ixodes scapularis* collected on the island (F. Larrousse, A. G. King, and S. B. Wolbach, 1928). One parasitized nymph of *Dermacentor variabilis* was recovered on Naushon in 1929 by C. G. Huff and A. T. Hertig (see M. Hertig and D. Smiley, 1937); but these parasites were not identified as to species. In 1940, five adult *H. hookeri* were found in the hair of a dog on Naushon, although the species was not recovered from 1,500 larvae and nymphs of *Dermacentor variabilis* and *Ixodes scapularis* collected at the same time. One nymph of *D. variabilis,* however, yielded two specimens of *Ixodiphagus texanus,* a species which had not been knowingly introduced in Naushon (S. Cobb, 1942). *I. texanus* was bred sometime before from specimens of *Haemaphysalis leporis-palustris* and *Ixodes dentatus* collected at Oak Bluffs on Martha's Vineyard. In 1929 *H. hookeri* was released by C. G. Huff and A. T. Hertig at several points on Martha's Vineyard and at Scraggy Neck on the mainland of Cape Cod, but nothing is known of the results of these introductions. As the two known chalcid parasites of ticks do not seem to be particularly attracted by *Dermacentor variabilis,* their introduction is hardly an effective control measure of the American dog tick.

4. *Individual Protection of Man and Domestic Animals.*—No repellent will effectively discourage ticks from reaching a host or kill them on the host before they have time to pierce the skin and

attach. DDT alone does not appear to be as powerful against ticks as against blood-sucking insects, although better results are claimed from a mixture in the right proportion of rotenone and DDT. Hydrogenated rotenone has been used by lumbermen in Alabama against "wood ticks" (presumably larvae and nymphs of *Amblyomma americanum*), apparently with some success (D. C. Byrnes, 1944).

Adequate clothing, covering the lower part of the body, is the best individual protection. High shoes or boots, long trousers and tight leggings are particularly recommended. At the tick season, walking in the woods and pastures should be avoided as much as possible. After returning from a heavily infested area, the clothing should be removed and thoroughly treated with some insecticide. If the clothes are hung outdoors on a rope from the branch of a tree the ticks will tend to climb up the rope into the tree. The body should be thoroughly searched for any ticks that might have attached. Dogs should be cleaned of ticks before being allowed to enter dwellings. Ticks removed from people or animals should be killed by fire or in some disinfectant, in gasoline, in kerosene, or in denatured alcohol. Particular care must be taken not to crush the tick. If at all possible, removal should be by means of tweezers or with gloves, not with the bare fingers, particularly in areas known to be infected with Rocky Mountain spotted fever or tularemia. Some human cases of Rocky Mountain spotted fever were definitely contracted by removing ticks. Mashing or crushing ticks between the fingers or with the nails is a particularly dangerous practice.

In most cases the removal of the tick from the human skin offers no difficulty, as a gentle and steady pull will dislodge the entire hypostome from the bite. A previous application of ether, turpentine, benzine or even tobacco juice is sometimes recommended and may perhaps help the process.[20] It is more important, however, to disinfect the site of the bite, after the tick is removed.

[20] The removal of ticks has given rise to many strange tales. For the sake of curiosity I quote a fanciful method advocated by a recent writer (D. J. Wilson, 1940): "Strike an ordinary household match. As soon as it flares, a vigorous shake of the hand extinguishes the flame. The hot match head is promptly applied to the caudal end of the tick. A few seconds later the tick has withdrawn his beak and can usually be easily picked off. Sometimes a second application is necessary. If the match is still flaming when applied the tick is often killed and must be forcibly pulled off."

5. *Preventive Measures Against Tick-Borne Diseases.*—As shown in the foregoing paragraphs, community control of ticks and the diseases they transmit is difficult and uncertain. It has been rarely attempted and is hardly ever successful. Furthermore, repellents and other protective measures are not fully reliable, particularly in areas heavily infested with ticks. It is largely up to the individual to guard himself and others as best he can. In general, the quick removal of the tick from the skin is the best protection against disease. In the case of tick paralysis, all symptoms subside promptly after the tick is removed.

In our territory, Rocky Mountain spotted fever is at present endemic only in the Cape Cod area, on Long Island, in some coastal districts of New Jersey and Pennsylvania, over most of Delaware and Maryland, in several counties of West Virginia, and in certain localities of southern Ohio. In all these sections, at the tick season, campers, hikers, farmers and hunters should carefully search the body for ticks directly upon returning from the fields and woods. Routine examination twice daily is to be recommended. Even when an infected tick has attached to the skin, it must as a rule feed for a few hours before inoculating the disease. Direct contact with ticks should be avoided and it is particularly urged not to crush them with bare fingers or nails. It is now possible to immunize people against spotted fever with a specific vaccine, prepared either from ground up tissues of infected ticks or from rickettsia cultures in the yolk sacs of fertile hens' eggs. Vaccination on a large scale is carried out in some areas of the western United States where the disease is particularly dangerous. The relatively few and often sporadic cases probably would not warrant general vaccination of rural residents and summer visitors in all of our endemic areas. It has, however, been used extensively and with success in Maryland (C. H. Halliday, 1936*b*). It may be noted that vaccination protects for one year only and should be given at least ten days before exposure to infected ticks. It is of no value in the treatment of cases.

Tularemia is a much more serious problem, as it is widespread and extremely contagious. It is particularly dangerous owing to the variety of wild reservoirs and the several ways in which it may be contracted. Moreover, there is as yet no specific treatment nor preventive vaccine. In our territory at any rate, the majority of human cases are due to direct contact with infected animals, particularly cottontail rabbits; while few are acquired from ticks or other blood-sucking arthropod vectors. For this reason one should

avoid handling with the bare hands any suspicious dead game, especially dead rabbits shipped in from areas known to be infected or found dead or sick in the woods. Rabbits caught by cats and dogs are likely to be sick and sluggish and therefore especially dangerous. Hunters and hikers should not touch wild animals found dead, nor kill slow-moving rabbits. Rubber gloves should be worn while dressing wild rabbits and the meat should be thoroughly cooked before eating.

(*To be continued*)

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ENTOMOLOGICA AMERICANA

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THE TICKS, OR IXODOIDEA, OF THE NORTHEASTERN UNITED STATES AND EASTERN CANADA

BY JOSEPH C. BEQUAERT*

(*Continued from page 120*)

DISTRIBUTION ACCORDING TO PROVINCES AND STATES

LABRADOR: *Ixodes muris; I. uriae;* (*Amblyomma americanum,* very doubtful record).

NEWFOUNDLAND: *Ixodes uriae* (on St. Pierre and Miquelon).

PRINCE EDWARD ISLAND: No record.

NOVA SCOTIA: *Ixodes uriae; I. muris; I. cookei; I. marxi; Dermacentor variabilis; D. erraticus* var. *albipictus; Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris.*

NEW BRUNSWICK: *Ixodes cookei; I. angustus; Dermacentor erraticus* var. *albipictus; Haemaphysalis leporis-palustris.*

QUEBEC: *Ixodes cookei; I. angustus; Dermacentor erraticus* var. *albipictus; Haemaphysalis leporis-palustris.*

ONTARIO: *Ixodes scapularis; I. cookei; I. marxi; I. texanus; I. auritulus; I. angustus; Dermacentor erraticus* var. *albipictus; D. variabilis; Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris; H. chordeilis.*

* From the Department of Comparative Pathology and Tropical Medicine, Harvard Medical School and School of Public Health, Boston, Mass.

MAINE: *Ixodes cookei; I. marxi; I. angustus; Dermacentor erraticus* var. *albipictus; Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris.*

VERMONT: *Ixodes cookei; I. marxi; Dermacentor variabilis; Haemaphysalis chordeilis.*

NEW HAMPSHIRE: *Ixodes cookei; I. muris; I. marxi; Dermacentor erraticus* var. *albipictus; Haemaphysalis chordeilis; H. leporis-palustris.*

MASSACHUSETTS: *Ixodes scapularis; I. brunneus; I. muris; I. dentatus; I. cookei; I. marxi; Amblyomma americanum* (not native); *Dermacentor variabilis; D. erraticus; Rhipicephalus sanguineus* (introduced); *Haemaphysalis chordeilis; H. leporis-palustris.*

RHODE ISLAND: *Ixodes muris; Haemaphysalis chordeilis; H. leporis-palustris.*

CONNECTICUT: *Ixodes brunneus; I. scapularis; I. cookei; Dermacentor variabilis; Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris.*

NEW YORK: *Ornithodoros kelleyi; Ixodes scapularis; I. muris; I. brunneus; I. angustus; I. cookei; I. marxi; I. dentatus; Amblyomma americanum* (no recent records); *Dermacentor variabilis; D. erraticus; D. erraticus* var. *albipictus; Rhipicephalus sanguineus* (introduced); *Haemaphysalis chordeilis; H. leporis-palustris.*

NEW JERSEY: *Ixodes brunneus; I. cookei; I. marxi; Amblyomma americanum; Dermacentor variabilis; Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris.*

PENNSYLVANIA: *Ornithodoros kelleyi; Ixodes scapularis; I. cookei; I. muris; I. marxi; I. dentatus; Amblyomma americanum; Dermacentor variabilis; D. erraticus; Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris.*

OHIO: *Ornithodoros kelleyi; O. megnini* (not native); *Ixodes scapularis; I. cookei; I. dentatus; I. marxi; Amblyomma americanum; Dermacentor variabilis; D. erraticus* var. *albipictus* (not native); *Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris.*

WEST VIRGINIA: *Ornithodoros kelleyi; Ixodes angustus; I. dentatus; Dermacentor variabilis.*

DELAWARE: *Ixodes cookei; I. marxi; I. dentatus; Amblyomma maculatum; A. americanum; Dermacentor variabilis; Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris.*

Maryland: *Argas persicus* (introduced); *Ixodes scapularis; I. brunneus; I. dentatus; I. marxi; I. cookei; Amblyomma americanum; Dermacentor variabilis; Rhipicephalus sanguineus* (introduced); *Haemaphysalis leporis-palustris.*

Distribution According to Hosts

BIRDS[21]

Falconiformes

Hawk (species?).—*Haemaphysalis chordeilis.*

Galliformes

Spruce grouse or partridge, *Canachites canadensis canadensis* (Linnaeus).—*Haemaphysalis leporis-palustris; H. chordeilis.*

Eastern ruffed grouse, *Bonasa umbellus umbellus* (Linnaeus).—*Haemaphysalis chordeilis; H. leporis-palustris.*

Eastern bob-white quail, *Colinus virginianus virginianus* (Linnaeus).—*Haemaphysalis leporis-palustris; Amblyomma americanum.*

Domestic turkey (not now native), *Meleagris gallopavo* Linnaeus.—*Haemaphysalis chordeilis; H. leporis-palustris.*

Domestic fowl (not native), *Gallus gallus* (Linnaeus).—*Argas persicus.*

Charadriiformes

Spotted sandpiper, *Actitis macularia* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Razor-billed auk, *Alca torda* Linnaeus.—*Ixodes uriae.*

Atlantic murre, *Uria aalge aalge* (Pontoppidan).—*Ixodes uriae.*

Atlantic puffin, *Fratercula arctica arctica* (Linnaeus).—*Ixodes uriae.*

Strigiformes

Snowy owl, *Nyctea nyctea* (Linnaeus).—*Ixodes cookei.*

Caprimulgiformes

Eastern nighthawk, *Chordeiles minor minor* (Forster).—*Haemaphysalis chordeilis.*

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[21] The nomenclature and sequence are those of the fourth edition (1931) of the A.O.U. "Check-list of North American Birds."

Passeriformes

Canada jay, *Perisoreus canadensis canadensis* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Northern blue jay, *Cyanocitta cristata cristata* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Eastern crow, *Corvus brachyrhynchos brachyrhynchos* Brehm.—*Haemaphysalis leporis-palustris.*

House wren, *Troglodytes aëdon aëdon* Vieillot.—*Ixodes muris.*

Catbird, *Dumetella carolinensis* (Linnaeus).—*Ixodes brunneus; Haemaphysalis leporis-palustris.*

Brown thrasher, *Toxostoma rufum* (Linnaeus).—*Haemaphysalis leporis-palustris; Ixodes dentatus.*

Eastern or American robin, *Turdus migratorius migratorius* Linnaeus.—*Ixodes brunneus; Haemaphysalis leporis-palustris.*

Eastern hermit thrush, *Hylocichla guttata faxoni* Bangs and Penard.—*Ixodes brunneus; Haemaphysalis leporis-palustris.*

Olive-backed thrush, *Hylocichla ustulata swainsoni* (Tschudi).—*Haemaphysalis leporis-palustris.*

Veery, *Hylocichla fuscescens fuscescens* (Stephens).—*Haemaphysalis leporis-palustris.*

Starling (not native), *Sturnus vulgaris vulgaris* Linnaeus.—*Haemaphysalis leporis-palustris.*

Red-eyed vireo, *Vireo olivaceus* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Black-throated green warbler, *Dendroica virens virens* (Gmelin).—*Haemaphysalis leporis-palustris.*

Oven-bird, *Seiurus aurocapillus* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Northern water-thrush, *Seiurus noveboracensis noveboracensis* (Gmelin).—*Haemaphysalis leporis-palustris.*

Kentucky warbler, *Oporornis formosus* (Wilson).—*Haemaphysalis leporis-palustris.*

Northern yellow-throat, *Geothlypis trichas brachidactyla* (Swainson).—*Haemaphysalis leporis-palustris.*

Hooded warbler, *Wilsonia citrina* (Boddaert).—*Haemaphysalis leporis-palustris.*

Eastern meadowlark, *Sturnella magna magna* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Eastern red-wing, *Agelaius phoeniceus phoeniceus* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Purple grackle, *Quiscalus quiscula quiscula* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Bronzed grackle, *Quiscalus quiscula aeneus* Ridgway.—*Haemaphysalis leporis-palustris.*

Eastern cowbird, *Molothrus ater ater* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Eastern goldfinch, *Spinus tristis tristis* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Red-eyed towhee, *Pipilo erythrophthalmus erythrophthalmus* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Eastern savannah sparrow, *Passerculus sandwichensis savanna* (Wilson).—*Haemaphysalis leporis-palustris.*

Eastern vesper sparrow, *Pooecetes gramineus gramineus* (Gmelin).—*Haemaphysalis leporis-palustris.*

Slate-colored junco, *Junco hyemalis hyemalis* (Linnaeus).—*Haemaphysalis leporis-palustris.*

Eastern chipping sparrow, *Spizella passerina passerina* (Bechstein).—*Ixodes brunneus; Haemaphysalis leporis-palustris.*

Eastern field sparrow, *Spizella pusilla pusilla* (Wilson).—*Haemaphysalis leporis-palustris.*

White-crowned sparrow, *Zonotrichia leucophrys leucophrys* (Forster).—*Haemaphysalis leporis-palustris.*

White-throated sparrow, *Zonotrichia albicollis* (Gmelin).—*Ixodes brunneus; Haemaphysalis leporis-palustris.*

Eastern fox sparrow, *Passerella iliaca iliaca* (Merrem).—*Ixodes brunneus; Haemaphysalis leporis-palustris.*

Lincoln's sparrow, *Melospiza lincolni lincolni* (Audubon).—*Haemaphysalis leporis-palustris.*

Swamp sparrow, *Melospiza georgiana* (Latham).—*Haemaphysalis leporis-palustris.*

Eastern song sparrow, *Melospiza melodia melodia* (Wilson).—*Ixodes muris; I. brunneus; Haemaphysalis leporis-palustris.*

MAMMALS[22]

Marsupialia

Opossum, *Didelphis virginiana virginiana* Kerr.—*Ixodes cookei; Dermacentor variabilis.*

Insectivora

Short-tailed shrew, *Blarina brevicauda aloga* Bangs.—*Ixodes muris; I. angustus.*

[22] The nomenclature and sequence are in the main those of G. S. Miller's List of North American Recent Mammals (1924, U. S. Nat. Mus., Bull. 128).

Chiroptera

Little brown bat, *Myotis lucifugus lucifugus* (LeConte).—*Ornithodoros kelleyi.*

Big brown bat, *Eptesicus fuscus fuscus* (Beauvois).—*Ornithodoros kelleyi.*

Carnivora

Raccoon, *Procyon lotor lotor* (Linnaeus).—*Ixodes cookei.*

Small weasel, *Mustela cicognanii cicognanii* Bonaparte.—*Ixodes cookei; Dermacentor variabilis.*

Large weasel, *Mustela noveboracensis noveboracensis* (Emmons).—*Ixodes cookei.*

Mink, *Mustela vison mink* (Peale and Beauvois).—*Ixodes cookei; I. texanus.*

Skunk, *Mephitis nigra* (Peale and Beauvois).—*Ixodes cookei.*

Red fox, *Vulpes fulva* (Desmarest).—*Ixodes cookei.*

Gray fox, *Urocyon cinereoargenteus borealis* Merriam.—*Ixodes cookei; Dermacentor variabilis.*

Domestic dog, *Canis familiaris* Linnaeus (not native).—*Ixodes scapularis; I. cookei; Rhipicephalus sanguineus; Dermacentor variabilis.*

Domestic cat, *Felis catus* Linnaeus (not native).—*Ixodes cookei; Dermacentor variabilis.*

Primates

Man (accidental host).—*Ixodes scapularis; I. cookei; Amblyomma americanum; Dermacentor variabilis.*

Rodentia

Woodchuck or ground hog, *Marmota monax rufescens* Howell.—*Ixodes cookei; Dermacentor variabilis.*

Woodchuck, *Marmota monax preblorum* Howell.—*Ixodes cookei; Dermacentor variabilis.*

Chipmunk, *Tamias striatus lysteri* (Richardson).—*Ixodes marxi; Dermacentor variabilis.*

Red squirrel, *Tamiasciurus hudsonicus loquax* (Bangs).—*Ixodes marxi; Dermacentor variabilis.*

Gray squirrel, *Sciurus carolinensis carolinensis* (Gmelin).—*Ixodes marxi.*

Gray squirrel, *Sciurus carolinensis leucotis* (Gapper).—*Ixodes marxi; Dermacentor variabilis.*

Flying squirrel, *Glaucomys volans volans* (Linnaeus).—*Ixodes marxi.*

Northern flying squirrel, *Glaucomys sabrinus macrotis* (Mearns).—*Ixodes marxi.*

White-footed or deer mouse, *Peromyscus leucopus fusus* Bangs.—*Ixodes scapularis; I. muris; Dermacentor variabilis.*

Bog lemming, *Synaptomys cooperi* Baird.—*Ixodes angustus.*

Red-backed mouse, *Clethrionomys* (or *Evotomys*) *gapperi carolinensis* (Merriam).—*Ixodes angustus.*

Meadow mouse, field mouse, or vole, *Microtus pennsylvanicus pennsylvanicus* (Ord).—*Ixodes scapularis; I. muris; I. dentatus; Dermacentor variabilis.*

Meadow mouse, *Microtus* sp.—*Ixodes auritulus.*

Labrador mouse, *Microtus enixus* Bangs.—*Ixodes muris.*

Pine mouse, *Pitymys pinetorum scalopsoides* (Audubon and Bachman).—*Dermacentor variabilis.*

Muskrat, *Ondatra zibethica zibethica* (Linnaeus).—*Ixodes muris; I. dentatus; Dermacentor variabilis.*

House or Norway rat, *Rattus norvegicus* (Erxleben) (not native).—*Ixodes muris; Dermacentor variabilis.*

House mouse, *Mus musculus musculus* Linnaeus (not native).—*Dermacentor variabilis.*

Jumping or kangaroo mouse, *Zapus hudsonius hudsonius* (Zimmermann).—*Ixodes muris; Dermacentor variabilis.*

Canada jumping mouse, *Napaeozapus insignis insignis* (Miller).—*Ixodes muris.*

Porcupine, *Erethizon dorsatum dorsatum* (Linnaeus).—*Ixodes cookei.*

Lagomorpha

Snowshoe or varying hare, *Lepus americanus virginianus* (Harlan).—*Ixodes marxi; Haemaphysalis leporis-palustris.*

New England cottontail rabbit, *Sylvilagus transitionalis* (Bangs).—*Ixodes dentatus; Haemaphysalis leporis-palustris.*

Eastern cottontail rabbit, *Sylvilagus floridanus mearnsi* (Allen).—*Ixodes dentatus; Haemaphysalis leporis-palustris; Dermacentor variabilis.*

Artiodactyla

Elk or wapiti, *Cervus canadensis canadensis* (Erxleben) (no longer native).—*Dermacentor erraticus* var. *albipictus.*

Virginia deer, *Odocoileus virginianus borealis* (Miller).—*Ixodes scapularis; Dermacentor erraticus; D. erraticus* var. *albipictus.*

Moose, *Alces americana americana* (Clinton).—*Dermacentor erraticus* var. *albipictus.*

Domestic cattle, *Bos taurus* Linnaeus (not native).—*Ixodes cookei; Dermacentor erraticus; D. erraticus* var. *albipictus; D. variabilis.*

Domestic pig, *Sus scrofa* Linnaeus (not native).—*Ixodes cookei; Dermacentor variabilis.*

Perissodactyla

Domestic horse, *Equus caballus* Linnaeus (not native).—*Dermacentor variabilis; D. erraticus* var. *albipictus.*

IXODOIDEA

Key to Families

1. Body alike in both sexes, covered uniformly with a flexible, leathery and roughened integument, without a differentiated dorsal hardened shield. Capitulum placed ventrally and often hidden by the anterior margin of the body. Coxae never with spurs ..... Argantidae.

   Integument of body partly hardened into a rigid shield (or scutum), which covers the whole of the dorsal surface in the male and its anterior portion only in the female, nymph and larva; softer, flexible parts of integument finely punctate or striate only. Capitulum placed at anterior end of body, fully exposed dorsally. One or more coxae often with spurs or ridges ..... Ixodidae.

Family ARGANTIDAE

(Argasidae)

Key to Genera

1. Dorsum and venter separated by a fine, continuous, impressed line, the adjoining lateral area with a regular sculpture differing from that of the remainder of the integument. *Argas.*

   Dorsum and venter not separated by a fine, continuous line, the lateral area similar in sculpture to the remainder of the integument ..... *Ornithodoros.*

Genus **Argas** Latreille, 1795

The two species of *Argas* found in America appear to have been introduced by man from the Old World, as they are usually found associated with domestic birds, near or in human dwellings. Only one species has been definitely reported thus far from the southern part of our territory.

Key to Species

Males, Females and Nymphs

1. Flattened marginal area of body rather broad and irregularly defined, coarsely reticulate, with many small, squarish granules. Apex of hypostome notched. Tarsi slightly angular dorsally before apex ..... *A. persicus.*

Flattened marginal area of body rather narrow and regular, with many transverse, more or less parallel, impressed lines at irregular intervals. Apex of hypostome evenly rounded. All tarsi with a strong, dorsal protuberance before apex.
A. reflexus.

Argas reflexus (Fabricius, 1794),[23] the "pigeon tick," is very rare in the United States, where it does not appear to have been definitely found with pigeons. There is no evidence that it occurs in our territory. N. Banks (1908, p. 16) states: "Thomas Wright, of Massachusetts, claims he has seen it in that state"; but this can hardly be accepted as a record.[24]

Argas persicus (Oken)

Rhynchoprion persicum Oken, 1818, Isis, 3, p. 1568; Pl. XIX, figs. 1–4 (Persia).

Argas persicus Neumann, 1896, Mém. Soc. Zool. France, 9, p. 7, figs. 4–5 (♀♂nl). Nuttall, Warburton, Cooper and Robinson, 1908, Ticks, 1, Argasidae, p. 8, figs. 3–26; Pl. 1, fig. 3 (♀♂nl.). Cooley and Kohls, 1944, American Midland Naturalist, Monograph No. 1, p. 17, figs. 4A–G and 5; Pl. I, 2 lower figs. (♀♂nl).

[23] The earliest valid specific name for the pigeon tick is *Acarus reflexus* Fabricius (1794, Entom. Syst., 4, p. 426; no host; Italy), not *Acarus columbarum* "Shaw, 1793," as claimed by A. C. Oudemans (1929, Tijdschr. v. Entom., 72, Suppl., p. 138). A most careful reading of both the Latin and English descriptions of *Acarus auratus* Shaw (1793, in Shaw and Nodder, Naturae Vivarium, 4, Pl. 128, with four pages of letterpress), a species of *Aponomma,* reveals no sentence nor part of sentence that could be construed as describing *Acarus columbarum,* which name is used only for comparison and is clearly a *nomen nudum.* Oudemans quotes only parts of a sentence which reads in full: "In the general form of the apparatus at the head, this species [*A. auratus*] bears a most striking affinity to the pigeon tick or *Acarus columbarum,* being furnished like that animal, with a serrated snout, the processes of which lying on the under surface, and pointing backwards, enable it to adhere with great firmness to the skin of the creature it infests." Oudemans also claims to know that Shaw's *Acarus columbarum* came from England, but this is nowhere stated by Shaw, who merely wrote that it is "not less plentiful on pigeons and some other animals."

[24] *Argas brevipes* N. Banks (1908), according to a cotype from Tucson, Arizona, is a synonym of *Argas reflexus.*

Argas miniatus Koch, 1844, Arch. f. Naturg., 10, pt. 1, p. 219 (no sex; Demerara, British Guiana); 1847, Uebersicht d. Arachnidensyst., 4, pp. 12 and 32; Pl. I, fig. 4. N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 15 and 52; Pl. I, figs. 1–2 (♀♂). Hooker, Bishopp and Wood, 1912, U. S. Dept. Agric., Bur. Ent., Bull. 106, pp. 46–61, fig. 1 (map); Pl. III, figs. 1–8 (♀♂nl). Bishopp, 1913, U. S. Dept. Agric., Bur. Ent., Circ. No. 170, pp. 1–14, figs. 1–5 (♀♂nl); 1919, U. S. Dept. Agric., Farmers' Bull. 1070, pp. 3–16, figs. 1–5 (♀♂nl). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 10, fig. 4 (map).

Argas americana Packard, 1873, Sixth Ann. Rept. U. S. Geol. Survey Terr. for 1872, p. 740, fig. 68 (no sex; Texas; "found among a number of *Ixodes bovis* taken from cattle"). Hassall, 1901,U. S. Dept. Agric., Bur. An. Ind., 16th Ann. Rept. for 1899, pp. 496–500, figs. 16–22; Pl. XVI (♀l).

Argas radiatus Railliet, 1893, Traité Zool. Médic. Agric., p. 718 (new name for *Argas americana* Packard, 1873).

Maryland—Seen: Landsdowne, August 3, 1941, off domestic fowl (E. N. Cory).

Argas persicus, the "fowl tick," is a fairly common pest of poultry, particularly of chickens and turkeys, in the southwestern United States and Florida. It often attacks other birds also, more rarely mammals and occasionally man. Oken's specific name *persicus* has many years priority over *Argas persicus* Fischer de Waldheim (1828), which may or may not have been the same species. *A. persicus* was brought accidentally to America by man from the Old World within historic times.

The economic importance and methods of control of this tick have been discussed in one of the introductory sections of this paper.

Genus **Ornithodoros** C. L. Koch, 1844

Only one species of *Ornithodoros, O. kelleyi* Cooley and Kohls, is native in our territory. I have seen two specimens of *Ornithodoros* (*Otobius*) *megnini* Dugès, the "spinose ear-tick," accidentally introduced from farther south. One of these was taken in Albany, New York, from a man's ear shortly after his return from Mexico. The other, sent by Mr. J. H. Hughes, had been removed by Dr. Carl A. Fredy at Athens, Ohio, from the ear of a calf shipped from Texas, in the spring of 1939. Many years ago, Hagen (1887) reported that a tick was removed alive in Boston from the ear of a

man who had returned, some four months previously, from a cattle ranch in Arizona. Dr. C. B. Philip has suggested to me that this tick also may have been *O. megnini.* Mr. F. R. Koutz informed me that *O. megnini* has been taken twice on imported cattle near Toledo, Ohio.

Ornithodoros kelleyi Cooley and Kohls

Ornithodoros kelleyi Cooley and Kohls, 1941, U. S. Publ. Health Reports, 56, p. 912, figs. 3A–D; Pl. I, figs. 1C–D (n; off *Pipistrellus* sp.; 4 mi. north of Thompsons, Grand Co., Utah; and 3 mi. east of Utah-Colorado state line); 1944, American Midland Naturalist, Monograph No. 1, p. 113, figs. 51A–G and 52; Pl. XII, 2 lower figs. (♀♂nl). Cooley, 1944, Jl. of Parasitology, 30, p. 294, figs. 2F and 3B, E, H and K (♀♂l).

Ornithodoros talaje Matheson, 1931, Parasitology, 23, p. 270. Herrick, 1935, Jl. of Parasitology, 21, p. 216 (occurrence in houses at Madison, Wisconsin). Matheson, 1937, Jl. Econ. Entom., 30, p. 70. Not of Guérin, 1849.

New York.—Seen: Ransomville, Niagara Co., several specimens taken over a period of five years inside a house; the occurrence was explained at the time by the fact that some sixteen years previously furniture had been brought to the house from San Antonio, Texas; but no doubt the ticks came from bats roosting in the house. These specimens were recorded as *O. talaje* by Matheson (1931), who sent me two of them.

Pennsylvania.—Recorded: Allentown, Lehigh Co., in attic frequented by bats [Cooley and Kohls].

Ohio.—Seen: Athens, larvae off *Eptesicus f. fuscus,* living in a colony in the attic room of a city store, early in August, 1938; Jackson, larvae off *Eptesicus f. fuscus* found in a storage room, September, 1939; some of the larvae were kept alive in a vial for several weeks and eventually produced nymphs (J. H. Hughes); Hebron, 2 adults in a house, December 12, 1938 (T. H. Parks); Fayette Co., adult, July 1, 1942 (L. Lampe).

West Virginia.—Seen: Moorefield, Hardy Co., larvae off *Myotis lucifugus,* July 20, 1944 (L. W. Wilson); Durgeon, Hardy Co., larvae off *Eptesicus f. fuscus,* in a cave, October 14, 1944 (L. W. Wilson).

In addition to the states here listed, *O. kelleyi* has been reported from Utah, Colorado, Minnesota, Iowa, Wisconsin, and Illinois. It is strictly a parasite of bats and there is as yet no evidence that it ever attacks man.

Family IXODIDAE

Key to Genera

Males

Eight-legged; dorsal face of body entirely covered by the rigid shield; capitulum dorsally without porose areas; venter with a genital orifice in the antero-median, intercoxal area.

1. Venter covered more or less completely by seven hardened, non-salient plates, with a distinct curved groove running in front of the anus and extending backward to the hind margin. Shield inornate, the hind margin without festoons. No eyes. Rostrum and palps elongate ..... *Ixodes.*

   Curved groove of venter running behind the anus or indistinct. Venter with or without salient plates. With or without eyes. Hind margin of shield with or without festoons ... 2.

2. Eyes absent. Shield inornate, the hind margin with festoons. Venter without salient plates. Palps short and broad, the outer base of the second segment more or less produced. *Haemaphysalis.*

   Eyes present ..... 3.

3. Capitulum narrow, not angulate at the sides; palps long and slender, particularly the second segment. Shield ornate in all local species, the hind margin with festoons. Venter without salient plates ..... *Amblyomma.*

   Capitulum and palps short and broad ..... 4.

4. Venter without salient plates. Capitulum rectangular. Shield ornate in all local species, the hind margin with festoons. *Dermacentor.*

   Venter posteriorly with four plates, the hind margins of which often protrude. Capitulum hexagonal. Shield inornate 5.

5. Hind margin of shield without festoons. Post-anal groove indistinct ..... *Boophilus.*

   Hind margin of shield divided into festoons. Post-anal groove distinct ..... *Rhipicephalus.*

Females

Eight-legged; dorsal face of body divided into an anterior, hardened shield and a softer, extensible, posterior portion; capitulum dorsally with two porose areas; venter with a genital orifice (vulva) in the antero-median, intercoxal area.

1. Venter with a distinct curved groove running in front of the anus. No eyes. Rostrum and palps elongate. Shield inornate ..... *Ixodes.*
   Venter with a curved groove running behind the anus, or the groove indistinct ..... 2.
2. No eyes. Palps short and broad, the outer base of the second segment more or less produced. Shield inornate. *Haemaphysalis.*
   Eyes present ..... 3.
3. Capitulum narrow, not angulate at the sides; palps long and slender, particularly the second segment. Shield ornate in all local species ..... *Amblyomma.*
   Capitulum and palps short and wide, more or less conical ..... 4.
4. Capitulum rectangular. Shield ornate in all local species. *Dermacentor.*
   Capitulum hexagonal. Shield inornate ..... 5.
5. Post-anal groove indistinct. Second and third segments of palps very short, with angular outer base. Coxa I ending in two very short, blunt spines ..... *Boophilus.*
   Post-anal groove distinct. Second and third segments of palps not unusually short, without projecting outer base. Coxa I divided into two long, parallel, sharp spines. *Rhipicephalus.*

The immature stages show most of the generic characters of the females and may usually be placed by means of the key for that sex. The nymphs are eight-legged and superficially resemble the females, only the anterior portion of the dorsum being covered by a hardened shield; but they lack the ventral antero-median genital orifice and the porose areas of the capitulum. The larvae are six-legged, but otherwise resemble the nymphs. The shield is inornate in the larvae and nymphs of all local species.

The genus *Boophilus* contains the true "cattle tick", *Boophilus annulatus* (Say), of the southern United States. This does not belong to the fauna of our territory, as it does not breed there, although specimens may be imported occasionally. Beardslee (1884) mentions a cattle tick taken from a man at Painesville, Ohio; and A. E. Miller (1925) saw specimens taken in 1906 off imported cattle in the stock-yards at Cleveland, Ohio. Jarvis (1910) also reports finding *B. annulatus* on imported cattle in Ontario.

Genus **Ixodes** Latreille, 1795

Key to Species

Males

The males of *I. brunneus* and *I. auritulus* are as yet undescribed.

1. Hypostome bilobed apically, with few vestigial denticles. Palps horn-like, curved upward, tapering at tips. All coxae without spurs. Some of the tarsi ending in a small spur below. Scutum ending posteriorly in five tufts of hair ..... *I. uriae.*

   Hypostome not bilobed, with distinct denticles or crenulations. Palps flattened, straight, rounded at tips. Some of the coxae with spurs. Tarsi not ending in a spur below. Scutum not ending in tufts of hair ..... 2.

2. Tarsus I short and thick, abruptly narrowed and vertically sloping beyond the dorsal hump, which is close to the tip. Anal and adanal plates at least twice as long as wide. Hypostome with the lateral denticles not well differentiated from the median transverse rows of crenulations. Spiracular plate subcircular ..... 3.

   Tarsus I long and slender, gradually tapering beyond the dorsal hump, which is far from the tip ..... 5.

3. Coxa I with a long, sharp internal spur. Scutum fairly uniformly covered with many moderately large and deep punctations. Median, anal and adanal plates all covered with small punctations ..... *I. cookei.*

   Coxa I with a very short, blunt or rudimentary internal spur. Median plate more finely punctate than anal and adanal plate ..... 4.

4. Spiracular plate with numerous goblets. Scutum with many moderately large and deep punctations, which are sparser only in the center, where there are faint rugosities. *I. texanus.*

   Spiracular plate with few goblets. Scutum with the large punctations in the lateral and posterior areas only, the median area of much smaller punctations rather extensive and without rugosities ..... *I. marxi.*

5. Hypostome with large lateral teeth, well differentiated from the median transverse rows of crenulations. First segment of palp ventrally without longitudinal ridge. Coxa I with a long, sharp internal spur. Spiracular plate longer than wide. Anal and adanal plates at most one and one-half times as long as greatest width ..... *I. scapularis.*

Hypostome with the lateral denticles not clearly differentiated from the median transverse rows of crenulations. Anal and adanal plates relatively longer, nearly twice as long as wide ..... 6.

6. Coxa I with a long, sharp internal spur. First article of palp ventrally with a longitudinal ridge, continuous with and extending the ridge of the second article. Hypostome rounded at apex, with ten to fourteen transverse rows of crenulations ..... *I. dentatus.*

Coxa I with a short, sharp internal spur. First article of palp ventrally without longitudinal ridge ..... 7.

7. Hypostome notched at apex, with eight to ten transverse rows of crenulations or denticles. Spiracular plate longer than wide, with numerous goblets. Anal plate with sides diverging posteriorly ..... *I. muris.*

Hypostome rounded at apex, with five or six transverse rows of crenulations or denticles. Spiracular plate subcircular or a little wider than long, with relatively fewer goblets. Anal plate with nearly parallel sides ..... *I. angustus.*

Females

1. Palps not flattened, somewhat clavate; third segment broader and much shorter than second and broadly rounded off at tip; first segment conspicuous. Basis capituli without auriculae. Tarsus I short, barely more than one and one-fourth times as long as metatarsus. All coxae unarmed. Scutum longer than wide, broadest anteriorly. Body very hairy. *I. uriae.*

Palps flattened; third segment not broader than second. Some or all coxae frequently with spurs ..... 2.

2. Tarsus I slender, one and one-half times to twice as long as metatarsus, tapering gradually to tip, the slight dorsal hump removed from apex ..... 3.

Tarsus I short and thick, barely over one and one-fourth times as long as metatarsus, abruptly narrowed before tip, the strong dorsal hump close to apex ..... 8.

3. Shield little or scarcely longer than broad, without lateral carinae, with submedian (cervical) grooves faintly marked, with many fine punctations and a few stronger ones posteriorly. Basis capituli ventrally with narrow, ridge-like auriculae; dorsally with short cornua. Palps elongate; second segment slightly over twice as long as broad and a

little longer than third; third about twice as long as broad; first ventrally without ridge or spur. Coxa I ending in a long, slender internal spur and a small external tooth. *I. scapularis.*

Shield markedly longer than broad, often twice as long as broad; in doubtful cases with distinct lateral carinae or some of the other characters do not agree ..... 4.

4. Palps moderately long: second segment longer than third, from which it is not clearly separated; first large, extended forward into a sharp prong (visible dorsally and ventrally). Basis capituli dorsally with large cornua and very large porose areas, ventrally with strong, pointed auriculae, directed backward. Coxa I with the internal spur shorter than the coxa ..... *I. auritulus.*

First segment of palps without a prong-like protrusion directed forward, either without spur or with a ventral retrograde spur ..... 5.

5. Shield without lateral carinae, with distinct submedian (cervical) grooves, medially with several, much spaced, large but shallow punctations bearing white hairs, laterally wrinkled. Basis capituli ventrally with broad, blunt auriculae; dorsally with weak or no cornua. Palps very slender; second segment nearly four times as long as broad and longer than third; third fully twice as long as broad; first ventrally without ridge. Coxa I with two subequal, short spurs; coxae II, III and IV each with a short external spur. On birds ..... *I. brunneus.*

Shield with distinct or very weak lateral carinae and more or less distinct submedian (cervical) grooves. Coxa I with two very unequal spurs, the internal much the longer, the external sometimes very small. Basis capituli dorsally with or without distinct cornua. Normally on mammals, rarely on birds ..... 6.

6. Basis capituli dorsally without cornua, ventrally without auriculae. Palps slender; third segment nearly twice as long as wide; first ventrally without retrograde spur. Hypostome acuminate, with 2 or 3 rows of teeth on each side. *I. angustus.*

Basis capituli dorsally with more or less distinct cornua, ventrally with auriculae ..... 7.

7. Shield medially with fine, uniformly scattered punctations, the

sides nearly impunctate, without larger punctations posteriorly. Basis capituli triangular, ventrally with broad, rather blunt auriculae. Palps slender; third segment nearly twice as long as wide; first ventrally without retrograde spur. Hypostome acuminate, with 2 or 3 rows of teeth on each side ..... *I. muris.*

Shield with fine to coarse punctations fairly uniformly distributed all over, more numerous and larger posteriorly. Basis capituli more transverse, ventrally with strong, hook-like, sharp auriculae. Palps broader; third segment at most one and one-half times as long as wide; first ventrally with a prominent, retrograde spur. Hypostome lanceolate, with 4 rows of teeth on each side ..... *I. dentatus.*

8. Coxa I ending in a long, stout internal spur, nearly as long as the remainder of the coxa. Basis capituli ventrally without auriculae, dorsally with moderately projecting cornua. Shield slightly or not longer than broad, with distinct, though weak, lateral carinae; submedian (cervical) grooves faint anteriorly, more pronounced posteriorly; surface with fairly uniformly scattered, medium-sized punctations. Palps short and broad; second segment not over twice as long as wide; third scarcely longer than wide; first ventrally with a prominent, oblique, ridge-like tooth ..... *I. cookei.*

Coxa I without long, stout internal spur, either broadly rounded off at apex or ending in a tooth much shorter than the remainder of the coxa ..... 9.

9. Shield nearly one and one-half times as long as broad, without definite lateral carinae, with broad and shallow submedian (cervical) grooves, rather sparsely punctate medially and more coarsely laterally. Basis capituli subtriangular, ventrally with broad and blunt auriculae, dorsally with weak cornua. Palps short and broad; second segment not over twice as long as wide, but longer than third; third slightly longer than wide; first ventrally with a weak transverse ridge. Coxa I ending in a broad internal spur, which does not reach coxa II ..... *I. marxi.*

Shield slightly or not longer than broad, without definite lateral carinae, with shallow submedian (cervical) grooves, finely punctate medially, rugose laterally. Basis capituli subrectangular, ventrally without or with barely indicated auriculae, dorsally with weak or no cornua. Palps short

and broad; second and third segments subequal; third scarcely longer than wide; first very slightly projecting ventrally. Coxa I broadly rounded off at inner tip.

I. texanus.

Nymphs

The nymph of *I. brunneus* is as yet undescribed.

1. All coxae without or with mere traces of external spurs ..... 2.
   All coxae with well-defined external spurs ..... 4.
2. Scutum widest near middle, without lateral carinae, with very few fine punctations. Spiracular plate subcircular, with few goblets. Basis capituli ventrally with auriculae. Palps flattened, not clavate ..... *I. marxi.*
   Scutum widest much before the middle ..... 3.
3. Palps not flattened, somewhat clavate. Basis capituli ventrally without auriculae. Scutum with many fine and a few larger punctations. Spiracular plate with many goblets ..... *I. uriae.*
   Palps flattened, not clavate. Basis capituli ventrally with auriculae. Scutum impunctate. Spiracular plate with few goblets ..... *I. texanus.*
4. Scutum with lateral carinae present, but sometimes faint ..... 5.
   Scutum without lateral carinae ..... 7.
5. Scutum nearly circular. Basis capituli subtriangular, ventrally with small, lobate auriculae. First article of palp ventrally without a large plate and without horn or tooth.

   I. dentatus.

   Scutum not nearly circular. Basis capituli not subtriangular. First article of palp ventrally with a large plate, produced posteriorly and sometimes also anteriorly into a horn or tooth ..... 6.
6. Basis capituli dorsally with a sinuous hind margin, ventrally with distinct, broadly rounded auriculae ..... *I. cookei.*
   Basis capituli dorsally with a straight hind margin, ventrally with slight traces of auriculae ..... *I. angustus.*
7. External spur of coxa I slightly longer than internal spur. Basis capituli ventrally with conspicuous, retrograde auriculae. First article of palp ventrally with a large plate, produced anteriorly into a horn ..... *I. auritulus.*
   External spur of coxa I not longer than internal spur, usually shorter. First article of palp ventrally without large plate and without horn ..... 8.
8. Basis capituli dorsally with long cornua, ventrally with small, inconspicuous auriculae ..... *I. scapularis.*

Basis capituli dorsally with short cornua, ventrally with conspicuous, pointed auriculae ..... *I. muris.*

No serious study of the larvae of the North American *Ixodes* has as yet been attempted. Of our local species, the larvae of *I. uriae, I. scapularis, I. angustus, I. muris, I. dentatus, I. auritulus,* and *I. cookei* have been described more or less completely.

Ixodes (Ceratixodes) uriae White

Ixodes uriae Ad. White, 1852, in P. C. Sutherland, Journal of a Voyage in Baffin's Bay and Barrow Straits in the Years 1850–1851, vol. 2, Appendix, p. ccx, fig. 10 (on p. ccix) (no sex given, but either ♀ or nymph; off *Uria troile;* region of Baffin's Bay and Barrow Straits). A. C. Oudemans, 1936, Kritisch Histor. Overzicht Acarologie, pt. 3, vol. B, p. 796. Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 223, figs. 86A–G (♀♂n).

Ceratixodes uriae P. Schulze, 1938, Zoolog. Anz., 123, p. 12.

Hyalomma puta Pickard-Cambridge, 1876, Proc. Zool. Soc. London, p. 260; Pl. XIX, figs. 3*a–d* (no sex given, but nymph; off *Pygosceles taeniatus;* Kerguelen Island); 1879, Philos. Trans. Roy. Soc. London, 168, p. 222; Pl. XIII, figs. 4*a–d.*

Ixodes putus Neumann, 1899, Mém. Soc. Zool. France, 12, p. 125, figs. 7–9 (♀n). Nuttall and Warburton, 1911, Ticks, vol. 2, *Ixodes,* p. 256, figs. 254–260; Pl. V, figs. 3–4 (♀♂n). Nuttall, 1912, Parasitology, 5, pt. 1, p. 60, fig. 9 (1); 1913, *op. cit.,* 6, pt. 1, pp. 74–86, fig. 2 (♀♂nl); 1915, *op. cit.,* 7, pt. 4, pp. 437–438.

Ceratixodes putus Neumann, 1902, Arch. de Parasitologie, 6, p. 115 (♀♂). N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 21 and 54; Pl. II, figs. 4–8; Pl. IX, fig. 6 (♀♂).

Ixodes (*Ceratixodes*) *putus procellariae* P. Schulze, 1930, Sitzungsber. Abh. Naturf. Ges. Rostock, (3) 2, (1927–1929), p. 123, figs. 1–3, 5, and 6 (♀; off *Procellaria;* no locality).

Ixodes borealis Kramer and C. J. Neuman, 1883, Vega-Exped. Vetenskap. Iakttag., vol. 3, p. 526; Pl. XLII, figs. *a–e* (♀; no host; Bering or Commander Islands).

Ixodes fimbriatus Kramer and C. J. Neuman, 1883, Vega-Exped. Vetenskap. Iakttag., vol. 3, p. 527; Pl. XLIII, figs. *a–d* (♂; no host; Bering or Commander Islands).

Ixodes hirsutus Birula, 1895, Bull. Ac. Sci. St. Pétersbourg, (5) 2, pt. 4, p. 356; Pl. I, figs. 7–9 (♀n; no host; Unalaska I., Aleutian Archipelago; and doubtfully from Eastern Siberia).

Labrador.—Seen: Parrakeet Island 3♀ without host (Arethusa Exped.—M.C.Z.).[25]

St. Pierre and Miquelon, off the coast of Newfoundland.—Recorded: without host [Neumann, 1899].

Nova Scotia.—Seen: Bird Islands off Cape Breton, ♀ off *Fratercula arctica,* June 27, 1933 (R. W. Smith); Great Bird Rock in the Gulf of St. Lawrence, n off *Uria aalge,* July 1, 1881 (Arethusa Exped.—M.C.Z.).—Recorded: Bay of Fundy, ♀ off *Alca torda* [Cooley and Kohls].

I have also seen a ♀ taken off *Uria lomvia lomvia* (Linnaeus), Southeast Greenland, July 10, 1933 (L. Kilham). Henriksen and Lundbeck (1918, Meddel. om Grönland, 30, pt. 2, p. 780) report it from West Greenland, off *Uria brunnichi* and *Larus glaucus tridactylus.* It is also known from British Columbia.

This peculiar tick is a specific parasite at all stages of certain marine birds both in the northern and southern seas. Its unusual "bipolar" distribution was discussed by P. Schulze (1938). Outside North America, it is recorded from Iceland, the Faroes, the British Isles, northern Russia, Norway, Finland, Kamchatka, Commander Is., Tierra del Fuego, Kerguelen, Antipodes Is., Macquarie Is., Campbell Is., New Zealand, South Georgia, and Antarctica. In the North Atlantic it has been taken off guillemot or murre (*Uria*), puffin (*Fratercula*), fulmar (*Fulmarus*), gannet (*Sula*), gull (*Larus*) kittiwake (*Rissa*), and auk (*Alca*). It has been placed in a special group, *Ceratixodes* Neumann, which should be given at least subgeneric rank.

As recognized by P. Schulze (1938), the oldest valid name for the "puffin tick," usually called *I. putus,* is *Ixodes uriae.* This was not a "nominal species" nor a *nomen nudum,* as has been asserted, but was validly proposed with the following description: "It is of a greyish black colour, and is rather wider in front than behind; the lateral margins are somewhat sinuated, and the legs appear to be long compared with other species of the genus." Moreover, the description is supplemented with a perfectly recognizable figure, showing the characteristic clavate palps. Combined with the host and locality data, this information removes all possible doubt as to the identity of the name. *Ixodes eudyptidis* Haskell, 1888, is a distinct species, not a synonym of *I. uriae.*

[25] No such island is shown on any map I have seen. It was probably one of several islets on the east coast of Labrador, where "parrakeets" or puffins breed.

Ixodes brunneus C. L. Koch

Ixodes brunneus C. L. Koch, 1844, Arch. f. Naturgesch., 10, pt. 1, p. 232 (♀; "North America"; no host); 1847, Uebersicht Arachniden-Systems, vol. 4, p. 101; Pl. XX, fig. 74 (♀ type, off "*Fringilla albicollis*" = *Zonotrichia albicollis*). N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 26 and 53; Pl. III, fig. 9 (♀); 1908, Occ. Papers Boston Soc. Nat. Hist., 7, p. 13. H. S. Peters, 1933, Bird-Banding, 4, pp. 72, 73, 74, and 75; 1936, *op. cit.*, 7, pp. 20, 21, 23, 25, 26, and 27. A. C. Oudemans, 1936, Kritisch Histor. Overzicht Acarologie, pt. 2, vol. B, p. 678, fig. 295. Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 32, fig. 12 (map). Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 205, figs. 79A–G (♀) and 80 (map).

Ixodes frontalis Neumann, 1899, Mém. Soc. Zool. France, 12, p. 133 (in part: ♀ off "*Turdus aonalaschkae pallasi*," Baltimore [= off eastern hermit thrush, *Hylocichla guttata faxoni*]). Not of Panzer, 1798.

Ixodes frontalis brunneus Schulze, 1933, Zeitschr. f. Parasitenk., 6, pt. 3, p. 437, fig. 8 (♀; Koch's type).

Massachusetts.—Recorded: probably from Amherst, off *Spizella p. passerina* [N. Banks]. Worcester, off *Dumetella carolinensis* and *Melospiza m. melodia* [H. S. Peters].

Connecticut.—Recorded: without more definite locality, off *Dumetella carolinensis* [H. S. Peters].

New York.—Seen: ♀ without more definite locality, off *Turdus m. migratorius* (C. M. Herman) and off *Passerella i. iliaca* (L. R. Penner).

New Jersey.—Seen: Princeton, n off *Melospiza m. melodia* (C. Brooks Worth).

Maryland.—Recorded: Baltimore, off *Hylocichla guttata faxoni* [Neumann].

Ixodes brunneus is strictly specific to birds, not being known from other hosts. There is no record from north of Massachusetts. The male, nymph and larva are as yet undescribed. Usually a single tick is found on a bird, attached preferably to the head. When engorged on the eyelid, the tick may impair the eyesight or even cause blindness, as reported by R. H. Thomas (1941) in Arkansas and by C. B. Worth (1942) in South Carolina. In other cases the tick seems to cause symptoms similar to those of tick paralysis (F. C. Bishopp and H. L. Trembley, 1945).

The Old World bird ticks which Nuttall and Warburton (1911, Ticks, vol. 2, *Ixodes,* p. 189) referred to typical *I. brunneus* probably did not belong to the form of eastern North America, but to some other species or race. Whether the Californian *I. kelloggi* Nuttall and Warburton (1908) is a synonym of *I. brunneus,* is also uncertain.

Ixodes auritulus Neumann

Ixodes auritulus Neumann, 1904, Arch. de Parasitologie, 8, p. 450 (based on specimens erroneously referred to *I. thoracicus* in 1899; ♀; off a bird; Punta Arenas, Straits of Magellan). Nuttall and Warburton, 1911, Ticks, vol. 2, *Ixodes,* p. 187, figs. 180–181 (♀). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, pp. 31 and 32, fig. 10 (map). Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 195, figs. 76A–J (♀n) and 77 (map).

Ixodes thoracicus Neumann, 1899, Mém. Soc. Zool. France, 12, p. 149, figs. 22–23 (♀; off a bird; Punta Arenas). Not of Koch, 1844.

Ontario.—Recorded: Temagami, n off "meadow mouse" (*Microtus* sp.) [Bishopp and Trembley].

Ixodes auritulus is strictly a parasite of birds in both North and South America. It attacks preferably land birds of the passerine and gallinaceous groups. The reported occurrence on a small rodent was no doubt accidental.

Ixodes scapularis Say

Ixodes scapularis Say, 1821, Jl. Ac. Nat. Sci. Philadelphia, 2, p. 78 ("United States," without more definite locality; no sex given, but evidently ♀; no host). Hunter and Hooker, 1907, U. S. Dept. Agric., Bur. Ent., Bull. 72, p. 57. N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 25 and 53; Pl. II, figs. 14–15; Pl. IX, figs. 1–2 (♀♂). Hooker, Bishopp and Wood, 1912, U. S. Dept. Agric., Bur. Ent., Bull. 106, p. 76, fig. 3 (map); Pl. V, figs. 1–8 (♀♂nl). A. E. Miller, 1925, Bull. Ohio Agric. Expt. Sta. No. 386, p. 127 (not seen from Ohio). Larrousse, King and Wolbach, 1928, Science, 67, p. 352. A. C. Oudemans, 1936, Kritisch Hist. Overzicht Acarologie, pt. 3, vol. B, p. 739. Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 13, figs. 2A–K, 3A–H, and 4 (♀♂n).

Ixodes ricinus var. *scapularis* Nuttall and Warburton, 1911, Ticks, vol. 2, *Ixodes,* p. 156, fig. 149 (♀♂).

Ixodes ricinus scapularis P. Schulze, 1939, Arkiv f. Zoologi, 31A, No. 18, p. 4, figs. 4–5 (♀♂). Cobb, 1942, Science, 95, p. 503. Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 41, fig. 15 (map).

Ixodes fuscous Say, 1821, Jl. Ac. Nat. Sci. Philadelphia, 2, p. 79 ("United States," without more definite locality; no sex given, but evidently ♂; no host). N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, p. 51.

Ixodes fuscus Walckenaer and Gervais, 1847, Hist. Nat. Insectes, Aptères, vol. 4, p. 352.

Ixodes reduvius Neumann, 1899, Mém. Soc. Zool. France, 12, p. 112 (in part: North American specimens only); 1911, Das Tierreich, Lief. 26, p. 12 (in part: North American records only). Not *Acarus reduvius* Linnaeus, 1758.

Ontario.—Recorded: Bracebridge, ♀ off man [Nuttall and Warburton].

Massachusetts.—Seen: Naushon Island, ♀♂ off *Odocoileus virginianus borealis* (J. Bequaert, September, 1924; S. Cobb, 1940), and nl off *Peromyscus leucopus fusus* (F. Larrousse, summer of 1926) and *Microtus pennsylvanicus* [C. N. Smith, in Cooley and Kohls, 1945]; Sagamore Beach, ♀♂ off dog (H. S. Fuller); Boston, ♀ off dog (J. Bequaert).—Recorded: Nonemesset Island [S. Cobb].

Connecticut.—Seen: Warrenville, ♀ off dog (J. S. Rankin).

New York.—Seen: Jeffersonville, Sullivan Co., ♀ off man (Am.M.N.H.); Mastic, Long Island, ♀ off dog (Am.M.N.H.).

Pennsylvania.—Recorded: ♂, without more definite locality [Neumann].[26]

Maryland.—Recorded: without more definite locality [N. Banks].

Ohio.—Recorded: vicinity of Columbus, off dog [F. R. Koutz, *in litt.*].

Ixodes scapularis, the "black-legged tick," is fairly common in the southeastern United States, from Maryland to Florida and from Iowa and Indiana to Texas. It is much rarer farther north and, in New England, is not known to breed north of the Cape Cod area. The single record from Ontario is no doubt based on an accidental introduction and there is no evidence that this tick is native anywhere in eastern Canada. The adults attack a variety of large and

[26] A. C. Oudemans (1936) assumes that Say's types of *I. scapularis* and *I. fuscous* came from Pennsylvania, but this is a mere guess. Say gave no locality and may have obtained his specimens from farther south in the United States.

medium-sized mammals, but seem to be most often found on Virginia deer. They stray occasionally onto man and are reputed to be more difficult to remove from the skin than *Dermacentor variabilis* and to cause more discomfort. The normal hosts of the immature stages are small mammals, particularly the white-footed mouse, *Peromyscus leucopus fusus;* but F. Larrousse (1928) found that they readily attach to domestic rabbits and guinea-pigs.

The North American *I. scapularis* and the European *Ixodes reduvius* (Linnaeus) are no doubt closely allied species, so much so that Nuttall and Warburton and, more recently, P. Schulze regarded *scapularis* as no more than a variety, race or subspecies of *reduvius.*[27] Neumann even went farther, believing that the North American specimens were identical with those of Europe, while he listed Say's *scapularis* among the unrecognized species. A careful comparison shows, however, that both sexes of *reduvius* and *scapularis* can be separated by several reliable characters. In the male, the spiracular plate is elongate elliptical and much longer than wide in *scapularis,* subcircular and scarcely longer than wide in *reduvius;* the legs are decidedly thicker in *scapularis* than in *reduvius,* as may be seen particularly by comparing tarsus I; the palps are relatively narrower in *scapularis* than in *reduvius;* and the punctations of the scutum are larger in *scapularis* than in *reduvius.* In the female, the same differences are evident in the legs and palps, but the puncturation of the scutum and the shape of the spiracular plate differ very little; in addition, however, the base of the capitulum has short though distinct cornua in *scapularis,* while there is no trace of them in *reduvius,* and the areae porosae are smaller and farther apart in *scapularis* than in *reduvius.* Most of these differences may be recognized by comparing published figures of the European *reduvius* with those given by Cooley and Kohls for *scapularis.* Whether they should be given specific rather than subspecific value is, of course, purely a matter of opinion. Similar differences are commonly used to separate other species in the genus *Ixodes,* and for this reason I prefer to follow Cooley and Kohls in giving *scapularis* full specific rank. In doing so, I am also in-

[27] *Ixodes reduvius* (Linnaeus), described as *Acarus reduvius* in 1758, is the first valid name for the tick commonly called *Ixodes ricinus* (= *Acarus ricinus* Linnaeus, 1758). See the discussions by A. C. Oudemans (1926, pp. 49–88; 1929, pp. 149–193; 1936, pp. 693–694), as well as my own remarks in 1942, Entomologica Americana, 22, No. 4, p. 201.

fluenced by the present known range of *scapularis,* which is restricted to the southeastern United States and the adjoining section of Mexico. This makes it difficult to believe that the European *reduvius* and the American *scapularis* could have been relatively recent offshoots from some common ancestral stock. In any case, there is at present no evidence that the true Old World *I. reduvius* was ever successfully introduced by man since the discovery of the New World. No specimens of *Ixodes* agreeing fully with *I. reduvius* are known at present from America. In this connection, it may also be noted that the adults of *I. scapularis* are most common on wild mammals and relatively rare on domestic animals, while the immature stages are known only from small wild hosts.

Nuttall and Warburton (1911) treated *Ixodes pacificus* Cooley and Kohls (= *Ixodes californicus* Banks, 1908, not of 1904), of western North America, also as a variety of *I. reduvius* (= *ricinus*). The morphological differences between *pacificus* and *reduvius,* or between *pacificus* and *scapularis,* are much of the same order as those pointed out above between *scapularis* and *reduvius.* The known range of *pacificus* is widely separated from that of *scapularis,* apparently without any very closely allied forms occurring in the intervening area.

Ixodes affinis Neumann (1899) was listed by N. Banks and by Nuttall and Warburton as a synonym of *I. scapularis.* Cooley and Kohls regard it as specifically distinct and I am of the same opinion.

As suggested by N. Banks (1908) and accepted by A. C. Oudemans (1936), Say (1821) described the female and male respectively of the same species as *Ixodes scapularis* and *Ixodes fuscous.* The original descriptions are subjoined.

Ixodes scapularis: "Body red, with a few short whitish hairs; thorax blackish-red, well defined, with numerous punctures; tergum, punctures sparsate, and four or five blackish, obsolete, dilated radii on the disk; a deeply indented submarginal line; no abbreviated marginal lines behind; edge rounded; head beneath and above blackish, posterior edge rectilinear, angles abruptly projected backward, very short, acute; eyes distinct, deeply impressed;[28] rostrum slightly canaliculate above, paler than the head; feet blackish-red, ciliate beneath, terminal joint reclivate near the tip on the anterior edge; origin of the anterior ones, armed behind with a large acute spine. Rather common in forests, and frequently found attached to different animals."

[28] Say mistook the porose areas for "eyes." Hence he saw them in the female (*scapularis*) and not in the male (*fuscous*).

Ixodes fuscous: "Body fuscous, ovate, punctured; tergum with a few black, obsolete lines, and a profoundly indented submarginal line, posterior marginal impressed line none; no distinct thorax; edge rounded; head, posterior edge rectilinear, angles not prominent beyond the rectilinear edge; eyes not visible;[28] palpi suboval, terminal joint rather longer than the preceding one. Cabinet of the Academy. A common species."

Ixodes angustus Neumann

Ixodes angustus Neumann, 1899, Mém. Soc. Zool. France, 12, p. 136 (♀; Shoshone Falls, Idaho, off *Neotoma occidentalis*). Nuttall and Warburton, 1911, Ticks, vol. 2, *Ixodes*, pp. 195 and 315, figs. 187, 188, and 190 (♂♀l) [fig. 189 and description of nymph erroneous]. Hewitt, 1915, Trans. Roy. Soc. Canada, (3) 9, Sect. IV, p. 226. Nuttall, 1916, Parasitology, 8, p. 307, footnote (correction of earlier figure and description of nymph). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 30. Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 69, figs. 10 (map), 28A–K and 29A–K (♀♂n).

New Brunswick.—Recorded: Jeffrey, off a "mouse" [Nuttall and Warburton; Hewitt].

Ontario.—Recorded: Quetico, without host.

Quebec.—Recorded: Gaspé, off *Blarina brevicauda* [Bishopp and Trembley].

Maine.—Recorded: Bar Harbor, ♀ off *Clethriomys gapperi* [collected by A. F. Brower.—Cooley and Kohls].

New York.—Seen: Huntington Forest, Newcomb, Essex Co., ♀ off *Synaptomys c. cooperi* (L. C. Stegeman.—Communicated by R. A. Cooley).—Recorded: Hart Lake, Essex Co., ♀ off *Clethriomys gapperi* [collected by F. Harper.—Cooley and Kohls].

West Virginia.—Seen: Morgantown, Monongalia Co., n off *Clethriomys gapperi carolinensis* (L. W. Wilson).

Ixodes angustus is a tick of small rodents, fairly common in the northwestern United States and western Canada, extending as far north as southern Alaska; but it is rare in our territory.

Ixodes muris Bishopp and Smith

Ixodes muris F. C. Bishopp and C. N. Smith, 1937, Proc. Ent. Soc. Washington, 39, p. 133, fig. 1*a–c;* Pl. III, figs. A–I (♀♂nl; Nantucket, Mass., off *Microtus p. pennsylvanicus;* Menemsha, Martha's Vineyard, Mass., off same host; Edgartown, Martha's

Vineyard, off same host and off *Rattus rattus norvegicus;* Barnstable, Mass., off *Microtus p. pennsylvanicus* and *Ondatra z. zibethica;* Wellfleet, Mass., off *Microtus p. pennsylvanicus*). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 39. Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 145, figs. 55 (map), 56A–J and 57A–F (♀♂n).

Labrador.—Seen: Eskimo Point, on the south coast of Labrador, ♀ off *Microtus enixus* (M.C.Z.).

Nova Scotia.—Seen: Lake Kedgemacooge, ♀ off *Napaeozapus i. insignis* (Miss C. Sheldon).

New Hampshire.—Recorded: Melvin Village [Bishopp and Trembley].

Massachusetts.—Apparently a common parasite of small rodents in the Cape Cod region. In addition to the localities listed above, Bishopp and Smith record it from West Falmouth, and give as additional hosts *Zapus h. hudsonius, Peromyscus leucopus fusus,* and *Blarina brevicauda aloga.* I have seen the specimens from Barnstable and Wellfleet; also several nymphs from Naushon Id., off *Microtus p. pennsylvanicus* (S. Cobb); and one ♀ from Groton, off *Melospiza m. melodia* (W. P. Wharton and E. A. Mason).

Rhode Island.—Seen: Conanicut Island, n off young *Troglodytes a. aëdon,* August 3 (Merrill Wood).

New York.—Recorded: Roosevelt Wild Life Experiment Station near Syracuse, off *Zapus h. hudsonius* [L. C. Stegeman.—Recorded by Cooley and Kohls].

Pennsylvania.—Seen: Pymatuning Swamp, Linesville, ♀ off *Zapus h. hudsonius,* March, and n off *Microtus p. pennsylvanicus,* March (J. K. Doutt).

Ixodes muris appears to be at all stages a frequent parasite of small rodents in the northeastern United States and eastern Canada; occasionally it attacks also small migratory birds, apparently both as adult and as nymph. Its known breeding range extends from southern Labrador to Pennsylvania. Most probably birds are only accidental hosts, acquiring this tick when nesting in locations previously occupied by rodents.

Ixodes dentatus Neumann

Ixodes dentatus "Marx" Neumann, 1899, Mém. Soc. Zool. France, 12, p. 119, figs. 4–5 (♀; North America; off rabbit). N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 28 and 53; Pl. IV, fig. 6; Pl. IX, figs. 3–7 (♀ type, off rabbit,

Maryland). Nuttall and Warburton, 1911, Ticks, vol. 2, *Ixodes*, p. 162, figs. 153–154 (♀). F. C. Bishopp and C. N. Smith, 1937, Proc. Ent. Soc. Washington, 39, p. 133. MacCreary, 1939, Delaware Agric. Expt. Sta., Bull. 220, p. 28. C. N. Smith, 1940, Proc. Ent. Soc. Washington, 42, p. 16; Pl. IV, figs. 1–9 (♀♂ln); 1942, *op. cit.*, 44, p. 52 (gynandromorph). S. Cobb, 1942, Science, 95, p. 503. Bell and Chalgren, 1943, Jl. Wildlife Manag., 7, p. 270, 271, and 274; Pl. XIV, figs. 1–8. Smith and Cheatum, 1944, *op. cit.*, 8, pp. 313 and 316. Bishopp and Trembley, 1945, Jl. of Parasitology, 31 p. 35, fig. 14 (map). MacCreary, 1945, Jl. Econ. Entom., 38, p. 126, footnote. C. N. Smith, 1945, Ann. Ent. Soc. America, 38, pp. 223–233 (biology). Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 61, figs. 25A–G, 26A–H (♀♂n), and 27 (map).

Ixodes diversifossus H. S. Peters, 1936, Bird-Banding 7, p. 14. Katz, 1941, Jl. of Parasitology, 27, p. 468. Not of Neumann, 1899.

Massachusetts.—Seen: West Tisbury and Oak Bluffs, Martha's Vineyard, off *Sylvilagus floridanus* (C. N. Smith and M. M. Cole).—Recorded: Nantucket, off rabbit [Bishopp and Smith]. Martha's Vineyard, off *Ondatra zibethica* and *Toxostoma rufum* [Smith].

New York.—Seen: Riverhead, Long Island, ♀ off *Sylvilagus floridanus* (R. Latham); Lyme Township, Jefferson Co., ♀ off *Sylvilagus floridanus*, July 31 (E. J. Gerberg).—Recorded: Wayne Co. and Suffolk Co., off *Sylvilagus floridanus* [Cooley and Kohls]. Fishers Island, Suffolk Co., off *Sylvilagus floridanus* [Smith and Cheatum].

Pennsylvania.—Recorded: Wildwood Park near Harrisburg [Bell and Chalgren]. Adams Co., Dauphin Co. and Westmoreland Co., all off *Sylvilagus floridanus* [Cooley and Kohls].

Ohio.—Recorded: Nile Township, Scioto Co., and Oxford Township, Erie Co., off *Sylvilagus floridanus mearnsi* [Katz].

Maryland.—Recorded: without definite locality, off *Sylvilagus floridanus* [N. Banks.—Holotype], and off *Colinus v. virginianus* [H. S. Peters].

Delaware.—Recorded: New Castle Co., ♀♂ln off *Sylvilagus floridanus*, and n off *Microtus p. pennsylvanicus* [D. MacCreary, 1940 and *in litt.*].

West Virginia.—Recorded: Tyler Co., off *Sylvilagus floridanus* [Cooley and Kohls].

Ixodes dentatus appears to be a specific parasite of Lagomorpha at all stages; but the immature stages are sometimes found also on rodents and birds. C. N. Smith (1945) engorged the larvae experimentally on a towhee. According to F. C. Bishopp and H. L. Trembley (1945), this tick is particularly abundant along the Atlantic coast from Maryland to Cape Cod. C. N. Smith (1942; 1945) made a careful study of the biology and also described a gynandromorph from Nantucket. Although this species mates on the host, males never attach nor feed. One nymph, taken off a rabbit captured at Martha's Vineyard, was infested with the chalcid parasite, *Ixodiphagus texanus* Howard.

J. F. Bell and W. S. Chalgren (1943) observed a massive subcutaneous infestation by *Ixodes dentatus,* which is so unusual that I reproduce their account in full. "A cottontail collected in Wildwood Park near Harrisburg, Pennsylvania, on August 21, 1941, had six ticks attached; these represented larvae and nymphs of the rabbit tick (*Haemaphysalis leporis-palustris*) and nymphs of *Ixodes dentatus.* One engorged tick near the base of the neck was attached to the left of the median line, and there was an indurated area about 5 mm. in diameter. When the tick was removed forcibly, the adjacent skin was compressed, causing the exudation of a small amount of serosanguineous fluid out of a hole about 1 cm. from the site of the attachment. The indurated part and some surrounding skin were removed, and underneath was found an area of necrosis of the fascia of about 5 sq. cm. In this area were nine dark, oval bodies of rather firm consistency, about 2 mm. long by 1 mm. in diameter. In the necrotic tissue they were sharply delimited and easily enucleated. The entire skin of the rabbit was then removed and many similar globules were revealed in other areas. Almost all were torn away with the skin, as the connective tissue surrounding them was continuous with the derma. The largest number were in the cervical region. None was seen on the head or extremities. In some places they were loosely aggregated in groups, and elsewhere were single. Necrosis accompanied the infestation only at the site first mentioned, to the left of the median line at the base of the neck. An accurate count of the number of bodies could not be made, as it was somewhat doubtful that all were of the same nature; however, more than 50 nodules could be identified as of like character. Microscopic examination revealed that the nodules were ticks enveloped in connective tissue. Of 17 nodules examined, 3 contained adult females, 11 contained nymphs,

and 3 held larvae, all of *Ixodes dentatus*. The appearance of the ticks in situ was variable. Some were completely covered by a mass of fibrous connective tissue and microscopically appeared as faint, dark spots in the centers of the translucent nodules; others were covered merely by a thin sheet of tissue and could be distinguished as ticks with the naked eye. After dissolving the tissue capsule, the ticks proved to be in varying states of preservation. Some were perfectly preserved, but in others only the scutum and cocci [coxae] remained, the capitulum and legs having been separated from the body and enfolded with connective tissue."

Ixodes cookei Packard

Ixodes cookei Packard, 1869 (between January 1st and July), 1st Ann. Rept. Peabody Ac. Sci., Salem, p. 67 (♀; Salem, Mass., off "*Arctomys monax*" = *Marmota monax preblorum*). Hunter and Hooker, 1907, U. S. Dept. Agric., Bur. Ent., Bull. 72, p. 55; Pl. III, fig. 4. N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 28 and 53; Pl. III, figs. 1–8; Pl. IX, fig. 4 (♀♂nl); 1908, Occ. Papers Boston Soc. Nat. Hist., 7, p. 13. Jarvis, 1910, 40th Ann. Rept. Ent. Soc. Ontario, for 1909, p. 97. Weiss, 1915, Ent. News, 26, p. 150. Felt, 1918, 33rd Rept. State Ent. New York, for 1917, p. 75. Headlee, 1938, Public Health News, Trenton, N. J., 22, p. 290; 1940, Circ. 395, New Jersey Agr. Expt. Sta., p. 4. Katz, 1941, Jl. of Parasitology, 27, p. 467. MacCreary, 1945, Jl. Econ. Entom., 38, p. 126, footnote. Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 33, fig. 13 (map). Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 91, figs. 36A–I (♀n), 37A–1 (♂), and 38 (map).

Ixodes hexagonus var. *cookei* Nuttall and Warburton, 1911, Ticks, vol. 2, *Ixodes*, p. 183 (♀). Nuttall, 1916, Parasitology, 8, pt. 3, p. 328. Hewitt, 1915, Trans. Roy. Soc. Canada, Third Ser., 9, Sect. 4, p. 227. Matheson, 1937, Jl. Econ. Entom., 30, p. 71.

Ixodes hexagonus Neumann, 1899, Mém. Soc. Zool. France, 12, p. 129 (in part: North American records only). N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 31 and 35; Pl. III, figs. 11 and 13 (♀). Nuttall, 1916, Parasitology, 8, pt. 3, p. 327 (in part: North American records only). Not of Leach, 1815.

Ixodes cruciarius Fitch, 1872, Trans. New York State Agric. Soc. for 1870, p. 366 (no sex given, but evidently ♀; White Creek, New York, off man; New York State, off man and off "*Putorius vison*" = *Mustela vison mink*). N. Banks, 1904, Proc. U. S. Nat. Mus., 28, p. 49, fig. 81 (♀).

Ixodes hexagonus var. *longispinosus* Neumann, 1901, Mém. Soc. Zool. France, 14, p. 283 (♀♂; Texas, off otter, *Mustela vison* and sheep; Maine, off "spermophile" and domestic cat; Colorado, off fox; also North America, without definite locality, off weasel, porcupine and woodchuck).

Ixodes ricinus Stegeman, 1939, Jl. of Mammalogy, 20, p. 494 (Central New York, off *Mephitis mephitis nigra*). Not *Acarus ricinus* Linnaeus, 1758.

Nova Scotia.—Seen: Shelburne Co., ♀ off *Mustela vison mink* (C. R. Twinn.—Ent.Br.Ott.).

New Brunswick.—Seen: St. George, ♀ (M. L. Prebble.—Ent.Br.Ott.); Pettcodiac River, ♀ off cow's udder (A. W. Thorn.—Ent.Br. Ott.).—Recorded: off cat [Nuttall, 1916].

Quebec.—Seen: Byron, n off *Marmota monax rufescens* (E. Davis); near Montreal, ♀ off dog (G. Chagnon); Chicoutimi, ♀ (G. Chagnon); Rimouski, n off "white owl," *Nyctea nyctea* (received from G. Chagnon); La Trappe, off *Marmota monax rufescens* (J. Ouellet); Guyon, ♀ off dog, July 3 (C. H. D. Clarke); Gaureau Lake near Wakefield, n off dog (C. R. Twinn.—Ent.Br.Ott.); Cascades, n off man (C. R. Twinn.—Ent.Br.Ott.); St. Lambert, n off cat (C. R. Twinn.—Ent.Br.Ott.).—Recorded: Shawinigan [C. R. Twinn, *in litt.*].

Ontario.—Seen: Ottawa, ♀ off dog (F. P. Ide.—Ent.Br.Ott.); Listowel, ♀ (M. Lenz.—Ont.A.C.); Guelph, ♀n off *Marmota monax rufescens* (A. W. Baker.—Ont.A.C.); Baden, ♀ (N. S. Hill.—Ont.A.C.); Kirkfield, n off *Mustela vison mink* (R. G. Law.—Bur.An.Ind.); Westboro, ♀ (I. L. Blair.—Ent.Br.Ott.); Smith Falls, ♀ off dog (C. Menagh.—Ent.Br.Ott.); Eganville, ♀ off man (C. R. Twinn.—Ent.Br.Ott.); Peterboro, ♀ off man (F. O. Reilly.—Ent.Br.Ott.); Hemmingford, ♀ off dog (A. L. Stewart.—Ent.Br.Ott.); Glenora Park, ♀ off dog (C. R. Twinn.—Ent.Br.Ott.); Stratford, ♀ off man (C. R. Twinn.—Ent.Br.Ott.).—Recorded: Calabogie, off dog [C. G. Hewitt, 1915]. London [J. D. Detwiler.—C. R. Twinn, *in litt.*]. Ottawa, off dog and off man [C. R. Twinn, *in litt.*].

Maine.—Seen: Blue Hill, n off man; Bangor, ♀ off man; Lucerne, n off *Erethizon d. dorsatum* (F. Harper); Norway, ♀ (G. Frost).—Recorded: Skowhegan (N. Banks); Lincoln, off *Mephitis, Mustela,* red fox and raccoon [Cooley and Kohls]. Neumann's *longispinosus* was based partly upon specimens taken in Maine off "spermophile" (probably some kind of squirrel, since there are no true spermophyles in Maine) and domestic cat.

VERMONT.—Seen: Wells River, ♀ laying eggs, July 26 (W. P. Smith); Mt. Mansfield, ♀n off *Erethizon d. dorsatum,* Sept. 15 (P. C. Stone); Saxtons River, n off man (F. L. Osgood); Rutland, n off man (F. L. Osgood); Mendon, n off *Mustela n. noveboracensis* (F. L. Osgood).—Recorded: Brattleboro, off man [Cooley and Kohls].

NEW HAMPSHIRE.—Seen: Ossipee, ♀ off *Erethizon d. dorsatum* (N. A. Preble); Peterboro, newly hatched ♂♀ wandering about in a house in April (D. L. Augustine); Antrim, ♀ off man; Tamworth, ♀ and n off *Erethizon d. dorsatum* (Lawrence Kilham); Dublin, ♀ (N. K. Concannon).

MASSACHUSETTS.—Seen: Salem, ♀ off *Marmota monax preblorum* (C. Cooke.—Packard's holotype; M.C.Z.), and n off *Mephitis mephitis nigra* (C. Cooke); Plymouth, ♀ off dog; Boston, ♀ off man; Sherborne, ♀n off young fox (A. P. Morse); Charles River Vilage near Boston, ♀nl off *Marmota monax preblorum* (F. Harper); Holliston, n off *Marmota monax rufescens* (W. H. Banks); Brookline, ♀ off *Mustela vison mink* (A. Smith); Buzzards Bay, ♀ off dog, June; Westboro, 1 off *Marmota monax rufescens,* June 5 (H. S. Fuller); Natick, at mouth of inhabited fox den, ♂, May 18, and engorded ♀, April 23 (C. A. Frost); Beverly, n off child's ear, September (R. T. Moulton); Leicester, ♀, September (Ed. Tierney); Essex, n off *Marmota monax preblorum* (A. B. Fuller); Medford, ♀ off domestic cat (Mrs. Wm. Pollary); Lexington, ♀♂ off *Marmota monax preblorum,* May 27 (G. Nelson); Needham, ♀ off dog, July (J. B. Williams); Concord, many nl off *Marmota monax preblorum,* July 17 (W. E. Schevill); Worcester, ♀ fixed to axilla of man, for two weeks (C. V. King); Wakefield, ♀ off *Marmota monax preblorum,* August 5 (E. E. Tyzzer); Barnstable, ♀ off *Mephitis mephitis nigra* (D. Griffin); North Eastham, ♀nl off *Mustela c. cicognanii* (C. M. Herman).—Recorded: Amherst [N. Banks].

CONNECTICUT.—Seen: Stamford, off dog; North Branford, off *Marmota monax* (Conn.A.E.S.); Storrs, ♀n off *Marmota monax* (L. R. Penner); Portland, ♀ off *Urocyon cinereoargenteus borealis* (Conn. Fish Game Div.).—Recorded: Mt. Carmel, off dog [Cooley and Kohls].

NEW YORK.—Seen: ♀ without locality, off *Mustela vison mink* (J. Akhurst); Ithaca, ♀ off *Mustela c. cicognani* (R. Matheson), and ♀ off *Marmota monax rufescens* (Baker); Delmar, ♀n off *Mustela n. noveboracensis,* August 1 (E. J. Gerberg), ♀n off *Mustela vison mink* (F. C. Goble), and engorged ♀ off *Vulpes fulva,* May 15 (F. C. Goble); Greenfield Center, ♀ off man (E. Muench); Albany Co., n off dog, July (F. C. Goble); Clarksville, Albany Co., 1 off *Didelphis*

virginianus (E. J. Gerberg); Reidsville, nl off *Mustela vison mink,* November 29 (F. C. Goble); Medway, ♀ off *Urocyon cinereoargenteus,* December 2 (F. C. Goble); Dutchess Co., ♀ off ferret, January 15 (F. C. Goble); Surprise, ln off *Urocyon cinereoargenteus* and *Mustela n. noveboracensis* (F. C. Goble); Stamford, n off *Urocyon cinereoargenteus* (S. C. Bishopp); Grayhead, n off *Urocyon cinereoargenteus* (F. C. Goble); Rensselaerville, nl off *Mustela n. noveboracensis;* Mehonk Lake, Ulster Co., ♀nl off *Mustela n. noveboracensis,* June 19 (D. Smiley, Jr.).—Recorded: One of Fitch's types of *"cruciarius"* came from White Creek. Washington Hollow; Manlius; Albany; Catskills; Crane Point; Green Co. [N. Banks]. Albany, off man [E. Felt]. Rochester, n, December 21 [Bishopp and Trembley]. Syracuse, off *Marmota monax;* Horse Shoe Island, off *Marmota monax;* South Onondaga, off *Mephitis mephitis nigra;* Huntington Forest, Newcomb, off *Mustela vison* and *Erethizon d. dorsatum;* Three Rivers, Westchester Co., off *Mustela;* Auburn, off *Marmota monax;* Ithaca, off *Marmota monax* and gray fox; Delmar, off gray fox [Cooley and Kohls]. At Cornell University, according to Professor Matheson, there are specimens from Alleghany Co. (off woodchuck); Ithaca (off woodchuck, *Mustela n. noveboracensis,* skunk, man); North Fairhaven; Vorheesville (off red fox); Moravia (off woodchuck); Wampsville (off dog); Ballston Lake; 3-mile Bay; Standfordville, Dutchess Co. (off dog); Canastota (off cat); Harford Mills (off man); Henderson (off dog); Hammond (off man); Fonda (off pig); Blackhead Mt. (n off *Erethizon d. dorsatum*); Rensselaer (♀ off *Marmota monax rufescens;* n off *Mustela n. noveboracensis*); Malden Bridge (n off *Mustela vison mink;* n off *Marmota monax rufescens*); East Schodack (♀ off *Marmota monax rufescens*).

New Jersey.—Seen: Readville, ♀ off dog (N.J.Agr.E.S.).—Recorded: Pine Co. [N. Banks].

Pennsylvania.—Seen: Philadelphia, ♀ (G. J. Cooke); Dauphin Co., ♀ off *Mustela n. noveboracensis,* May 1 and November 18 (P. F. English); Ligonier, ♀n off *Vulpes fulva,* October 14 (J. Link); Lycoming Co., ♀ off *Mustela n. noveboracensis,* March 3 (P. F. English); Montoursville, Lycoming Co., ♀n off *Mustela vison mink,* March 26 (P. F. English), and off *Mustela n. noveboracensis* (Pa. Game Comm.); Coraopolis, ♀ off *Urocyon cinereoargenteus borealis,* October 13 (R. L. Fricke); Chapel Road, Pittsburgh, ♀ off fox (W. J. Powell); Pymatuning Swamp, Linesville (J. K. Doutt); Wildwood Park, Harrisburg, Dauphin Co., n off *Mustela n. noveboracensis;* Bear Meadows, Centre Co., n off *Mustela n. novebora-*

censis; Vincent Township, Chester Co., n off *Mustela n. noveboracensis* (in July, September and November; all by P. F. English); Pyle, Fayette Co., n off *Mustela vison* (J. K. Doutt); Evans City (Mrs. Barrett); Chinchilla, Lackawanna Co., off *Mustela n. noveboracensis* (F. E. Jenkins); Centre Co., off *Mustela n. noveboracensis* (F. A. Glover).—Recorded: without definite locality, ♀ off weasel, December 28 and January 14 [Bishopp and Trembley].

Ohio.—Seen: Athens Co., n off dog and off fox; ♀nl off *Urocyon cinereoargenteus borealis* (J. H. Hughes); Liberty, Jackson Co., ♀ off dog (J. H. Hughes).—Recorded: Oxford Township, Erie Co., off *Marmota monax, Didelphis virginianus* and *Mustela noveboracensis* [Katz]. Cincinnati, off dog [Cooley and Kohls].

Delaware.—Recorded: without definite locality [MacCreary]. Dover, off *Vulpes fulva* [R. Traub.—Corn.Univ.]. Magnolia, off *Vulpes fulva* [Cooley and Kohls].

Maryland.—Seen: Garrett Co. (2 miles East of Cransville, W. Va.), ♀ off *Mephitis mephitis nigra,* May (L. Llewellyn).—Recorded: Aberdeen, off *Vulpes fulva* [Virginia Thomas.—Md.S.H.D.]. Plummers Island [N. Banks]. Baltimore [N. Banks, as *I. hexagonus*]. Off rabbit, Laurel and Easton [E. N. Cory, *in litt.,* as *I. hexagonus*].

Ixodes cookei, the "American castor bean tick," is one of the few common species of Ixodidae in our territory. I regard it as a distinct species, not as a variety or race of the European *Ixodes hexagonus* Leach, which does not occur in North America. The breeding range of *I. cookei* extends beyond the borders of the United States into southern Quebec and Ontario. The favorite hosts of the larva, nymph and female are medium-sized mammals, particularly Carnivora. Males are found only free in the dens or burrows, where they mate before the females reach the host. This tick occasionally attacks man. F. C. Bishopp and H. L. Trembley (1945) report 11 lots (5n and 8♀) taken from this host, 8 being from the New England States, 2 from Pennsylvania and 1 from Quebec. R. Matheson (1937) reports finding one deeply imbedded in the scalp of a two-year-old child, without causing noticeable symptoms or leaving a scar. The father of this child was later bitten by *I. cookei,* in the axilla of the left arm; after the tick was removed, he suffered pain for over two weeks and noticed the effects for almost a year.

N. Banks (1908) figured the larva, as well as the tips and base of the palp of the nymph, but did not describe these stages. The nymph has fairly distinct, but narrow, oblique, ridge-like auriculae on the ventral side of the basis capituli; the ventral ridge of the

basal palpal segment is much stronger and more tooth-like than in the female; the inner spine of coxa I is shorter than in the female.

Four engorged females were taken from a woodchuck at Wakefield, by Dr. E. E. Tyzzer, on August 5, the largest being 14 mm. long. They started laying eggs indoors on August 19 and continued doing so until September 8. On September 15 all females were dead and the first eggs were hatching.

Original description of *Ixodes cookei;* "Female. Body thick oblong oval, being less orbicular than usual, smooth, leathery. Head transversely oblong, but somewhat rounded in front at the insertion of the mandibles, being a little longer than usual; the posterior angles, which are minute, are produced acutely. The mouth-parts are small; maxillary palpi short and very broad, scarcely longer than the head is wide, the inner edge being expanded into a slight angle in the middle; beak small, slender, reaching to the end of the palpi; labium narrow, covered with spines. Thoracic shield about as long as broad, produced triangularly behind; median convexity slightly marked (though distinct in the young), the two impressed lines being nearly obsolete; surface smooth with fine shallow numerous punctures. Body behind leathery, with microscopic wavy lines; hind edge without any crenulations. Vulva situated between the third pair of legs. Body dark reddish brown (young much paler) with pale red slender legs. Length of body .21 of an inch; width, .12 of an inch."

Fitch described three female ticks as *Ixodes cruciarius,* but all three descriptions, although very superficial, appear to refer to *I. cookei.* The first description was of a specimen taken off man at White Creek, New York: "Dimensions, 0.40 long, 0.25 wide, 0.10 high [evidently decimal fractions of an inch]. Color of the body gray, tinged with blue; anteriorly white, of a tallow-like appearance, here and there with a blackish dot or irregular blotch, six of these dots being in a transverse row on the neck. Head and legs chestnut brown. It is of an oval form, with a gentle contraction forward of the middle and narrower forward of this contraction than it is behind it, the ends bluntly rounded, flattened upon the back and also beneath; the back anteriorly sloping gently downward toward the head. The surface very finely and closely striated transversely. The head (in strictness termed the buckler or shield) is coriaceous and glossy, longer than wide, rounded, its sides back of the middle rectilinear for a short distance, and its anterior end cut off transversely. Its surface is punctured, the punctures minute and shallow, more dense on each side, where are two impressed lines

which at their anterior ends approach each other. The beak is short, about a third of the length of the head. The back anteriorly is occupied by large irregular ridges and intervening hollows, which are mostly transverse or oblique. The middle and hind parts present three parallel, wide and deep longitudinal grooves, the middle one less broad, extending farther back, and ending anteriorly in a line with the contraction. Crossing the two interspaces between the longitudinal lines near their middle, is a transverse groove which is less deeply impressed. On the under side two large grooves begin at the throat, and, diverging from each other, extend the whole length, and between them posteriorly is a medial groove which reaches backward beyond the ends of the lateral ones.'' The next description is of a specimen from New York State, without definite locality: ''Length 0.10 [inch]. Of a lurid dove color or leaden-blue, with an impressed furrow on each side of the back, the furrow slightly interrupted near its forward end; and, posteriorly, a similar furrow along the middle, extending a little farther back than the lateral ones, its anterior end more slender, and terminating about opposite to the middle of the lateral ones. Beneath, similar, but the lateral furrows almost in contact at their anterior ends, and diverging backward; and the middle furrow short, being merely a deep, oblong, oval indentation. The head, or clypeus, is crustaceous and shining, diamond shaped, with the posterior end and lateral angles rounded and the fore end transversely truncated. It is finely punctured, with two impressed lines reaching almost its entire length, with a shorter line on each side between these and the outer edge. The head is of pale chestnut color, as are also the beak and legs. These last are shortish, thread-like and equal in length, each composed of six short joints, about twice as long as thick.'' The third description was based on a specimen off *Mustela vison mink* [''*Putorius vison*''], from somewhere in New York State: ''The specimen measures 0.38 by 0.23 [inch], and is regular oval, with bluntly rounded ends. It is flattened and glossy, of a white color tinged with leaden blue, the head, mouth and legs being dark brown and shining. On the back are three dilated, impressed lines or grooves, which are uneven, the lateral ones being narrowed by a contraction toward their anterior ends. The middle groove commences farther back than the lateral ones, and its anterior portion is shallow. Posteriorly it is prolonged beyond the ends of the lateral ones. Beneath are two longitudinal grooves, and between their hind ends is an elliptic impression, in depth and width similar to the grooves. One and another of these grooves becomes small and slight, and again

becomes deep and wide at the will of the animal when it is living; and in the lateral ones, on the back, a series of punctures, five in number, are at times quite conspicuous. And I notice the middle groove on the back at times becomes for a moment or two greatly increased in its depth and width, the lateral grooves simultaneously being almost obliterated. Over the whole surface are very close minute transverse striae. The coriaceous chestnut brown head has numerous punctures evenly scattered over its surface, and four impressed longitudinal lines, the middle ones diverging backward. The two lines on each side incline to unite at their ends, thus inclosing an elliptic space."

Original description of *Ixodes hexagonus* var. *longispinosus* (translated): "Coxae I with a long, sharp spine, which covers part of the following coxa; the short spines of the other coxae slightly stronger than in the typical form."

Ixodes marxi N. Banks

Ixodes hexagonus var. *inchoatus* Neumann, 1901, Mém. Soc. Zool. France, 14, p. 283 (in part: ♀ off squirrel and fox, United States).

Ixodes marxi N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 32 and 53; Pl. III, fig. 10; Pl. IX, fig. 8 (♀; off red squirrel: Washington, D. C.; Salineville and Wauseon, Ohio; Ithaca, New York; Portland, Michigan; Guelph, Ontario; off fox: Denver, Colo.). Jarvis, 1910, 40th Ann. Rept. Ent. Soc. Ontario, for 1909, p. 97. Nuttall and Warburton, 1911, Ticks, vol. 2, *Ixodes,* p. 173, fig. 167 (♀). Hewitt, 1915, Trans. Roy. Soc. Canada, Third Ser., 9, Sect. 4, p. 228. Nuttall, 1916, Parasitology, 8, pt. 3, p. 329. Katz, 1941, Jl. of Parasitology, 27, p. 468. Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 39. MacCreary, 1945, Jl. Econ. Entom., 38, p. 126, footnote. Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 125, figs. 47A–K (♀n), 48A–F (♂), and 49 (map).

Nova Scotia.—Recorded: Kedgemokooge, off *Lepus americanus virginianus* [Cooley and Kohls].

Ontario.—Seen: Ottawa, off *Tamiasciurus hudsonicus loquax* (De Lury); Guelph, ♀n, paratypes, off *Tamiasciurus hudsonicus loquax* (Jarvis).—Recorded: Toronto, off *Tamiasciurus hudsonicus loquax* [Bishopp and Trembley].

Maine.—Seen: Five Islands, Georgetown, Sagadahoe Co., ♀ off *Tamiasciurus hudsonicus loquax,* April 11 (J. D. Smith); E. Blue

Hill, Hancock Co., ♀n off *Tamiasciurus hudsonicus loquax,* August 28 (V. G. Dethier).—Recorded: Bar Harbor, off *Tamiasciurus hudsonicus loquax* [Cooley and Kohls].

New Hampshire.—Seen: Peterboro, n off *Glaucomys sabrinus macrotis,* March 23 (C. F. Batchelder); Center Ossipee, ♀n off *Tamiasciurus hudsonicus loquax,* August 31 (H. S. Fuller).

Vermont.—Recorded: Rutland, in nest of *Glaucomys sabrinus macrotis* [Cooley and Kohls].

Massachusetts.—Seen: Sagamore Beach, ♀n off *Tamiasciurus hudsonicus loquax,* June 15 (H. S. Fuller).

New York.—Seen: Ovid, ♀ off *Tamiasciurus hudsonicus loquax,* and ♀ off *Sciurus carolinensis leucotis* (R. Matheson); Ithaca, ♀ and n paratypes, off *Tamiasciurus hudsonicus loquax* (N. Banks; R. Matheson); Turkey Hill, ♀n off *Tamiasciurus hudsonicus loquax* (R. Matheson).—Recorded: Webster, off red squirrel [Bishopp and Trembley]. Newcomb, off *Tamiasciurus hudsonicus loquax* and *Tamias striatus;* Ithaca, off *Tamias striatus, Tamiasciurus hudsonicus loquax* and *Sciurus carolinensis leucotis* [Cooley and Kohls].

New Jersey.—Seen: Riverton, ♀ off *Tamiasciurus hudsonicus loquax* (O. W. Leister).

Pennsylvania.—Seen: Pittsburgh, ♀ off *Glaucomys v. volans* (R. Matheson); Pymatuning Swamp, Linesville, ♀ off *Tamiasciurus hudsonicus loquax,* March (J. K. Doutt); Haverford Township, Delaware Co., ♀ off *Tamiasciurus hudsonicus loquax* (B. J. Davis).—Recorded: Dauphin Co., off *Sciurus carolinensis* [Bishopp and Trembley].

Ohio.—Recorded: Salineville; Wauseon [N. Banks]. Nile Township, Scioto Co., off *Sciurus c. carolinensis;* Ashtabula Co., off *Tamiasciurus hudsonicus* [Katz; Bishopp and Trembley]. State University woodlot, off *Sciurus c. carolinensis* [Cooley and Kohls].

Delaware.—Recorded: New Castle Co., off *Tamiasciurus hudsonicus loquax* (D. MacCreary.—Del.A.E.S.). Faulkland, off *Tamiasciurus hudsonicus loquax* [Bishopp and Trembley].

Maryland.—Recorded: Laurel, off *Sciurus c. carolinensis;* Langley Park, off *Sciurus c. carolinensis* [Bishopp and Trembley].

Ixodes marxi, the "squirrel tick," is moderately common and widespread in our territory. It occurs normally, as nymphs and adult females, on chipmunks and squirrels. The larva and its host are as yet unknown.

Ixodes texanus N. Banks

Ixodes texanus N. Banks, 1909, Proc. Ent. Soc. Washington, 10, pts. 3–4, p. 172, figs. 16–17 (♀; Live Oak Co., Texas; off raccoon).

Nuttall and Warburton, 1911, Ticks, vol. 2, *Ixodes,* p. 214, figs. 210–211 (♀). Bishopp, 1912, Proc. Biol. Soc. Washington, 25, p. 32 (♀). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 43, fig. 16 (map). Cooley and Kohls, 1946, U. S. Nat. Inst. Health, Bull. 184, p. 77, figs. 30A–K (♀n), 31A–F (♂), and 32 (map).

Ixodes pratti N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 27 and 53 (in part: ♀ from Kerrville, Texas, only).

In disposing of the name *I. pratti,* I follow Cooley and Kohls' recent Monograph (1946). N. Banks originally confused three species under his *I. pratti* and his figures seem to have been in part composites drawn from more than one specimen. The specimens from Sherwood, Texas, and Walker Pass, Death Valley, California, were separated by Bishopp in 1911, and included under his *Ixodes kingi,* a species not found in our territory. This left the female and male from Kerrville, Texas, as possible types of *I. pratti.* Cooley, in reviewing this type lot noted that the male was a specimen of *I. scapularis.* This male was selected by Cooley and Kohls (1946) as the lectotype, thus making the name *pratti* a synonym of *scapularis.* The female from Kerrville, however, was badly mutilated, but nevertheless recognizable as that of *I. texanus.* Mr. McIntosh and I examined this female some time ago and we had reached the same conclusion.

Ontario.—Seen: Kirkfield, 2♀ off *Mustela vison mink* (R. G. Law.—Bur.An.Ind., communicated by Mr. A. McIntosh).

Ixodes texanus is fairly common in western North America, from British Columbia to California and eastward to Iowa, Texas, and Louisiana. The only record from our territory is based on specimens found on a mink in a fur farm and was most probably due to an accidental introduction. There is no real evidence that any part of our territory falls within the natural breeding range of the species. The usual hosts are wild Carnivora and squirrels.

Genus **Rhipicephalus** C. L. Koch, 1844

Only one species is known from North America, where it was introduced by man from the Old World.

Rhipicephalus sanguineus (Latreille)

Ixodes sanguineus Latreille, 1806, Gen. Crust. Ins., vol. 1, p. 157 (no sex; France; no host).

Rhipicephalus sanguineus Hooker, Bishopp and Wood, 1912, U. S. Dept. Agric., Bur. Ent., Bull. 106, p. 102; Pl. VI, figs. 10–17 (♀♂nl). Larrousse, King and Wolbach, 1928, Science, 67, p. 352. McIntosh, June, 1931, North American Veterinarian, 12, p. 37, figs. 1–2 (♀♂); August, 1933, *op. cit.*, 14, p. 31, figs. 1–2 (♀♂). Matheson, 1937, Jl. Econ. Entom., 30, p. 70. Headlee, 1938, Publ. Health News, Trenton, N. J., 22, p. 290; 1940, Circ. 395 New Jersey Agr. Expt. Sta., p. 4, figs. 1–2 (♀♂). MacCreary, 1940, Delaware Agric. Expt. Sta., Bull. 227, p. 30. P. C. Stone, 1941, Proc. Missouri Ac. Sci., 6, pp. 75–77. Koutz, 1944, Jl. Amer. Vet. Med. Assoc., 104, p. 201. MacCreary, 1945, Jl. Econ. Entom., 38, p. 126, footnote. Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 46, fig.18 (map).

Rhipicephalus texanus N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 34 and 56; Pl. V, figs. 1–4 (♀♂; Texas: San Antonio; Victoria; Brownwood; Brownsville; Green Lake. New Mexico: Albuquerque. Mexico. Off dog and horse).

Ontario.—Recorded: Espanola, Nipissing District, off dog. March, 1940 [Mrs. Laurie K. Harvie.—Record published in Canad. Insect Pest Rev., 18, 1940, pp. 129 and 161, according to C. R. Twinn, *in litt.;* the ticks were apparently imported on the dog from either Washington, D. C., or New York City].

Nova Scotia.—Seen: Baddeck, Cape Breton Id., ♀ off dog, August, 1939 (M. H. Grosvenor).

Maine.—Recorded: in 1938 [according to P. C. Stone].

Massachusetts.—Seen: Boston, ♀ off dog, April, 1936 (J. Bequaert), and gravid ♀ in house, May, 1938 (N. K. Concannon); Brookline, n in house, August 1937 (L. Weintraub); Needham, n off dog, August, 1939.—Recorded: Naushon Id. [Larrousse, King and Wolbach, 1928].

Connecticut.—Recorded: New Haven, off dog and in cracks of wood finish in a house [Conn. A. E. S.].

New York.—Seen: New York City, ♀♂ off dog (J. Bequaert); Elsmere (R. E. Thorpe); Bronx, New York City, ♀ off dog (Dr. Baker); Albany, gravid ♀ in house, March, 1940 (D. Stoner), and 2♀ (one gravid) off dog, January, 1944 (F. C. Goble); Mt. Kisco, ♀♂ off dog (O. R. Hoffman); Chappaqua, ♀♂n in house, 1936 (R. Matheson); Delmar, gravid ♀ off dog, July, 1941 (C. B. Seagears).—Recorded: Yonkers; Buffalo [McIntosh, 1931].

New Jersey.—Seen: Beach Haven, n in house, September, 1932

(E. B. Way); New Brunswick, engorged ♀ off dog, February, 1938 (J. B. Schmitt); Metuchen, ♂n engorged ♀ off dog and in house, March, 1939 (J. B. Schmitt).—Recorded: without definite locality [Headlee, 1938].

Pennsylvania.—Seen: Philadelphia, in house, under wall paper.—Recorded: in 1927 [according to P. C. Stone].

Ohio.—Seen: Columbus (T. H. Parks; F. D. Ford).—Recorded: according to F. R. Koutz (1944), common near Columbus and becoming more widespread in the State.

Delaware.—Recorded: Wilmington, November 1939 [MacCreary].

Maryland.—Seen: 8 miles south of Prince Frederick, ♀ August, 1941 (H. Field).—Recorded: first record in 1936 [P. C. Stone]. Baltimore; Salisbury; Stockton; from 1939 on [E. N. Cory, *in litt.*—Md.S.H.D.].

Rhipicephalus sanguineus, the "brown dog tick," was introduced by man into the New World with its favorite and normal breeding host, the domestic dog. A careful comparison of American and Old World specimens discloses no appreciable difference. Cotypes of *Rhipicephalus texanus* (M.C.Z.), which I examined, are also indistinguishable from European and African *R. sanguineus.* This tick is as yet relatively scarce in the northern United States, but is much more frequent in the southern states. It is, however, on the increase and becoming more widespread in recent years (McIntosh, 1931; Matheson, 1938; P. C. Stone, 1941). It is now known as far north as Ontario, Nova Scotia, Massachusetts, northern New York, Ohio, Indiana, Illinois and Michigan. In North America *R. sanguineus* is essentially a domestic tick, and does not occur in fields, pastures or woods. Owing to the small size of the larvae and nymphs, infestation of dogs may readily be overlooked and the tick may thus become well established in kennels and houses, where it will breed throughout the year. In the fall of 1937, Prof. Matheson writes me, a lady at Chappaqua, New York, vacated her house because of the abundance of *R. sanguineus.* Although the rooms were treated by vermin exterminators twice, ticks remained too abundant for comfort. Prof. Matheson also heard of a house at Flushing, New York, so heavily infested with ticks that two fumigations with hydrocyanide fumes failed to eliminate them. Headlee (1940) reports two similar infestations of houses in New Jersey. A gravid female, found freely moving in Boston on May 16, oviposited about June 3 and died on June 10. The eggs, kept in a box at room temperature, hatched June 20.

In many tropical and subtropical countries, *R. sanguineus* is the carrier of canine piroplasmosis or malignant jaundice of dogs, a disease caused by *Babesia canis* (Piana and Galli-Valerio). This disease was recently reported from Florida.

Although in infested dwellings *R. sanguineus* sometimes crawls onto people, there is as yet no authenticated case of its attaching to man in North America. It does so frequently, however, in certain regions of the Old World, particularly in southern Europe and North Africa. Here it transmits from dog to man so-called "fièvre boutonneuse," a relatively mild type of spotted fever. In this connection, it is of interest that this tick has not yet been found on a wild host in North America, whereas in the Old World all stages, but more often the larvae, occur on wild rabbit, badger and hedgehog.

Genus **Dermacentor** C. L. Koch, 1844

Key to Species

Females and Males

In the adults of our local species the scutum has more or less extensive white enamel markings.

1. Spiracular plate with a distinct, short and broad dorsal prolongation and with many minute goblets. Scutum with anastomosing white enamel markings or mostly white. Coxae II to IV of male with the external spur scarcely longer than wide at base ..... *D. variabilis.*

   Spiracular plate without distinct dorsal prolongation and with a moderate number of medium-sized goblets. Coxae II to IV of male with the external spur nearly twice as long as wide at base ..... 2.

2. Scutum with extensive white enamel markings or mostly white with brown streaks and spots. Basis capituli, palps and legs blotched with white ..... *D. erraticus* var. *albipictus.*

   Scutum mostly reddish-brown, with few white enamel spots; in the male with black lines. Basis capituli, palps and legs not blotched with white ..... typical *D. erraticus.*

Nymphs

1. Spiracular plate with many small goblets. Coxa IV without spur. Basis capituli triangular, with pointed sides. *D. variabilis.*

Spiracular plate with about ten large goblets. Coxa IV sometimes with a faint external spur. Basis capituli subquadrate, with convex sides ..... *D. erraticus.*

Larvae

1. Basis capituli drawn out into sharp points at the sides. *D. variabilis.*

Basis capituli bluntly pointed or rounded off at the sides. *D. erraticus.*

Dermacentor variabilis (Say)

Ixodes variabilis Say, 1821, Jl. Ac. Nat. Sci. Philadelphia, 2, p. 77 (no sex, but apparently ♂; "United States"; no host). A. C. Oudemans, 1936, Kritisch Histor. Overzicht Acarologie, pt. 3, vol. B, p. 587.[29]

Dermacentor variabilis N. Banks, 1907, Proc. U. S. Nat. Mus., 32, p. 608. Hunter and Hooker, 1907, U. S. Dept. Agric., Bur. Ent., Bull. 72, p. 50; Pl. IV, fig. 5. N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 49 and 55; Pl. VII, figs. 3, 4, 6, 8; Pl. X, figs. 3–4 (♀♂); 1908, Occ. Papers Boston Soc. Nat. Hist., 7, p. 13. Jarvis, 1910, 40th Ann. Rept. Ent. Soc. Ontario, for 1909, p. 97. Stiles, 1910, U. S. Treasury Dept., Hygienic Labor., Bull. No. 62, p. 29, figs. 3–6, 51, 52, 72, 84, 103, 104, 122 and 123 (♀♂). Neumann, 1911, Das Tierreich, 26, Acarina, Ixodidae, p. 101. Hooker, Bishopp and Wood, 1912, U. S. Dept. Agric., Bur. Ent., Bull. 106, p. 190, fig. 16 (map); Pl. XV, figs. 1–11 (♀♂nl). Hawden, 1913, Parasitology, 5, p. 234. Weiss, 1915, Ent. News, 26, p. 150. A. E. Miller, 1925, Bull. Ohio Agric. Expt. Sta., No. 386, p. 129; Pl. II, fig. 6 (♀). Zebrowski, 1926, Trans. Amer. Ent. Soc., 51, pp. 331–369; Pls. XII–XIV (♀♂nl). Larrousse, King and Wolbach, 1928, Science, 67, p. 352. Shipley, 1932, Johns Hopkins Hosp. Bull. 51, p. 86. Parker, Philip and Jellison, 1933, Amer. Jl. Trop. Med., 13, p. 348, map (on Pl. I). Hertig and Smiley, 1937, The Vineyard Gazette, January 15 (and reprint). Clarke, 1937, Canad. Field-Natur., 51, p. 99. Bishopp and Smith, 1938, U. S. Dept. Agric. Circ. 478, pp. 1–25, figs. 1–13 (♀♂nl). Cooley, 1938, U. S. Nat. Inst. Health,

[29] Oudemans claims that this and *I. punctulatus* were described without country of origin; but the title of Say's paper states that all his Arachnida came from the United States.

Bull. No. 171, p. 23; Pl. II, fig. 9; Pl. III; Pl. IV, figs. 1–7; Pl. XXI, figs. 5–16; Pl. XXVI, figs. 15–19; Pl. XXVII, figs. 1–9 (♀♂nl). Headlee, 1938, Public Health News, Trenton, N. J., 22, p. 290. Trager, 1939, Jl. of Parasitology, 25, p. 233. MacCreary, 1939, Delaware Agri. Expt. Sta., Bull. 227, p. 29. Headlee, 1940, Circ. 395, New Jersey Agric. Expt. Sta., p. 8, figs. 3A–C (♀♂). Friedman, 1940, Arch. Derm. Syph., 41, p. 882, figs. 1–2 (♀). Katz, 1941, Jl. of Parasitology, 27, p. 467. Smith and Cole, 1941, Ann. Ent. Soc. America, 34, pp. 426–431. S. Cobb, 1942, Science, 95, p. 503. Bell and Chalgren, 1943, Jl. Wildlife Manag., 7, p. 275. Wilson, 1943, Jl. of Mammalogy, 24, p. 103. Eddy and Joyce, 1944, Iowa State Coll. Jl. Sci., 18, pp. 313–324. Koutz, 1944, Jl. Amer. Vet. Med. Assoc., 104, p. 201. MacCreary, 1945, Jl. Econ. Entom., 38, p. 126, footnote. Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 22, fig. 9 (map).

Ixodes albipictus Packard, 1869 (January to July), 1st Ann. Rept. Peabody Ac. Sci., Salem, p. 65 (in part: ♀ without host, from Munson's Hill near Washington, D. C.; not the ♀ off moose, presumably from Nova Scotia, nor ♀ of Packard, August, 1869, Guide to Study of Insects).

Ixodes 5-striatus Fitch, 1872, Trans. New York State Agric. Soc. for 1870, p. 366 (no sex, but evidently ♀; Virginia and Tullahassee, Oklahoma; no host).

Ixodes robertsonii Fitch, 1872, Trans. New York State Agric. Soc. for 1870, p. 366 (no sex, but evidently ♂; Tullahassee, Oklahoma; no host).

Dermacentor electus C. L. Koch, 1844, Arch. f. Naturgesch., 10, pt. 1, p. 235 (♀♂; Pennsylvania; no host); 1847, Uebersicht Arachniden-Systems, vol. 4, p. 109; Pl. XXII, figs. 83–84 (♀♂).

Ixodes punctulatus Say, 1821, Jl. Ac. Nat. Sci. Philadelphia, 2, p. 78 (no sex, but apparently ♀; "United States"; no host).

?Ixodes cinctus Fabricius, 1805, Syst. Antliat. p. 356 (no sex; North America; no host). N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, p. 52. A. C. Oudemans, 1936, Kritisch Histor. Overzicht Acarologie, pt. 3, vol. B, p. 574.

Ixodes bovis Lintner, 1874, Country Gentleman, XXXIX, p. 631; 1890, 43rd Rept. State Mus. Nat. Hist. Albany, p. 156, figs. 24–25 (Bucks Co. and Montgomery Co., Pennsylvania; according to the figures this was *Dermacentor variabilis*). Not *Ixodes bovis* "Riley" Packard, 1869.

Dermacentor americanus Neumann, 1897, Mém. Soc. Zool. France, 10, p. 365 (♀♂). Not *Acarus americanus* Linnaeus, 1758.

?Ixodes bifurcatus Neumann, 1899, Mém. Soc. Zool. France, 12, p. 122 (♀; Texas; off wildcat).

?Dermacentor bifurcatus Neumann, 1904, Arch. de Parasitologie, 8, p. 453; 1911, Das Tierreich, 26, Acarina, Ixodidae, p. 104.

Ontario.—Seen: Bothwell, 2♂, May 28, 1936 (Marjorie McLean. —Ont.A.C.); Vineland, ♀♂ off dog (W. C. Garlick.—Ent.Br.Ott.); Walpole Island, mouth of St. Clair River, ♀ (W. A. Dent.—Ent. Br. Ott.).—Recorded: Guelph, off dog [Jarvis]. Six Nations Indian Reservation near Brantford, off dog [C. B. Clarke]. London; Chatham, off man [R. Matheson, *in litt.*]. Scotland, off dog [C. R. Twinn, *in litt.*]. Strathray, off man [A. Gibson.— C. R. Twinn, *in litt.*].

Nova Scotia.—Recorded: Sissiboo River, Digby Co., adults off man, May, 1943, and 1944 [A. Kelsall.—C. R. Twinn, *in litt.*, and 1944, Canad. Insect Pest Rev., 24, p. 170].

Vermont.—Recorded: Bellows Falls [N. Banks].

Massachusetts.—Seen: Naushon Id., ♀♂n, October 25 (J. Bequaert); Marion; Cotuit; Lowell; Eastham, off dog; North Eastham, ♀♂ off *Marmota monax preblorum*, and ♂ off *Mustela c. cicognanii* (C. M. Herman); Rochester, ♀ off man; Berlin, ♂ taken sweeping in woods, July, 1940 (C. A. Frost); Nonamesset Id., ♀♂, August (C. E. Renn); Barnstable, ♂ off *Ondatra z. zibethica*, and ♂ off *Marmota monax preblorum* (D. Griffin); Manomet Point (J. Bequaert); Duxbury, ♀♂ off dog, April, 1945 (Ruth Turner); Plymouth, June, 1943 (W. L. Nutting); Jamaica Plain; Newtonville; Cambridge, ♂ off man (J. Bequaert); Wellesley, ♀♂ off domestic cat, May 20, 1943 (said to be acquired locally); West Somerville, off dog (J. H. Blake); Wareham (O. Bangs); Worcester, ♂ off man (H. S. Fuller); Sagamore Beach, 2,080♂ and 2,893♀ taken off one dog during the summer months, 1934 to 1938;[30] 1♂ (June) and 1n (September) off *Sciurus carolinensis leucotis*, 2n off *Tamiasciurus hudsonicus loquax* (July), 1n off *Tamias striatus lysteri* (June) (all H. S. Fuller); Chatham (J. H. Emerton); Nantucket; Menemsha and Gay Head, Martha's Vineyard (P. H. Parker); Woods Hole, off dog (A. P. Morse); Dedham, gravid ♀ off a dog said not to have left the locality, July, 1941.—

[30] The only other ticks taken off this dog were 1♀ and 2♂ of *Ixodes scapularis*. It is noteworthy that this large lot contained no nymphs nor larvae of *D. variabilis*.

Recorded: Siasconset; West Falmouth, Buzzards Bay [C. W. Stiles]. Duxbury; Harwich; Wellfleet [P. C. Stone, *in litt.*]. Amherst, off a dog recently arrived from New Jersey [P. C. Stone, *in litt.*]. Naushon Id. [Larrousse, King and Wolbach]. Martha's Vineyard [Hertig and Smiley; C. N. Smith].

CONNECTICUT.—Seen: South Norwalk (F. D. Kingsbury); Darien, off dog (C. K. Sharpe).—Recorded: Saybrook, off dog; Wethersfield, off dog; Stratford, off a man who became infested in Massachusetts [all Conn.A.E.S., *in litt.*].

NEW YORK.—Seen: Port Henry, Essex Co.; Long Island: King's Park (Herrick); Mattituck; Riverhead; Sag Harbor; Orient; Gardiner's Island (R. Latham); Montauk (J. H. Cohen; R. D. Glasgow and D. L. Collins); Hither Hills State Park (R. D. Glasgow and D. L. Collins).—Recorded: Ithaca; Elmhurst, Long Island; Schenectady, off dog; White Plains, off man [all R. Matheson, *in litt.*]. Murray Isle [N.J.A.E.S., *in litt.*].

NEW JERSEY.—Seen: Lakehurst (F. E. Lutz); New Brunswick; Long Branch; Westfield; Ocean City; Newark (N.J.A.E.S.); Hohokus.—Recorded: Lyndhurst; Port Jervis; Reaville; Hackensack; Cape May Court House; Rahway; Shrewsbury; Elberon; Elizabeth; Trenton; Metuchen; Locust; Montclair [N.J.A.E.S., *in litt.*]. Princeton [Trager].

PENNSYLVANIA.—Seen: Bryn Mawr; Berwyn (G. W. Pyle).—Recorded: Bucks Co. and Montgomery Co. [Lintner]. Near Philadelphia [Zebrowski]. Berks Co. [Bell and Chalgren].

OHIO.—Seen: Athens and Chauncey, Athens Co.; Pomeroy, Meigs Co., 1♀ off young *Urocyon cinereoargenteus borealis* (W. E. Ellis); Liberty, Jackson, Scioto, Lick, Franklin and Hamilton, Jackson Co.; Meigs, Adams Co.; Perry and Raccoon, Gallia Co. (all collected by J. H. Hughes; of 160 lots, all adults, sent by him, 124 were off dog, 6 off cattle; 1 off horse, 1 off fox, 1 off cat, 10 off man, the remainder without host); Crane Hollow, Hocking Co.; Fairfield Co.; Columbus; Delaware Co.; Shawnee State Forest (these five localities, D. J. and J. N. Knull); Ross Co. (D. J. Borror).—Recorded: Nile Township, Scioto Co. [Katz]. Without more definite locality [Miller].

WEST VIRGINIA.—Seen: Moorefield, Hardy Co., 2♀ off *Microtus p. pennsylvanicus* and 2 fully engorged ♀ off dog (L. W. Wilson).

DELAWARE.—Seen: Woodkill (C. T. Brues).—Recorded: throughout the state, adults off horse, cow, pig, dog, domestic cat, fox, opossum, ground hog, and gray squirrel; larvae and nymphs off meadow mice (*Microtus*), pine mice (*Pitymys*), white-footed mice

(*Peromyscus*), kangaroo mice (*Zapus*), house mice (*Mus musculus*), domestic rat (*Rattus norwegicus*), and rabbit (*Sylvilagus*) [D. MacCreary, 1939 and 1940].

MARYLAND.—Recorded: very abundant in the state [P. G. Shipley, 1932]. Easton; Somerset; Silver Hill; Laurel; Herald Harbor; Hyattsville; College Park; Baltimore; Annapolis [J. H. Roberts, A. Holdridge, and E. N. Cory.—Md.S.H.D., through E. N. Cory, *in litt.*].

Dermacentor variabilis, the "American dog or wood tick," is abundant in many localities throughout the coastal plain of the eastern United States, where its normal breeding range is known to extend as far north as Duxbury in eastern Massachusetts. Climatic conditions, rather than the lack of suitable hosts, seem to preclude its becoming established permanently farther north in New England and also in the Appalachian Mountains. Farther west it is known to breed in the southernmost counties of Ohio and in the Tama Indian Reservation (Tama Co.) of Iowa. It also breeds in southern Ontario at about the latitude of Boston, as well as much farther north in the region of the Sissiboo River in Nova Scotia. In the Middle West the breeding range should be worked out more carefully by locating the early stages on their natural hosts. As adult ticks are freely transported in the summer by people, particularly on dogs, records based on adults alone are of no value for this purpose. R. R. Parker, C. B. Philip and W. L. Jellison's map (1933) shows this tick as occurring over the entire eastern United States[31] and R. A. Cooley's may (1938) also extends it over this entire area. I can find no records from Maine, New Hampshire, New Brunswick, and Quebec, although I do not doubt that imported adults may have been taken there. The single record from Vermont may be regarded as based on a stray introduction. Thus far there is no conclusive evidence that *D. variabilis* breeds north of Boston, except in a small area of Nova Scotia. The true breeding range of this tick is of practical importance, as it determines the area where the diseases of which it is a potential vector, could become established. Various aspects of this problem have been discussed before.

[31] This map seems to be based upon an earlier one by W. A. Hooker, F. C. Bishopp and H. P. Wood (1912), who, however, claimed to show only the *probable* range. Some authors include even Labrador in the distribution, but there appears to be no evidence that *D. variabilis* was ever seen there.

The following account of the life-history is based mainly on observations by F. C. Bishopp and C. N. Smith (1938), and by C. N. Smith and M. M. Cole (1941). *D. variabilis* is a three-host tick in the sense that the larva and nymph drop off the host before moulting. However, both immature instars may attach in succession to the same species of host, even to the same individual; but the adults almost invariably engorge on a host of a different type.

Under favorable conditions unengorged adults are very long-lived away from a host. In Maryland, bred males and females, kept under natural conditions of temperature and moisture, survived from 755 to 988 days; but longevity was not so great in the laboratory. The life of adults which have attached to hosts is comparatively shorter, lasting usually only a few weeks, rarely five or six months. The full engorgement of the female requires from five to thirteen days in the presence of males, but is retarded by the lack of mating. Mating takes place on the host, from four to six days after attachment of the female, but is always preceded by a feeding period for both sexes. After dropping off the host, the engorged female goes through a maturation or preoviposition period of from 3 to 24 days. Oviposition itself lasts from 14 to 32 days, during which time usually from 4,000 to 6,500 eggs are laid, sometimes up to 800 in one day. When egg-laying is completed, the female dies in from 3 to 36 days. The natural lifetime of the completely fed male is not accurately known, but no doubt shorter than that of the female.

The eggs hatch after an incubation period of from 26 to 39 days. Unengorged larvae may survive long periods, particularly when kept moist and cool. Some have been kept alive from eight to eleven months, the maximum periods observed being between 345 and 377 days. Larvae 318 days old became engorged when put on a host. In experiments larvae one day old refused to attach and the largest percentage of engorgement occurred among larvae five or more days old. Larval engorgement lasts about 4 days on the average, with an observed minimum of 2 days and maximum of 12 days.

The larval moulting period varies greatly, from a minimum of 6 days to a maximum of 87 days, and is markedly shortened by increasing temperature. Unfed nymphs usually do not survive more than six months, but some have lived up to 309 days. Of three nymphs alive after from 271 to 273 days, two were able to engorge on a host. In the laboratory the engorgement period of the nymph was between 3 and 10 days, with an average of slightly over 5 days.

Some nymphs may engorge the same day moulting occurred and most of them do so readily the second day after.

The shortest nymphal moulting period observed was 17 days, the longest from 105 to 109 days. It is evidently greatly lengthened during cold weather. It is about the same for both sexes. The females outnumber the males slightly. This is shown by lots bred from engorged nymphs, as well as by collections of unengorged ticks in nature.

The larvae and nymphs engorge preferably on small rodents, which are the true breeding hosts of the immature instars. A few of these stray sometimes onto rabbits, larger mammals, or birds; but there is a question whether they are able to moult after engorging on these unusual hosts. The meadow mouse, *Microtus p. pennsylvanicus,* is the preferred host of larvae and nymphs in the Cape Cod area and elsewhere along the Atlantic coast. F. C. Bishopp and C. N. Smith (1938) state that in one case more than 100 larvae were found on a single meadow mouse. On Martha's Vineyard the immature instars are most active in seeking their hosts from the end of March or the middle of April until the end of September. The larvae hibernate in large numbers; whereas the number of nymphs that hibernate may be large or small, varying from year to year. In more southern localities, as for instance in Maryland, the hibernation of the immature instars is less complete. The length of day seems to be an important factor in controlling their seasonal activity (C. N. Smith and M. M. Cole, 1941).

Most adult *D. variabilis* attach to and engorge on large and medium-sized mammals. In eastern North America the preferred hosts were originally, no doubt, native deer and perhaps also buffalo, before the latter were exterminated. At present the favorite host is the domestic dog, which appears to be very suitable to it from every point of view. Adults are occasionally found also on cattle, horse, cat, and fox, and exceptionally on smaller mammals. While they readily attach to man, he is no more than an accidental or stray host from the point of view of the survival of the species.[32] In the Cape Cod area adult ticks appear and are active from the latter part of April to the end of August in normal years; but during the abnormally warm spring of 1945, males and females started infesting dogs at Duxbury early in April. The adults do not feed during the winter months, but hibernate away from the host, being found quies-

[32] A nymph of *D. variabilis* was taken from the stomach of an 8-year-old girl at Jamaica Plain, Boston.

cent deep down in clumps of bunch grass or sometimes under loose bark.

From the foregoing account it is clear that the total lifetime of an individual *D. variabilis,* from the hatching of the egg to the natural death of the adult, varies between very wide limits. This peculiarity again has some bearing on the epidemiology of diseases transmitted by the tick. Theoretically at least, the whole life-cycle might be completed, with an interpolated hibernation period, in approximately one year, eggs laid in the early summer producing adults that die in the early summer of the following year. Most probably this happens rarely in nature, the lifetime being usually extended several months more and occasionally running to two years or over.

Synonymy.—It is reasonably certain that Say's descriptions of *Ixodes variabilis* and *I. punctulatus,* reproduced below, were based upon the male and female respectively of the same species of *Dermacentor,* which Koch later described as *D. electus.* What Say called the "impressed eyes" of *punctulatus* were the porose areas of the capitulum.

Ixodes variabilis: "Body oblong-ovate, gradually attenuated before; sides hardly arquated; a few remote deeply impressed punctures not more numerous behind; posterior margin with about twelve impressed, abbreviated lines; a lateral, impressed, punctured, submarginal line, obsolete behind; two deeply indented, abbreviated lines before; head, hind edge rectilinear, angles abruptly a little extended backward, acute; rostrum rather short; palpi ovate; colour reddish or ferruginous, varied with white, incisures of the feet white. Very much resembles the preceding [*I. erraticus*] in form; the white of the back is more or less reticulated, and the feet are white above or only their joints. May not this be *I. lineatus,* if so, my name must of course be rejected."

Ixodes punctulatus: "Body oblong-ovate, gradually attenuated before, sides hardly arquated, crowded with impressed, confluent punctures; thorax destitute of punctures, but with two impressed undulated lines; abbreviated lines of the posterior margin not deeply impressed, almost obsolete; lateral submarginal line deeply impressed, obsolete behind; head, hind edge rectilinear, angles abruptly a little projected backward, acute; rostrum rather short; palpi oval; eyes distinct, impressed; colour ferruginous, thorax white lineated or varied with ferruginous; incisures of the feet white. Considerably like the preceding [*I. variabilis*]."

There are two possible earlier names for *D. variabilis.* Say himself suggested that his tick might have been *Acarus lineatus*

Fabricius (1775, Syst. Ent., p. 811.—America), described as follows: "Acarus ovatus, ferrugineus; lineis duabus undatis albis. Corpus punctatum, obscure ferrugineum, lineis duabus longitudinalibus, valde undatis, albis. Puncta duo parva supra anum. Pedes geniculis albis. Magnitudo praecedentis [*Ixodes iguanae*]." Koch placed *lineatus* in *Amblyomma,* but he never saw it. Neumann merely followed Koch. Robinson (1926) does not mention it. A. C. Oudemans (1929, p. 209, and 1936, p. 499) is positive that it was *Amblyomma oblongoguttatum* Koch, but in that species the legs are uniformly maroon-brown, not "geniculis albis." Unless Fabricius' type could be found, the interpretation of his description will always be guesswork.

The description of *Ixodes cinctus* Fabricius reads: "I. oblongus ferrugineus albus, scutelli margine thoraceque antice albis.—Reliquis magis oblongus. Caput ferrugineum. Scutellum triangulum ferrugineum: margine albo. Thorax et abdomen ferruginea, antice cerea, scutellum late alba. Pedes ferruginei." The type, collected by v. Rohr, came from North America, where only a species of *Dermacentor* seems to fit the description, possibly drawn from a female, as suggested by A. C. Oudemans (1936). In some respects the pattern agrees best with that of *D. erraticus* var. *albipictus.* Again, it seems unsafe to adopt the name, unless the type could be examined.

The original descriptions of Fitch's two species of 1872 leave little doubt that they were based upon the female and male respectively of *D. variabilis.*

"Five-lined tick, *Ixodes 5-striatus.* Ovate, rust-colored; thorax and scutel tallow white with irregular rust-colored spots and punctures; abdomen with punctures and five impressed longitudinal lines; the outer one of each side being sub-marginal; legs paler, their joints white. Length 0.20 [inch]."

"Robertson's tick, *Ixodes robertsoni.* Oval, punctured, rust-colored, above marbled with tallow white on the head, thorax and abdomen, with rust-colored punctures; abdomen with a submarginal impressed line, between which and the edge are deeply impressed, equi-distant, transverse lines with white interstices; joints of the legs white. Length 0.16 [inch]."

Dermacentor erraticus (Say)

Dermacentor erraticus offers an unusual and rather baffling type of color variation. Some adult specimens are very extensively marked with white and often somewhat iridescent enamel, while

in others these markings are much reduced, faint or lacking, a blackish pattern appearing instead. No consistent or reliable morphological or biological differences seem to exist between these two forms, which are evidently of one species. In the eastern United States the two forms are readily separated by color and have a somewhat different distribution, the white-marked form (var. *albipictus*) being more northern, while the form with black lines (typical *erraticus*) has a more southern range. According to R. A. Cooley (1938), the two forms intergrade farther west, where they are said to occur together, particularly in California and western New Mexico. As a result, Cooley considers the variant with black or dark lines to be a weakened strain of the species. He states that in this form, for some peculiar reason not as yet understood, the dorsal sclerotized wall of the body has become transparent, showing the diverticula of the digestive tract as dark lines. I am far from satisfied that Cooley's view is entirely correct. At any rate, in view of the different range of the two forms, it would seem useful to separate them by name, were it only to call attention to the interesting problem involved. Moreover, it is not difficult to distinguish the adults in our territory, where I have never seen intergrades.

Dermacentor erraticus, typical

Ixodes erraticus Say, 1821, Jl. Ac. Nat. Sc. Philadelphia, 2, p. 77 (no sex, but evidently ♂; southeastern United States; no host). N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, p. 51. A. C. Oudemans, 1936, Kritsch Hist. Overzicht Acarologie, pt. 3, vol. B, p. 578.

Ixodes nigrolineatus Packard, 1869 (between January 1st and July), 1st Ann. Rept. Peabody Ac. Sci., Salem, p. 66 (described as ♀, but really ♂; northern New York, off "*Cervus virginianus*").

Dermacentor nigrolineatus N. Banks, 1907, Proc. U. S. Nat. Mus., 32, p. 608; 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 48 and 55; Pl. VIII, figs. 3, 9 and 11 (♀♂). Stiles, 1910, U. S. Treasury Dept., Hygienic Labor., Bull. No. 62, p. 51, figs. 20–25, 60–64, 77, 78, 93, 94, 112, 113, 129 and 130 (♀♂ n). Bishopp and Wood, 1913, Parasitology, 6, p. 180, fig. 1 (map); Pl. X, figs. 8–11; Pl. XII, figs. 1–8 (♀♂n). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 17, fig. 5 (map).

Dermacentor albipictus form *nigrolineatus* Cooley, 1938, U. S.

Nat. Inst. Publ. Health, Bull. No. 171, Pl. XVI; Pl. XXIV, figs. 1–5; Pl. XXX, figs. 1–12 (♀♂).

Massachusetts.—Seen: Naushon Id., ♀♂n off *Odocoileus virginianus borealis,* August 28 (J. Bequaert).

New York.—Seen: northern part of the State, ♂ off *Odocoileus virginianus borealis* (F. G. Sanborn.—Type of Packard's *I. nigrolineatus;* M.C.Z.). Catskill Mts. (M.C.Z.).—Recorded: Adirondack Mts. [N. Banks].

Pennsylvania.—Seen: Remono, ♀♂ off *Odocoileus virginianus,* December (H. Clement); Clinton Co., ♀♂ off *Odocoileus virginianus,* December 1941 (R. L. Fricke).—Recorded: Snowshoe, off cattle [R. Matheson, *in litt.*].

Typical *Dermacentor erraticus* (or *nigrolineatus,* as it has been called thus far), the "red-brown winter tick," is one of the rarer species of our territory. It is also known from Oklahoma, Tennessee, New Mexico, Texas, Wisconsin, and Minnesota. The normal host is Virginia deer, but it is sometimes taken on cattle and horses.

I am not aware that observations on the life-history of this form have ever been published. R. A. Cooley (1938) states, however, that there are no biological differences between the typical form and the var. *albipictus,* both being one-host ticks. All stages feed on the same large mammals, without leaving the host to moult.

Original description of *Ixodes erraticus:* "Body oblong-ovate gradually narrowed before, sides hardly arquated, with distant punctures, those behind more deeply impressed, posterior margin with ten or twelve impressed lines which are abbreviated by a submarginal impressed line, two abbreviated lines before; head, posterior edge transversely rectilinear, angles extended backward abruptly, and subacute; rostrum rather short; palpi oval-orbicular; the color is reddish or ferruginous, with acute black lines." I feel certain that this description was based on a male of the tick later described by Packard as *I. nigrolineatus,* as was suggested by Banks. There is no other tick known in the eastern United States to which it could possibly apply.

Original description of *Ixodes nigrolineatus:* "Female. Body oblong oval, the sides very straight, not arcuated, being much more oblong, with much straighter, less curved sides than in *I. variabilis,* while the body gradually increases in width to the end; it is much thicker. Head not so wide as in *I. variabilis,* depressed centrally, with the sides much thickened and ending in an unusually stout thick obtuse spine, tipped with black; palpi and beak of the same

length, both being short and small; palpi ovate, broad at end, second joint shorter than the first. Thoracic shield not distinct; the convexity and impressed lines observed in the two preceding species are obsolete, there being a slight convexity just behind the head. Body behind irregularly spotted and lineated with irregular faint linear black lines, being transverse in the middle of the body, while posteriorly there are three longitudinal parallel faint black lines; the surface is smooth, polished, with scattered punctures, becoming rather dense behind. Hinder edge with a slight ridge, incised by about ten abbreviated rather indistinct lines. Beneath, the body is paler, legs concolorous with the body, short and thick, much more so than in *I. variabilis*. The color of the single specimen, which is dry, is a deep blood red. Length, .16 of an inch; breadth, .10 of an inch." Although described as a female, Packard's type is really a male. Moreover, the description contains several features not found in the female.

Dermacentor erraticus var. **albipictus** (Packard)

"Moose tick," W. J. Hays and Packard, 1868 (December), American Naturalist, 2, p. 559, fig. 1 (off a moose raised in Nova Scotia and brought through New York; the exact locality where the host became infested is not known). No scientific name used.

Ixodes albipictus Packard, 1869 (between January 1st and July), 1st Ann. Rept. Peabody Ac. Sci., Salem, p. 65 (in part: ♀ from moose kept in Nova Scotia, referred to in December, 1868, by Hays and Packard); 1869 (September), American Naturalist, 3, p. 365, fig. 61 (engorged ♀ and larva off moose kept in Nova Scotia); 1869 (between October and December), A Guide to the Study of Insects, pt. 10, p. 662, fig. 638 (♀ off moose as before).

Dermacentor albipictus N. Banks, 1907, Proc. U. S. Nat. Mus., 32, p. 608. Hunter and Hooker, 1907, U. S. Dept. Agric., Bur. Ent. Bull. 72, p. 51. N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 44 and 55; Pl. VII, figs. 5, 9 and 11; Pl. X, fig. 11 (♀♂); 1908, Occ. Papers Boston Soc. Nat. Hist., 7, p. 13. Jarvis, 1910, 40th Ann. Rept. Ent. Soc. Ontario, for 1909, p. 97. Stiles, 1910, U. S. Treasury Dept., Hygienic Labor., Bull. No. 62, p. 60, figs. 37–39, 67, 68, 80, 97, 98, 116, 117 and 133 (♀♂n.). Bishopp and Wood, 1913, Parasitology, 6, p. 161, fig. 1 (map); Pl. X, figs. 5–7; Pl. XI, figs. 1–11 (♀♂ln). Hewitt, 1915, Trans. Roy. Soc. Canada, Sect. IV, 9, p. 231;

Pl. II, figs. 5–6. Cameron and Fulton, 1927, Bull. Ent. Res., 17, pt. 3, p. 249, figs. 1–8 (♀♂ln). Cooley, 1938, U. S. Nat. Inst. Health, Bull. No. 171, p. 59, fig. 7; Pl. II, fig. 12; Pl. XV; Pl. XVII, figs. 1–7; Pl. XXIII, figs. 1–9; Pl. XXIX, figs. 1–10 (♀♂ln). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 13, fig. 5 (map).

Dermacentor variegatus "Marx" Neumann, 1897, Mém. Soc. Zool. France, 10, p. 367, figs. 22–24 (♀♂; Washington State, off "*Cariacus* sp." [= *Odocoileus*]; Nevada; Nebraska). Salmon and Stiles, 1902, 17th Ann. Rept. Bur. Animal Ind. U. S. Dept. Agric. for 1900, (1901), p. 452, figs. 178–185 (♀♂). Neumann, 1911, Das Tierreich, 26, Acarina, Ixodidae, p. 101 (♀♂). Not *Crotonus variegatus* Duméril, 1829.

Dermacentor varius P. Schulze, 1933, Zeitschr. f. Parasitenk., 6, p. 424, footnote (new name for *Dermacentor variegatus* Neumann, 1897; not of Duméril, 1829).

Dermacentor salmoni Stiles, 1910, U. S. Treasury Dept., Hygienic Labor., Bull. No. 62, p. 55, figs. 26–36, 65, 66, 79, 95, 96, 114, 115, 131, and 132 (♀♂n; types off cattle, Oklahoma; also off horse, Nashville, Tennessee; Montana).

Ixodes oregonensis Stiles, 1910, U. S. Treasury Dept., Hygienic Labor., Bull. No. 62, p. 60 (quoted as a manuscript label of specimens of *D. salmoni,* without locality).

Nova Scotia.—Seen: near James River, Antigonish Co., ♂ off deer (Ent.Br.Ott.); Skinner Lake, vicinity of Hubbards Cove, ♀♂ off dead moose, May 5 (V. D. Vladykov.—Ont.A.C.).—Recorded: Beaverbank, Halifax Co., off cattle [R. Matheson, *in litt.*]. Annapolis Royal [F. C. Gilliatt.—C. R. Twinn, *in litt.*]. South Shore, off moose [C. R. Twinn, *in litt.*]. According to the Annual Reports of the Entomological Society of Ontario, common on moose (see, for instance, 66th Rept. for 1935, 1936, p. 94).—I have also seen Packard's types (at M.C.Z.), which may have come from Nova Scotia.

New Brunswick.—Seen: Cookville, ♀♂ (G. M. Cook.—Ent.Br. Ott.); Central Blissville, ♀♂ off cow (E. A. Watson.—Ent.Br.Ott.); Little La Preaux, off moose (C. B. Hayes).—Recorded: Peniac, York Co., off horse [Hewitt]. Without definite locality, off moose and cow [64th Rept. Ent. Soc. Ontario for 1933, 1934, p. 78; 66th Rept., *ibid.* for 1935, 1936, p. 95]. Harcourt [C. R. Twinn, *in litt.*]. Fredericton, off cattle and moose [C. R. Twinn, *in litt.*]. York Co., off moose, June, 1931 [R. P. Gorham.—C. R. Twinn, *in litt.*]. Sunbury Co., off cow, April, 1935 [C. R. Twinn, *in litt.*].

QUEBEC.—Recorded: Hudson Heights, off a wapiti imported from Wyoming [Hewitt].

ONTARIO.—Seen: Smoky Falls near Kapuskasing, ♀♂ off moose, April, 1937 (R. V. Whelan.—Ent.Br.Ott.).—Recorded: off moose in northern Ontario [Jarvis].

MAINE.—Seen: Right bank of Penobscot River (about a mile above Bowlan Stream), ♂ and ♀, found on the snow where a moose had rested, March 4, 1932 (Ralph W. Gray).

NEW HAMPSHIRE.—Recorded: Blue Mountains, off moose [Salmon and Stiles; N. Banks].

NEW YORK.—Recorded: Adirondack Mountains [N. Banks].

OHIO.—Recorded in northern Ohio from horses imported from Colorado [F. R. Koutz, *in litt.*].

Hooker (1909, p. 405) includes the moose tick among the Massachusetts ticks, supposedly from the type, but this is an error.

The correct name of the moose tick is *albipictus,* as established by N. Banks. When first proposed by Packard, early in 1869, the name covered specimens of two distinct species of *Dermacentor.*[33] The first paragraph of the description, based on a female from Munson's Hill near Washington, D. C., clearly refers to *D. variabilis,* the differences from that species pointed out being either trivial or purely sexual. I have not been able to trace this specimen; at the Museum of Comparative Zoology a vial with a label, presumably in Packard's hand, "*Ixodes albipictus,* Munson's Hill," now contains an *Ixodes* in no way agreeing with the description; another vial contains the male from Munson's Hill which he correctly named *variabilis.* In the second paragraph Packard includes in his *I. albipictus* female ticks from moose which Hays and Packard had described and figured, without a name, in December, 1868. A brief description of these is given, some differences from the Munson Hill specimen being particularly noted. Two female types of this moose tick, labelled "*Ixodes albipictus* Pack., types, from a partly domesticated moose," together with many larvae hatched from eggs, are now at the Museum of Comparative Zoölogy. Thus *I. albipictus* was originally a composite species; but the first selection of types was by N. Banks (1908) who stated definitely: "The types from the moose

[33] The First Annual Report of the Peabody Academy of Science is dated "January, 1869," on the cover. It may, however, have been actually issued later. At the Boston Society of Natural History it was entered as received July 26, 1869, so that it certainly was distributed before that date.

are still in the Museum of Comparative Zoölogy, where I have examined them." His action appears to settle the matter.

Dermacentor erraticus var. *albipictus,* the "winter or moose tick," is indigenous throughout the northern United States and southern Canada, from the Atlantic to the Pacific. Its life history has been studied in detail by D. A. Howell (1941), in California. It is a one-host tick, all stages being found on the same host and the larvae and nymphs not dropping for ecdysis. The breeding range covers that of its normal hosts, the moose, *Alces americana,* and the wapiti or American elk, *Cervus canadensis.* It has also been found on deer and beaver, and it sometimes attacks horses and cattle, among which it is said to cause serious losses. It has been blamed for epizoötics in moose, which it is said to infect with a bacterium, *Klebsiella paralytica* (Thomas and Kahn, 1932; Wallace, Kahn and Thomas, 1933). Boynton, Herms, Howell, and Woods (1936) have shown that in the laboratory it transmits anaplasmosis, a disease of cattle.

An early account of the moose tick in Nova Scotia by C. Hardy (1869, p. 80) is well worth quoting: "A tick affects the moose especially in winter and early spring. The animal strives to free itself from their irritation by striding over bushes and brambles. The ticks may often be seen on the beds in the snow where moose have lain down, and whence they are quickly picked up by the ever-attendant moose birds or Canada jays (*Corvus canadensis*). These vermin will fasten on the hunter when backing his meat out of the woods. The Indian says: 'Bite all same as a piece of fire.' "

In the discussion of *Dermacentor variabilis,* I have stated the possibility of *Ixodes cinctus* Fabricius (1805) being based on *D. erraticus* var. *albipictus.*

Original description of *Ixodes albipictus:* "Female. An elongated oval flattened species, marked with silvery white on the thorax and tips of the leg-joints. Beak broad, large and flattened, as long as one-third the width of the body at the widest. Palpi scarcely as long as the beak, broad, flattened, ovate, second joint nearly as long as the first; head transversely oblong with rectilinear angles, the two posterior ones being produced into an acute stout spine; on the surface is a pair of oval smooth pits diverging from the median line (at the bottom of which I can detect, however, no ocelli). The body is a little arcuate, being contracted at the middle of the thoracic plate; it is scattered sparsely with deep punctures, which are thicker and arranged in three lines on the side of the anterior half of the thorax. The smooth, shining thorax, is reddish along the middle,

but darker on the sides, and around the outer edge is broadly margined with silvery white, being irregular within and broken up into points and dots; the middle behind the head is raised, convex, with a rather deeply impressed line on each side anteriorly. The whole white spot is nearly half the length of the body. Abdomen black brown; surface rough, with deep punctures and corrugations, with four irregular deeply impressed longitudinal lines not reaching the white spot; a submarginal deep line around the whole abdomen; end of the abdomen crenulated by thirteen lines. Beneath blackish brown; the body is smooth, with fine scattered punctures, becoming larger toward the end of the body; between the second pair of legs is a depression, surrounded by a circular impressed line (vulva); towards this two impressed lines converge, beginning at the end of the body, thus enclosing an acute triangle, near the base of which is another pit (anus) containing two twin tubercles, twice as long as broad. Legs red, coxae of the two front pair with a stout spine, that of the first pair three times as large as in the second; the legs are stout, with short hairs beneath, and the joints above are either partially covered or tipped with silvery white. Length of body, including palpi, .20 of an inch; width, .12 of an inch. Closely allied to Say's *I. variabilis,* but the white is confined to the thoracic shield, and the body is dark brown, the legs deeper red, and the incisures are not white as in *I. variabilis,* while the body is more oblong, the convexity behind the head much more marked, the impressed lines limiting it, extending farther behind. We found one specimen of this and *I. variabilis* at Munson's Hill, near Washington, D. C.—To *I. albipictus* I refer specimens found by Mr. W. J. Hays in great abundance on a moose which had been kept in confinement in Nova Scotia; and noticed and figured in the American Naturalist, vol. II, p. 559. The figure (*e*) of the adult after it had laid its eggs, is worthless, as its form had been distorted, but the palpi are the same, and also the silvery thoracic shield, though in the Nova Scotian specimens the silver is more diffused over the middle of the thorax, and the upper part of the joints of the legs are silvered over, and the deep punctures have disappeared. Length of egg $2\frac{1}{2}$ one-hundredths of an inch; length of freshly hatched young, nearly .03 of an inch. Length of the adult after oviposition, .40 of an inch. The young is deep orange red, the legs a little paler, the body is smooth, convex, without punctures, and with ten minute impressed lines on the hinder edge of the abdomen; anal papilla present; the thoracic median convexity just behind the head is well marked; the head is a little larger in proportion than in the adult first described.

According to Mr. Emerton's drawings the third joint of the palpi is free, though very small and tipped with hairs; the beak (*a*) is armed with five rows of teeth besides those of the extreme tip, and the maxillae with nine rows of teeth, with four large terminal ones. The pulvillus of the claw (*d*) is much larger than in the adult. Except in the addition of a fourth pair of legs, and the differences noted above, the larva does not essentially differ from the adult. The ticks, according to Mr. Hays, began to lay their eggs on the first of May, and 'continued to do so until the 25th of June, when they died. The eggs are forced out in large masses. On the 3d of July, the day after I sent the drawings to you, the entire mass of eggs seemed to hatch at once, the shell opening like a clam and releasing a six-legged insect.' ''

Genus **Amblyomma** C. L. Koch, 1844[34]

Two species are known in the southern part of our territory.

Key to Species

Males

1. Coxa I with two very unequal spurs, the internal spur very small, often barely visible. Metatarsi II to IV with a pair of prominent spurs at the tip below. Scutum elongate-oval, with several, more or less longitudinal pale enamel stripes and with many, rather small punctations, mostly restricted to the enamel areas ..... *A. maculatum.*

   Coxa I with two unequal spurs, but the internal spur well developed, at least half as long as the outer spur. Metatarsi II to IV without apical spines. Scutum more broadly oval, with a few, small pale enamel markings on the sides and behind, with evenly distributed small punctations. *A. americanum.*

Females

1. Coxa I with a long external spur and a very small or indistinct internal spur. Metatarsi II to IV with a pair of prominent spurs at the tip below. Scutum with extensive pale enamel markings, reaching forward to beyond the eyes, with many fine punctations ..... *A. maculatum.*

[34] The generic name *Amblyomma,* with type *Acarus cajennensis* Fabricius, has been placed in the Official List of Nomina Conservanda by the International Commission of Nomenclature (Opinion 73).

Coxa I with two distinct spurs, but the internal spur much shorter than the external spur. Metatarsi II to IV without terminal spurs. Scutum with a large pale enamel spot in the posterior angle and only faint traces of enamel areas anteriorly, with many medium-sized punctations.
A. americanum.

Nymphs

The scutum is inornate, without enamel markings in the nymphs of our local species.

1. Basis capituli pointed at the sides, ventrally with two prominent spines. Coxa I with only one distinct spur ..... *A. maculatum.*
Basis capituli rounded off at the sides, ventrally without spines. Coxa I with two distinct spurs, the internal spur much shorter than the other ..... *A. americanum.*

Larvae

The scutum is always inornate.

1. Basis capituli pointed at the sides. Coxa I with only one distinct spur ..... *A. maculatum.*
Basis capituli rounded off at the sides. Coxa I with two distinct, short spurs ..... *A. americanum.*

Amblyomma americanum (Linnaeus)

Acarus ("wood-louse") P. Kalm, 1754, Kongl. Svensk. Acad. Handl. (Stockholm), 15, pp. 19–31; 1756, Abh. Kön. Schwed. Akad. Wiss. (Leipzig), 16, pp. 21–30; 1761, En Resa till Norra America, vol. 3, p. 223 ("*Acari americani*").

Acarus americanus Linnaeus, 1758, Syst. Nat., 10th Ed., vol. 1, p. 615 (♀; "America," no host). A. C. Oudemans, 1926, Tijdschr. v. Entom., 69, Suppl., p. 90. Not of Treviranus, 1832.

Ixodes americanus Fabricius, Syst. Antliat., p. 355. Gervais, 1844, in Walckenaer, Hist. Nat. Ins., Aptères, vol. 3, p. 247. Fitch, 1872, Trans. New York State Agric. Soc. for 1870, p. 363 (♀). A. C. Oudemans, 1929, Tijdschr. v. Entom., 72, Suppl., p. 198.

Amblyomma americanum C. L. Koch, 1844, Arch. f. Naturgesch., 10, pt. 1, p. 229 (♂); 1847, Uebersicht Arachniden-Systems, vol. 4, p. 90; Pl. XVII, figs. 62–63 (♀♂). Neumann, 1899, Mém. Soc. Zool. France, 12, p. 209 (♀♂n); 1901, *op. cit.,* 14, p. 296. Salmon and Stiles, 1902, U. S. Dept. Agric., Bur. An. Industry, 17th Ann. Report for 1900 (1901), p. 475, Pls. XCVI–XCVIII, figs. 236–255 (♀♂n). Hunter and Hooker, 1907, U. S. Dept.

Agric., Bur. Ent., Bull. 72, p. 59. N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 40 and 54; Pl. VI, figs. 1–4; Pl. X, fig. 5 (♀♂n); 1908, Occ. Papers Boston Soc. Nat. Hist., 7, p. 14. Hooker, Bishopp and Wood, 1912, U. S. Dept. Agric., Bur. Ent., Bull. 106, p. 142; Pl. XI, figs. 1–10 (♀♂nl). A. E. Miller, 1925, Bull. Ohio Agric. Expt. Sta., No. 386, p. 129. Robinson, 1926, Ticks, vol. 4, *Amblyomma*, p. 45, figs. 14–15 (♀♂). H. S. Peters, 1936, Bird-Banding, 7, p. 14. A. C. Oudemans, 1936, Kritisch Histor. Overzicht Acarologie, pt. 3, vol. B, p. 455. Headlee, 1938, Public Health News, Trenton, N. J., 22, p. 290. MacCreary, 1939, Delaware Agric. Expt. Sta., Bull. 220, p. 28. Headlee, 1940, Circ. 395 New Jersey Agric. Expt. Sta., p. 4. W. A. Riley, 1944, Jl. of Parasitology, 30, p. 201. Cooley and Kohls, 1944, Jl. of Parasitology, 30, pp. 82, 83 and 87, figs. 3A–M and 4A–I (♀♂nl). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 3, fig. 1 (map). MacCreary, 1945, Jl. Econ. Entom., 38, p. 126, footnote.

Acarus nigua Degeer, 1778, Mém. pour Servir à l'Histoire des Insectes, vol. 7, p. 153, in part: Pl. XXXVII, figs. 11–13 (♀; Pennsylvania; off man); not figs. 9–10 (♀; Surinam).

?Ixodes orbiculatus Say, 1821, Jl. Ac. Nat. Sci. Philadelphia, 2, p. 76 (no sex; Southern United States; off *"Sciurus capistratus"*).

Ixodes unipunctata Packard, 1869 (between January 1st and July), 1st Ann. Rept. Peabody Ac. Sci., Salem, p. 66 (♀; "Massachusetts," no host).

Ixodes unipictus "Packard" Verrill, 1870, 4th Ann. Rept. Connecticut Bd. Agric. (1869–1870), p. 118. Perkins, 1880, 6th Ann. Rept. Vermont Bd. Agric., p. 59. Misspelling of *unipunctata*.

Amblyomma foreli Stoll, 1890, Biol. Centr.-Amer., Acaridea, pp. 21 and 50; Pl. XII, figs. 3, 3*a–b;* Pl. XIV, figs. 3, 3*a–d* (♀; Retalhuleu, Guatemala; no host).

Labrador.—Neumann's (1899) and Hooker's (1909) records from Labrador were based on the same specimen in the Marx Collection. The record is extremely dubious and was probably due to erroneous labelling, rather than based on a stray or accidentally imported tick. The only other record of the species from the Dominion of Canada is by Hadwen (1912) and Hewitt (1915) from southern Manitoba (Aweme), probably an importation.

Massachusetts.—Seen: Boston, ♀ from a woman's shoulder (Bost.M.); also a ♀ taken at the Army Base, July 16, 1942, from a soldier who had acquired it farther south.—Recorded: by Packard,

about 1868, type of *Ixodes unipunctata,* without indication of host. All three cases were evidently stray specimens imported accidentally from farther south.

New York.—Recorded: According to P. Kalm (1761) common in 1740–1750 in the region of Fort Anne (between Saratoga and Lake George). According to Fitch (1872), one specimen was taken in New York State about 1830.

New Jersey.—Seen: Newark, ♀ off man (N.J.A.E.S.).—Recorded: According to P. Kalm (1754), common in the woods. Leidy's tick, said to be common in 1890 at Beach Haven, may have been this species.

Pennsylvania.—Seen: Thornburg, gravid ♀, June 28, 1939 (Mrs. Reynolds).—Recorded: According to P. Kalm (1754), common in the woods. Off man [types of *Acarus nigua.*—Acrelius in Degeer, 1778]. Lancaster [J. Stauffer; cited by Packard].

Ohio.—Seen: Liberty, Jackson Co., ♀ off man, April 1939 (J. H. Hughes; specimen recorded by Riley, 1944).—Recorded: Bellefontaine [Miller].

Delaware.—Recorded: New Castle Co., n off man [D. MacCreary, 1939].

Maryland.—Recorded: without definite locality, off *Colinus v. virginianus* [H. S. Peters]. Ocean City [E. N. Cory.—Md.S.H.D.].

Amblyomma americanum, the "lone star tick," is found throughout most of the southeastern United States, being by no means rare as far north as Virginia and Washington, D. C. In many southern localities the adults are common cattle ticks, but there is as yet no record from this type of host in our territory, where the species is at present very rare. The northern limit of its breeding range appears to lie now in southern New Jersey and Pennsylvania. Possibly it extended farther north formerly, as discussed in the sequel.

Outside the United States, *A. americanum* seems to be extremely rare, its distribution being imperfectly known. According to Mr. R. A. Cooley (*in litt.,* 1946), the large tick collection of the Rocky Mountain Laboratory contains only two lots from Mexico: one from Reynosa, State of Tamaulipas, off "wild hog, javelina"; the other off a tinamou, without definite locality. Farther south a specimen appears to have been taken in Guatemala, *Amblyomma foreli* Stoll being almost certainly a synonym of *americanum* (both Neumann and Robinson regarded it as such). L. H. Dunn (1923, Amer. Jl. Trop. Med., 3, p. 97) recorded *A. americanum* off dog and hog, on San Miguel Island near Panama City. In later years, however, no

additional specimens have been taken in Panama. The species does not exist in the Antilles and all published records from South America proper are unreliable. Those from Guiana and Brazil are based on the authority of Degeer and of Neumann and, as shown below, are clearly erroneous. The nymph from Argentina, referred to *americanum* by C. Ribega, was no doubt misidentified.

Amblyomma americanum is a three-host tick. In the southern United States, where it is prevalent, adults are usually found on larger mammals, such as cattle, horse, deer, dog, and wolf. The early stages develop preferably upon smaller animals, such as rabbits and squirrels, and are occasionally found on birds, particularly on quail and wild turkey. Where this tick is common it will attach frequently to man, as adult, larva or nymph. In such localities the larvae, or "seed-ticks," may occur at the proper season in unbelievable numbers on low vegetation and are then a most annoying pest. The bite causes extreme irritation of the tissues, the itching persisting for some weeks after the tick has been removed.

Experimental transmission by *A. americanum* was demonstrated for Rocky Mountain spotted fever and the disease was recovered from nymphs collected in nature in Oklahoma. Circumstantial evidence points to this tick being the vector in some human cases in Oklahoma and Texas. It is also regarded as a potential vector of tularemia (Cooley and Kohls, 1944). The species is, however, too rare in our territory to be of much practical importance.

(*To be continued*)

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THE TICKS, OR IXODOIDEA, OF THE NORTHEASTERN UNITED STATES AND EASTERN CANADA

BY JOSEPH C. BEQUAERT*

(*Continued from page 184*)

Historical Note.—Amblyomma americanum has the distinction of being the first tick recorded from the United States. In 1739, Thomas Salmon wrote in his description of Virginia (Modern History, vol. 3 of the part on America, p. 371) :[35] "Seed-ticks and red-worms are small insects that annoy the people by day as musqueto's and chinches do by night; but both these keep out of your way if you keep out of theirs; for seed-ticks are nowhere to be met with but in the track of cattle, upon which the great ticks fasten and fill their skins so full of blood that they drop off, and wherever they happen to fall they produce a kind of egg, which lies about a fort-

* From the Department of Comparative Pathology and Tropical Medicine, Harvard Medical School and School of Public Health, Boston, Mass.

[35] Modern History; or the Present State of all Nations. Describing their Respective Situations, Persons, Habits, Buildings, etc. (London). I have consulted the first edition, in which the part on America covers four volumes (1736–1738). There have been many editions of this work, as well as translations into other languages. A. C. Oudemans (1926, p. 101) apparently consulted the second English edition.

night before the seedlings are hatch'd. These seedlings run in swarms up the next blade of grass that lies in their way, and then the first thing that brushes that blade of grass gathers off most of these vermine, which stick like burs upon anything that touches them. They void their eggs at their mouth. Red-worms lie only in old dead trees and rotten logs, and without sitting down upon such a man never meets with them nor at any other season but only in the midst of summer. A little warm water immediately brings off both seed-ticks and red-worms, tho' they lie ever so thick upon any part of the body. But without such remedy they will be troublesome; for they are so small that nothing will lay hold of them but the point of a penknife, needle, or such like; but if nothing be done to remove them, the itching they occasion goes away after two days."

Salmon's account was based upon information furnished by one Colonel Beverley (see vol. 3, p. 369). In my opinion, the seed-ticks referred to were those of *Amblyomma americanum,* which is the common cattle tick of Virginia, North Carolina, and South Carolina. They readily attack man, causing intolerable itching, and I have found them fully as troublesome as *Amblyomma cajennense* in tropical America. A. C. Oudemans (1926, p. 101) refers Salmon's seed-ticks to the better known cattle tick, *Boophilus annulatus* (Say); but that species is found only accidentally on cattle in Virginia and it is doubtful whether it ever bred there to any extent. Moreover, the seed-ticks of *Boophilus* scarcely ever attack people.

In 1754, Peter Kalm gave a detailed and surprisingly accurate description of ticks which he had observed in New Jersey and Pennsylvania. His brief diagnosis, "*Acarus ovalis planus ruber, macula dorsali alba,*" and his mentioning the "filiform" palpi and "small white spot in the center of the back" definitely mark his ticks as *Amblyomma americanum.* Nevertheless, he may have confused two or more species when he claimed that the same tick also plagued him in "the wilds between the English Colonies and Canada."

In his later "Travels into North America" (English Edition, vol. 2, p. 303), Kalm writes of his journey from Saratoga to Lake George: "Wood lice (*Acarus americanus* Linn.) abound here, and are more plentiful than on any part of the journey. Scarcely any one of us sat down but a whole army of them crept upon his clothes. They caused us as much inconvenience as the gnats, during the last night, and the short time we stayed there. Their bite is very dis-

agreeable, and they would prove very dangerous, if any one of them should creep into a man's ear, from whence it is difficult to extract them. There are examples of people whose ears were swelled to the size of the fist, on account of one of these insects creeping into them, and biting them."[36] Although Fitch (1872) and others have referred this passage to *A. americanum,* concluding that the species became very scarce or extinct in New York in later years, it seems simpler to assume that Kalm was assailed in New York by some species of *Dermacentor,* which from superficial observation and memory he thought identical with his New Jersey "*Acari americani.*"

Linnaeus' description of *Acarus americanus* is very short: "*A. obovatus rubicundus scutello geniculisque pedum albidis. Kalm Act. Stockh. 1754. Habitat in America.*" It is doubtful whether he saw a specimen; but his reference to Kalm's detailed and accurate account of 1754 may be regarded as settling the identity of his tick.

Degeer's *Acarus nigua* was based upon two females, one sent from Surinam (figs. 9–10) by Rolander, the other sent from Pennsylvania (figs. 11–13) by Acrelius. Both were clearly of the genus *Amblyomma,* but not of the same species. In any case, the specimen from Pennsylvania was certainly what we now call *Amblyomma americanum.*[37]

[36] In the original Swedish Edition, the passage quoted occurs in vol. 3, p. 223, and is essentialy the same, but the "wood-lice" are merely called "*Acari americani.*" Ticks are also mentioned elsewhere in this work. On p. 16 of vol. 2 (English Edition) there is a general account, part of a discussion of the several noxious "insects" which Kalm met with in North America. On p. 136 of vol. 2 "wood-lice" are stated to be exceedingly abundant in the New Jersey woods, in April; and on p. 288, vol. 2, they are said to be abundant in the woods near Saratoga.

[37] Degeer's figure of the Surinam tick seems to agree best with the female of *Amblyomma cajennense* (Fabricius) or with one of the other closely related and common woodticks of South America. Although Neumann extends the range of *A. americanum* to Guiana and Brazil, there appears to be no absolutely reliable record of this species from South America. Neumann (1899, p. 211) stated that "the young female, described by Koch, came from Brazil or Surinam"; but Koch's specimen was *Amblyomma oblongoguttatum,* which Neumann synonymized with *A. americanum,* but which is

Say described *I. orbiculatus* as follows: "Body nearly orbicular, slightly narrower before, punctured, ten or twelve longitudinal, abbreviated, impressed lines on the posterior margin, marginal impressed lines none, two longitudinal indented lines before the middle; head transverse subquadrate, posterior edge very obtusely rounded, the posterior angles complying with the general curve; palpi oblong, sublinear." This description, apparently based on an engorged female, is hardly adequate, but fits *Amblyomma americanum* perhaps better than any other tick known from the southern United States. Yet it seems strange that Say should have ignored the characteristic mark of the scutum.

Packard's (1869) description of *Ixodes unipunctata* reads: "Female. Body orbicular, flattened, with a central white spot, and points of legs tipped with white. Head as long as broad, smooth, with two eyes (?) sunken in round pits,[38] hinder edge emarginate, but not angulated on the sides. Mandibles and maxillary palpi very long, palpi slender, long, with the second joint half as long as the first; beak smooth, spinulated at the tip; labium with the basal half smooth, slender; beyond much broader and densely spinulated. Thoracic shield extending beyond the middle of the body, polished, thickly punctured, with two impressed lines behind the head, and on the hind edge which is a little produced, a conspicuous white spot, hind edge of body crenulated with twelve lines; legs rather pale, slender, with the joints tipped with white. A white ring nearly surrounds the anus, and the spiracles, situated on the edge, just behind the hind pair of legs form conspicuous scales. Length of body, .15 of an inch; width .08 of an inch. Body reddish; a single dried specimen from Mass. (F. G. Sanborn). Mr. J. Stauffer of Lancaster, Pa., has also sent me a drawing of this species which had almost completely buried itself in the arm of a girl, producing a raised tumor." It is clear that the description was made from a single dried, unengorged and probably somewhat shrivelled female of *Amblyomma americanum*.[39] This type is apparently lost. It is

actually a distinct species. All later statements of *A. americanum* being found in the Guianas and Brazil appear to have been copied from Degeer and Neumann. Aragão lists no Brazilian specimens. Robinson saw none from South America and I have none in my rather extensive South American collection.

[38] The porose areas of the basis capituli.

[39] Neumann (1899, p. 211) misunderstood Packard's account. The female producing a tumor in the arm of a girl was not the type and was only known to Packard from a drawing.

not now at the Museum of Comparative Zoölogy and no subsequent author has seen it. N. Banks (1908, p. 40) lists *A. americanum* from "St. Louis (Packard's type), Mo." There are at the Museum of Comparative Zoölogy two unengorged females of this species preserved in alcohol and labelled "*Ixodes albipunctata* Pack. St. Louis, Mo. Riley"; the vial also contains two smaller labels: "Peab. Acad." and "A. S. Packard type." These females are, however, not the types of *I. unipunctata* and I cannot find that Packard ever published the name *I. albipunctata.*

Fitch (1872) described *A. americanum* correctly and stated: "The most common tick of our country, called the wood tick from its inhabiting the woodlands, and not occurring in cleared and cultivated grounds, though formerly abundant throughout the northern and middle States, has now become nearly or quite extinct [in New York State]. The Swedish naturalist Kalm, in passing through the east part of our State one hundred and twenty years ago, when crossing from the Hudson River to Lake Champlain, speaks of the discomfort he experienced from the wood ticks with which the forests there abounded. At this day, along the route he pursued, not one of these insects can probably be found. Residing in that vicinity, I have never met with this wood tick except in a single instance. Forty years ago one was found in a decaying log in the forest." As I have pointed out before, it seems more probable that the ticks Kalm saw in northern New York were a species of *Dermacentor,* which he confused with the more southern *A. americanum.*

Amblyomma maculatum C. L. Koch

Amblyomma maculatum C. L. Koch, 1844, Arch. f. Naturg., 10, pt. 1, p. 227 (♂; Carolina; no host); 1847, Uebersicht Arachniden-Systems, vol. 4, p. 76; Pl. XIV, fig. 49(♂). Neumann, 1899, Mém. Soc. Zool. France, 12, p. 249, fig. 54 (♀♂n). N. Banks, 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 39 and 54; Pl. VI, figs. 5, 7, 9, and 10 (♀♂). Hooker, Bishopp and Wood, 1912, U. S. Dept. Agric., Bur. Ent., Bull. 106, pp. 135–142, fig. 10 (map); Pl. X, figs. 6–10 (♀♂nl). Bishopp, 1912, Proc. Biol. Soc. Washington, 25, p. 37 (n). Robinson, 1926, Ticks, vol. 4, *Amblyomma,* p. 40, figs. 12–13 (♀♂). Bishopp and Hixson, 1936, Jl. Econ. Entom., 29, pp. 1068–1076, fig. 1 (♀♂). MacCreary, 1940, Delaware Agric. Expt. Sta., Bull. 227, p. 29. Cooley and Kohls, 1944, Jl. of Parasitology, 30, pp. 82, 83, and 94, figs. 5A–K and 6A–J

(♀♂nl). MacCreary, 1945, Jl. Econ. Entom., 38, p. 126, footnote. Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 7, fig. 3 (map).

Delaware.—Recorded: Rehoboth Beach, adult by dragging, August 10 [D. MacCreary, 1940].

Amblyomma maculatum, the "Gulf coast tick," is a southern species, distributed over most of Central and South America, as well as in the Antilles. In the United States, its breeding range covers the southeastern section, particularly the area adjacent to the Gulf of Mexico and to the Atlantic coast from Florida to Virginia. Farther north it is very rare, possibly only accidental, and doubtfully breeding there at present.

It is a three-host tick, the larvae and nymphs dropping off the host to moult, so that each individual in the course of its life will usually engorge on three different animals, sometimes of different species. The adults are found mainly on larger mammals, in the United States particularly on cattle, horse, sheep, goat and dog, and rather rarely on man. There are also records from wolf, coyote, skunk and deer. The larvae and nymphs prefer small wild mammals and birds. About a dozen species of birds have been found infested in nature with the immature stages. Of these, the meadowlark, *Sturnella magna,* appears to be the most important host during fall and winter. Bishopp and Hixson (1936) state that of 138 meadowlarks collected in Georgia between October 1 and February 15, 49.2 per cent were infested, one of the birds bearing 289 larvae. Transport by migratory birds no doubt accounts for occasionally finding adults outside the normal breeding range. Although any stage of *A. maculatum* may survive the winter, that season is generally passed in one of the immature instars.

A. maculatum has recently been shown to harbor an infectious agent of the *Rickettsia* type; but it is not known in what animal this organism produces a disease in nature (Parker, Kohls, Cox, and Davis, 1939).

Genus **Haemaphysalis** C. L. Koch, 1844

Key to Species

Males

1. Coxa IV with one long spur, nearly as long as the coxa; coxae I, II and III with one short spur. Scutum with lateral grooves very long and deep, including two or three festoons, and with three wide dorsal grooves posteriorly. Capitulum without ventral cornua ..... *H. chordeilis.*

All coxae with short or very short spurs. Scutum with lateral grooves short and faintly continued to include one to three festoons, without dorsal grooves posteriorly. Capitulum with minute ventral cornua ..... *H. leporis-palustris.*

Females

1. Scutum polygonal, slightly longer than broad, somewhat broader anteriorly, with many small to medium-sized, discrete punctures. Coxa I with a short, slender, sharp inner spur. Palps scarcely longer than greatest width. Capitulum without ventral cornua. Hypostome with many small teeth, placed in five rather irregular rows on each side. *H. chordeilis.*

Scutum elongate-oval, markedly longer than wide, with a few shallow, large, somewhat confluent punctures. Coxa I with a short, broad, blunt inner spur. Palps distinctly longer than broad. Capitulum with well-marked ventral cornua. Hypostome with three regular rows of rather large teeth on each side ..... *H. leporis-palustris.*

Nymphs and Larvae

The characters used in this key are those which have been pointed out to me as the most reliable by Dr. F. C. Bishopp, who also sent some unpublished drawings of the immature stages of both species.

1. Dorsal aspect of base of capitulum transversely hexagonal, the sides protruding as angles. Capitulum ventrally slightly angular posteriorly, but without cornua ..... *H. chordeilis.*

Dorsal aspect of base of capitulum nearly rectangular, the sides straight or slightly curved. Capitulum ventrally with short but distinct cornua ..... *H. leporis-palustris.*

Haemaphysalis chordeilis (Packard)

Ixodes chordeilis Packard, 1869 (between January 1st and July), 1st Ann. Rept. Peabody Ac. Sci., Salem, p. 67 (♀; Massachusetts; off a nighthawk, *"Chordeiles popetue"* = *Chordeiles minor*).

Haemaphysalis chordeilis N. Banks, 1907, Proc. U. S. Nat. Mus., 32, p. 608; 1908, U. S. Dept. Agric., Bur. Ent., Techn. Ser., No. 15, pp. 34 and 54; Pl. IV, fig. 11 (♀); 1908, Occ. Papers Boston Soc. Nat. Hist., 7, p. 12. Hadley, 1909, Science, N. S., 30, p. 606. Bishopp, 1911, Proc. Biol. Soc. Washington, 24, p. 207 (♂). Hooker, Bishopp and Wood, 1912, U. S. Dept. Agric.,

Bur. Ent., Bull. 106, p. 97; Pl. VII, figs. 7–10 (♀♂nl). Herrick, 1915, Cornell Univ. Agric. Expt. Sta., Bull. 359, p. 260. A. E. Miller, 1925, Bull. Ohio Agric. Expt. Sta., No. 386, p. 128. Pettit, 1928, 67th Ann. Rept. State Bd. Agric. Michigan, for 1927–28, p. 199 (off turkey; Bluzonia, Michigan). Bishopp and Trembley, 1945, Jl. of Parasitology, 31, p. 25, fig. 10 (map).

Haemaphysalis cinnabarina Nuttall and Warburton, 1915, Ticks, vol. 3, *Haemaphysalis,* p. 372, figs. 316, 317, 319 and 320 (♀♂nl, bred from adults off cattle, Winnipeg). Nuttall, 1915, Parasitology, 7, pt. 4, p. 430. McIntosh, 1934, Proc. Helminth. Soc. Washington, 1, pt. 1, p. 21. Clarke, 1936, Univ. Toronto Stud., Biol. Ser., No. 41, pp. 89 and 95. Not of Koch, 1844.

Haemaphysalis punctata punctata Fisher, 1939, Michigan State Coll., Techn. Bull. 166, p. 37 (off ruffed grouse; Michigan).

Ontario.—Recorded: Frank's Bay, Lake Nipissing; Buckshot Lake, Addington Co.; in both cases adults off *Bonasa umbellus* [C. H. D. Clarke]. Also Frank's Bay, off *Cannachites canadensis* [C. H. D. Clarke].

Vermont.—Seen: Norwich, ♀ off domestic turkey (Hadley); Woodstock, ♀ (A. P. Morse).—Recorded: Taftville, off domestic turkey [N. Banks].

New Hampshire.—Seen: Concord, n off young ruffed grouse (F. B. White).

Massachusetts.—Seen: ♀ holotype off *"Chordeiles popetue,"* without definite locality (F. G. Sanborn.—M.C.Z.); Milton, ♀ (E. A. Samuel.—M.C.Z.);[40] Naushon Id., ♂, cursorial, Aug. 25 (J. Bequaert).

Rhode Island.—Seen: Kingston, ♀♂ off domestic turkey (Theobald Smith.—Bur.An.Ind., U. S. Dept. Agric.); Newport, ♀ off hawk (M.C.Z.); ♀ off turkey, without definite locality (M.C.Z.).

[40] N. Banks (1908, p. 34) states that he saw at the M.C.Z. "the types, two engorged females from a nighthawk at Milton, Mass." This collection now contains two females, both labelled "type," but placed in different vials. One has no definite locality nor full collector's name, but only a label "from *Chordeiles popetue.* F. G. S. Mass." The other is labelled: "E. A. Samuel, Milton, Mass.," without indication of host. As Packard evidently had only one specimen when he wrote the original description, and gave only "Mass." as locality, but mentioned the host, only the first of these two specimens is the true type. N. Banks (1908*a*, p. 12) also gives "Salem" as a locality for *H. chordeilis,* probably on the assumption that the type was collected there.

New York.—Seen: ♂nl off *Bonasa umbellus,* without more definite locality (Bur.An.Ind., U. S. Dept. Agric.); Bolton Landing, Warren Co., ♀ off domestic turkey, July 13 (Herrick); Westport, Essex Co., ♂ off *Bonasa umbellus,* June 27 (E. J. Gerberg); Tioga Co., ♂ in stomach of *Bonasa umbellus,* June 10 (E. J. Gerberg); Caroline, Tompkins Co., ♀♂n off *Bonasa umbellus* (R. Matheson); Deposit, Delaware Co., ♀ off *Bonasa umbellus* (R. Matheson); Connecticut Hill, ♀ off *Bonasa umbellus* (Crissey).[41]

Haemaphysalis chordeilis is one of the three "bird ticks" of eastern North America, but the extent of its breeding range is at present unknown. In our territory the chief natural host of all stages is ruffed grouse. C. H. D. Clarke (1936) found some larvae and nymphs considered to be *H. chordeilis* on spruce grouse in Ontario. Although all stages occur also on smaller, migratory birds, this species is much rarer on these hosts than the early stages of *H. leporis-palustris.* In addition to the birds listed above, it is recorded, outside our territory, from meadowlark, jackdaw, red-winged blackbird, seaside sparrow, Savannah sparrow and marsh hawk. I have seen adults and nymphs taken off spruce grouse in Oregon and off sharp-tailed grouse in North Dakota. The winter seems to be passed on the ground, away from the host.

The type (♀) of *chordeilis,* at the Museum of Comparative Zoölogy, was examined again and carefully compared with *H. leporis-palustris.* It agrees in every respect with Nuttall and Warburton's description of the female of their *cinnabarina* (1915, p. 374) and their fig. 317, drawn from a tick raised from adults taken off cattle in Winnipeg. In particular, the outline of the scutum is almost exactly as in that drawing, being only very slightly longer than wide. Their fig. 318, drawn from a female from Victoria, Texas, off meadowlark (*Sturnella magna*), received from Dr. F. C. Bishopp, shows a relatively longer scutum. I was at first inclined to regard these figures 317 and 318 as representing different species. More probably, though, the relative width of the scutum varies. Possibly a racial difference might be involved, in which case the more northern specimens represent the typical form of the species.

Nuttall and Warburton (1915) synonymized *H. chordeilis* with *Haemaphysalis cinnabarina* Koch, with which they also united *H.*

[41] A. E. Miller (1925) records *H. chordeilis* from Ostrander, Ohio, off rabbit. As there is no other known record of this species from rabbit, while *H. leporis-palustris* is common on this host in Ohio, Miller's record was most probably based on a misidentification.

sanguinolenta Koch, both these ticks being described from single females, off unknown hosts, from Brazil. Neumann (1897, Mém. Soc. Zool. France, 10, pp. 331 and 332) redescribed Koch's types, stating that they came from Pará. Later (1905, Arch. de Parasitologie, 9, p. 237) he reduced *cinnabarina* to the rank of a variety of the European *H. punctata* Canestrini and Fanzago (1877). *H. cinnabarina* does not seem to have been observed again in South America. Until both sexes of the South American form can be carefully compared with the North American *H. chordeilis,* it seems safer to treat the latter as distinct.

The Old World *H. punctata* I regard as a distinct species, not as a race or variety of the North American *H. chordeilis,* as Nuttall and Warburton did, although they indicated clearly the differences between the two. I have never seen any approach to the Old World form among the North American specimens. It may also be noted that the name *chordeilis* antedates *punctata.*

Original description of *Ixodes chordeilis:* "Female. Allied to the two preceding species [*I. unipunctata* and *I. leporis-palustris*], the thoracic shield being short and small, while the body is thick and leathery. The palpi are very short and broad, when placed together forming a triangle wider than long, being scarcely twice as long as the head itself, and together much wider; they are equilaterally triangular, and conceal the beak; the basal joint is nearly square, the second being triangular; labium small, shorter than usual, rather narrow, and covered with spinules. Head transversely oblong, being just half as long as wide, with straight sides; the hind angles are rectangular, but not produced into spines. The thorax is shield-shaped, rather small, not much longer than broad; the usual convexity is distinct, contracted in the middle, the impressed lines being curved; surface thickly covered with shallow punctures, dark red, concolorous with the legs, the body being very dark blood red. The body is rounded oval, the legs being short. The vulva opens nearer the head than usual, being situated just behind a point opposite the space between the first and second pair of legs. The anus opens near the middle of the body. Length, of body, .25 of an inch; width, .17 of an inch."

Haemaphysalis leporis-palustris (Packard)

Ixodes leporis-palustris Packard, 1869 (between January 1st and July), 1st Ann. Rept. Peabody Ac. Sci., Salem, p. 67 (♀; Fort Macon, North Carolina, off *Sylvilagus palustris*).

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Haemaphysalis leporis Neumann, 1897, Mém. Soc. Zool. France, 10, p. 343, fig. 9 (♀♂nl; in part: North American records only); 1911, Das Tierreich, 26, Acarina, Ixodidae, p. 111, fig. 54 (♀♂; in part: North American records only).

Nova Scotia.—Seen: Yarmouth, ♀ off rabbit (M.C.Z.); Queens Co., n off *Bonasa u. umbellus* (Ent.Br.Ott.); Wolfville, nl off *Zonotrichia albicollis, Melospiza m. melodia, Melospiza georgiana, Turdus m. migratorius, Junco h. hyemalis, Perisoreus c. canadensis, Geothlypis trichas brachidactyla, Vireo olivaceus, Dendroica v. virens,*

and *Hylocichla f. fuscescens* (R. W. Smith.—Ent.Br.Ott.).—Recorded: Apple River, Cumberland Co. [R. Matheson, *in litt.*].

New Brunswick.—Seen: Jeffrey Corner, Kings Co., ♀ off rabbit (C. G. Hewitt.—M.C.Z.); Prince Wiliams Sta., nl off *Bonasa u. umbellus* (D. McGarvey.—Ent.Br.Ott.).

Quebec.—Seen: St. Hyacinthe, ♀ off rabbit (G. Chagnon); Laniel, ♀ off rabbit (D. Gray.—Ont.A.C.).—Recorded: Matamek River, off *Bonasa u. umbellus* and *Canachites c. canadensis* [Gross].

Ontario.—Seen: Brunt Lake, North Almond, ♀♂ off *Lepus americanus virginianus* (Ent.Br.Ott.); Guelph, ln off *Bonasa u. umbellus* (T. D. Jarvis); Arnprior, ♀ off *Lepus americanus virginianus* (Macnamara.—Ent.Br.Ott.).—Recorded: Smoky Falls on Mattagami River; Hornings Mills; Plevna; Arden; Batchawana; Biggar Lake in Algonquin Park; Dacre; Frank's Bay on Lake Nipissing; Mansfield; Sundridge; in all these localities off *Lepus americanus* [MacLulich]. Almonte, ♀ off young domestic turkey [R. O'Connell.—C. R. Twinn, *in litt.*].

Maine.—Seen: Orono, n off *Actitis macularia* (R. S. Palmer).—Recorded: without more definite locality, off *Bonasa u. umbellus* [Peters], and off *Lepus americanus* [Severaid].

New Hampshire.—Recorded: without more definite locality, off *Melospiza m. melodia, Dumetella carolinensis,* and *Bonasa u. umbellus* [Peters].

Massachusetts.—Seen: Canton, ♀♂ off *Sylvilagus transitionalis* (Lyman); Sagamore Beach, off *Toxostoma rufum* (H. S. Fuller); Norwell, l off *Cyanocitta c. cristata* (C. V. MacCoy); North Eastham, nl off *Melospiza m. melodia, Dumetella carolinensis, Spizella p. passerina, Pipilo e. erythrophthalmus, Pooecetes g. gramineus,* and *Colinus v. virginianus* (C. M. Herman); West Newton, ♀ off rabbit (A. Loveridge); Needham, ♂ off *Sylvilagus transitionalis* (J. D. Smith); Groton, ln off *Turdus m. migratorius, Zonotrichia albicollis, Melospiza m. melodia, Melospiza georgiana, Seiurus n. noveboracensis* and *Pipilo e. erythrophthalmus* (W. P. Wharton and E. A. Mason); Weymouth, n off rabbit (J. D. Smith).—Recorded: Groton, off *Hylocichla guttata faxoni, Hylocichla ustulata swainsoni, Seiurus aurocapillus, Passerculus sandwichensis savanna* and *Dumetella carolinensis* [Peters]. North Eastham, off *Passerella i. iliaca* [Peters]. Naushon Id. [Larrousse, King and Wolbach]. Martha's Vineyard [Hertig and Smiley]. Without more definite locality, off *Bonasa u. umbellus, Zonotrichia l. leucophrys,* and *Melospiza l. lincolni* [Peters].

Rhode Island.—Recorded: without more definite locality, off *Bonasa u. umbellus* [Peters].

Connecticut.—Seen: Storrs, ♂ off *Sylvilagus floridanus,* March, 1944 (N.W.H.).—Recorded: without more definite locality, off *Melospiza m. melodia* [Peters].

New York.—Seen: One mile west of Clear Lake, off *Lepus americanus* (F. Harper); Valcour Island, 1 off *Lepus americanus,* n off *Sylvilagus floridanus,* Nov. 15, and many ♀♂, a few n off *Lepus americanus,* May 9 (F. C. Goble).—Recorded: Keene Valley; Dannemora [N. Banks]. Loon Lake, ♀♂ off *Lepus americanus virginianus* [R. Matheson, *in litt.*]. Fishers Island, Suffolk Co., off *Sylvilagus floridanus* [Smith and Cheatum]. Without more definite locality, off *Molothrus a. ater* [Peters].

New Jersey.—Seen: without more definite locality, off rabbit (N.J.A.E.S.).—Recorded: without more definite locality, off *Spizella p. pusilla* [Peters]. Without locality or host [Headlee].

Pennsylvania.—Seen: Centre Co. ♂ off *Sylvilagus floridanus mearnsi,* March 25 (P. F. English), and off *Sylvilagus transitionalis* (F. Glover); Franklin Co., ♀♂n off *Sylvilagus floridanus mearnsi* (D. Jenkins; P. F. English).—Recorded: Wildwood Park near Harrisburg, off *Sylvilagus floridanus* [Bell and Chalgren].

Delaware.—Recorded: New Castle Co., off rabbits and *Sturnella m. magna* [D. MacCreary]. Without definite locality, off *Melospiza m. melodia, Sturnus v. vulgaris, Turdus m. migratorius,* and *Agelaius p. phoeniceus* [H. S. Peters].

Maryland.—Recorded: without more definite locality, off rabbit [J. H. Roberts.—Md.S.H.D., according to E. N. Cory, *in litt.*]. Without more definite locality, off *Corvus b. brachyrhynchos, Zonotrichia albicollis, Turdus m. migratorius, Hylocichla guttata faxoni, Oporornis formosus, Wilsonia citrina, Quiscalus q. quiscula, Quiscalus q. aeneus, Spizella p. pusilla, Junco h. hyemalis, Pipilo e. erythrophthalmus, Melospiza m. melodia, Spinus t. tristis,* and *Toxostoma rufum* [H. S. Peters].

Ohio.—Seen: Lick, Jackson Co., off rabbit; Liberty, Jackson Co., off rabbit (J. H. Hughes).—Recorded: Nile Township, Scioto Co., off *Sylvilagus floridanus mearnsi, Dumetella carolinensis,* and *Colinus v. virginianus;* Huron Co., off *Sturnus v. vulgaris;* Oxford Township, Erie Co., off *Sylvilagus floridanus mearnsi;* Linville, Licking Co., off *Sylvilagus floridanus mearnsi* [Katz]. Gates Mills, off *Junco h. hyemalis* and *Melospiza m. melodia* [H. S. Peters] Without more definite locality, off *Turdus m. migratorius, Sturnus v. vulgaris, Spizella p. passerina,* and *Zonotrichia albicollis* [H. S. Peters].

Haemaphysalis leporis-palustris, the "rabbit tick," occurs probably over the entire United States and much of Canada. In the East, its breeding range extends northward at least to the Matamek River (51° N., 65° W.), in Quebec. It is apparently not a winter feeding tick in the northern States, where it hibernates away from the host. The normal breeding hosts of the adults and early stages are the several species of wild rabbits and hares, on which this tick occurs sometimes in enormous numbers. D. A. MacLulich (1937), in Ontario, found in 1932, that in one locality 10 snowshoe hares averaged 1,000 ticks each, while the next summer the average on two hares in the same locality was 2,700 ticks each. He states that he never saw any other species of tick on the snowshoe hare in Ontario. All stages may be found at the same season on the same animal, the ears being often particularly selected as sites. The largest engorged female I have seen was 11 mm. long.

H. leporis-palustris apparently never bites man; at any rate, I know of no reliable, definite record of its being removed from the human skin. Adults have been reported exceptionally from domestic cats. The larvae and nymphs are common on rabbits and hares, and much rarer on groundhog, opossum, cat and dog. These early stages are, however, frequent during the summer on many of our small migratory birds, more than fifty species being recorded as hosts, and they are found occasionally on ruffed grouse, spruce grouse and quail. In the Cape Cod area, C. M. Herman (1938) found 18 out of 31 song sparrows infested, one bird carrying at least 18 ticks. As larvae were taken off birds in Massachusetts as late as October 15, this tick is obviously distributed by the migrations of the birds.

The relations of *H. leporis-palustris* to animal and human diseases are fully discussed in one of the introductory chapters. I pointed out that this tick is the most important vector of tularemia in nature among rabbits and hares, and that it is probably also of importance in maintaining and spreading Rocky Mountain spotted fever. It does not, however, transmit these diseases to man.

The chalcid wasp, *Ixodiphagus texanus* Howard, appears to be mainly a parasite of *H. leporis-palustris* (A. B. Gahan, 1934), from which it was reared on four different occasions. The original type specimens were bred in May from nymphs off wild rabbits in Jackson Co., Texas. Later other specimens were obtained in April from nymphs off a chapparal cock (*Geococcyx californianus*) at Reagan Wells, Texas (F. C. Bishopp, 1934). In Iowa, C. R. Joyce and G. W. Eddy (1943) reared in April 14 wasps from one engorged

nymph off a brown thrasher (*Toxostoma rufum*). There is also a record at the U. S. Department of Agriculture of this parasite hatching from *H. leporis-palustris* collected at Oak Bluffs, Martha's Vineyard (S. Cobb, 1942).

Ixodes (*Gonixodes*) *rostralis* Dugès (1888, Bull. Soc. Zool. France, 13, p. 129, fig. 2; ♀ only, described as ♂; no host; State of Guanajuato, Mexico) is listed by Neumann (1897 and 1911) and by Nuttall and Warburton (1915) as a synonym of *H. leporis-palustris*. I believe, however, that it is a distinct species, to which most Central and South American records of *H. leporis-palustris* should perhaps be referred. This *I. rostralis* may be the tick described from Brazil by Aragão (in Rohr, 1909) as *Haemaphysalis leporis-palustris* var. *proxima* (not *H. proxima* Warburton and Nuttall, 1909).

Original description of *Ixodes leporis-palustris:* "Female. Closely allied to *I. cookei*, but a little more orbicular; the body is thick, smooth, not punctured, and the thoracic shield is nearly one-third the length of the body exclusive of the mouth-parts, with scattered punctures; the median convexity extends nearly to the hind edge of the shield, the impressed lines being strongly marked. The maxillary palpi are still more triangular on the outer half; the mandibles project slightly beyond the palpi. The vulva is situated between the second pair of feet, which are paler red than the body, which is dark red. Length, .14 of an inch; width, .09 of an inch."

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INDEX

Valid genera and species in Roman; synonyms in *Italics;* ø indicates animals, not arthropods; * plants; main page reference in **bold face.**

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Index to Vol. XXV (n.s.), 1945

New species and other forms in **bold face**; valid species in Roman; synonyms in *Italics;* not included in this Index: Ticks, pp. 73 et seqq., indexed separately at end of paper.

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CONTENTS

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A SYNOPSIS

of the

HEMIPTERA-HETEROPTERA

of

America North of Mexico

BY J. R. DE LA TORRE-BUENO

(*Continued from vol. XXI, no. 2, p. 122*)

PART III

Family XI—Lygaeidae

CONTENTS

FOREWORD

Here is presented the Family Lygaeidae, out of its regular order, Part III of this Synopsis, a work devised to ease the tedious task of naming the North American Heteroptera.

This work has no pretensions to originality in classification. Its only aim is to furnish workable recognition keys to the groups. It

is hoped that the keys following will be found helpful by hemipterists, especially by those with private collections who are far from too-busy museums and their overworked staffs.

This Part is out of the serial order of the families, for the Family Lygaeidae is so rich in genera and species, with descriptions so scattered through an enormous number of fragmentary or partial works of all kinds, that to assemble them is both laborious and tedious, and far too often highly unsatisfactory. Up to recent years the mass of descriptions has been based on color, with here and there a casual reference to some structure, this, for the most part, in the genera; authors have seldom repeated the same specific structure, even in the description of an immediately following species in the same genus in the same paper and page.

In the Lygaeidae, the second largest family of the Heteroptera, following the Miridae, we have an assemblage of readily recognizable forms, ranging in size from the minute 2 mm. *Cligenes* to the nearly 20 mm. long *Oncopeltus*. The Tribe Lygaeini contains the most gaily colored of the species, in flaming reds or clear oranges, with black and white patterns. The other subfamilies and tribes are of smaller species, in blacks and sober browns, sometimes patterned in white. Unfortunately, these patterns are not always uniform within the species; in consequence, many color varieties and synonyms clutter the nomenclature. But Barber has shown that there are ample differential structures. However, to apply these structures widely calls for monographic revisions, with a wealth of material in hand, and with all the types (if extant) subjected to a minute study of structural characters. Until that happy day is here, we shall have to stagger along as best we may.

In the Family and upper groups, the basic keys have been recast or expanded in the light of subsequent studies, but they are essentially the original keys of the masters. After all, the major divisions have been established by competent systematists who have examined deeply into relationships and have essayed to set them in a reasonable order. Hence, the major keys herein are modifications of those of Stål, Reuter, Horváth, Barber, and other outstanding students of the Lygaeidae. The credit is theirs; any errors from recasting, changing or adding, arise from such modifications. How great is my debt to the masterly works of Stål is obvious; and no less so to the fine and painstaking monographs of my friend Mr. H. G. Barber. Certain keys are from monographic keys to genera, notably those to *Lygaeus,* which is that of Barber with additions; this applies also to the keys to *Ligyrocoris* and *Plinthisus,* and to those of the

Ptochiomera complex. The key to *Geocoris* is a combination of those of Barber and McAtee; that to *Arphnus* is based on the key of Van Duzee. A different condition prevails in other keys to species, of which there is none for a number of the American forms. Many keys to such species, in general, are new and derived from descriptions, original and secondary, from comments of authors, and also from figures, checked with specimens in hand; or even made up from determined specimens. As far as possible, these keys are devised on a basis of pure structure, without reference to color-pattern. In small genera of four or less species, there are enough structural characters mentioned in descriptions for differentiation, even though the greater part of the description be by color. However, some keys are on pure color, which original and secondary describers appear to consider the true criterion of a species. An example of the last is the unkeyed genus *Ischnorhynchus,* in which all authors have shown a perfect independence from structural characters, with the single exception of Van Duzee.

In those species separated by color, some individuals in a lot of specimens, because of the changeableness of pattern, or even of color itself, will not fit into a color key. But if such a specimen be one of a like series, except for the color variation, it may be recognized easily by other characteristics, such as facies or some outstanding structure, as belonging in the series. This is unfortunate, of course, but where variable groups are specifically separated by color only, this problem is to be expected and to be overcome as well as possible. Such a condition as this becomes a perfect Garden of Eden, with everything still to be named, for the manufacturer and maker of varieties and even of minuter subforms; but it becomes quite another place for the systematist who is trying to introduce some sort of order into an unholy mess, and to get some idea of what the structural species really is.

It has been claimed that practical keys cannot be made up from descriptions. This is not so; it has been done here. The basic implication in this contention is that descriptions fail to describe, which is tantamount to a charge that descriptions are useless to distinguish one species from another in a given complex. It follows logically from such a principle that a species is not knowable from its description, nor can it be unquestionably named by the description. The further inevitable logical step is that *no* identification of a specimen from a specific description is valid, hence, that only a minute comparison with the type specimen by a known and skilled taxonomist can be certain. This principle of the type specimen as

the sole criterion for knowing a species would also call for wide travel, literally from China to Peru, to check all the species in any one genus. And to crown this idea, so many of the actual type specimens have vanished at the hands of vandals, in the dust of Anthrenus, and into the womb of Time. Further, not every describer fixed or preserved a type specimen, especially so the early describers.

In this postulate of the inescapable need of the type specimen in order to know the species, all determinations from descriptions and keys sink to the low level of vague aspirations.

This is the inevitable road along which worshippers of the Type Fetish would lead us, a road going nowhere, except to certain confusion.

The strongest commentary that may be made on the classification of the Family Lygaeidae is that this great aggregate will continue in more or less confusion until every genus is adequately monographed with abundant material before the systematist, an example of which adequacy is H. G. Barber's fine Key to the Genus *Ligyrocoris*.

References

The references following are on the same plan as those in Parts I and II (q.v.), and name only the works *after* 1917. It contains only such as refer to the one family in Part III. The Miridae are omitted as before. This enumeration of genera and species therefore, as far as it goes, supplements the Van Duzee Catalogue of 1917.

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Barber, H. G. 1918. Concerning Lygaeidae—No. 1. Jour. N. Y. Ent. Soc., XXVI: 44/46.
Describes: *Caenopamera* Barber (p. 45); *Zeridoneus* Barber (p. 45).

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Describes: *Kolenetrus* Barber (p. 49); *Valonetus* Barber (p. 50); *Valonetus pilosulus* Barber (Texas, p. 50); *Esuris fulgidus* Barber (Arizona, California, p. 51); *Ozophora ampliatus* Barber (Arizona, p. 52); *Malezonotus* Barber (p. 54); *Malezonotus fuscosus* Barber (New York, New Jersey, p. 56); *Trapezonotus derivatus* Barber (Arizona, p. 57); *T. diversus* Barber (California, p. 57); *Sphragisticus simulatus* Barber

(New Mexico, p. 58); *Peritrechus saskatchewanensis* Barber (Saskatchewan, California, p. 60); *Valtissius* Barber (p. 62); *Cryphula abortiva* Barber (Arizona, p. 63); *Togodolentus* Barber (p. 64); *T. genuinus* Barber (California, p. 64); *Scolopostethus pacificus* Barber (California, p. 65).

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1921. Revision of the Genus *Ligyrocoris* Stål. Journ. N. Y. Ent. Soc., XXXIX: 100/114.
Describes: *Ligyrocoris rubricatus* Barber (Arizona, California, p. 105); *L. coloradensis* Barber (Colorado, p. 106); *L. latimarginatus* Barber (California, Oregon, p. 107); *L. obscurus* Barber (Maryland, Illinois, Kansas, p. 108); *L. depicius* Barber (Massachusetts, Connecticut, New York, New Jersey).

1924. Two New Species of *Cymus*. Bul. Bklyn. Ent. Soc., XIX: 87/90.
Describes: *Cymus robustus* Barber (New York, Michigan, p. 87); *C. reductus* Barber (Arizona, p. 88).

1924. Corrections and Comments on Hemiptera Heteroptera. Journ. N. Y. Ent. Soc., XXXII: 133/137.
Describes: New genus *Neosuris* Barber for (*Esuris*) *castanea* Barber (p. 133); new genus *Neogorpis* Barber for (*Gorpis*) *neotropicalis* Barber (p. 136).

1926. A New *Geocoris* from Illinois. Bul. Bklyn. Ent. Soc., XXXI: 38/39.
Describes: *Geocoris frisoni* (Illinois, p. 38).

1926. In "The Phenomenon of Myrmecoidy, with New Examples from Cuba" J. G. Myers & G. Salt). Trans. Ent. Soc. London, Pt. II: 427/436, pl. XCIII.
Describes: *Pamphantus mimeticus* Barber (Cuba, p. 434).

1928. The Genus *Eremocoris* in the Eastern United States with Description of a New Species and a New Variety. Proc. Ent. Soc. Wash., XXX: 59/60.

Describes: *Eremocoris depressus* Barber (North Carolina, Louisiana, Mississippi, New Jersey, Virginia, District of Columbia, p. 59); var. *setosus* Barber of *E. plebejus* Fall. (Virginia, Massachusetts, New York, Ohio, Indiana, District of Columbia, Georgia, Florida, p. 60).

1928. Revision of the Genus *Ptochiomera* Say. Journ. N. Y. Ent. Soc., XXXVI: 175/177.
Describes: *Exptochiomera* Barber (p. 175).

1928. Two New Lygaeidae from the Western United States. Bul. Bklyn. Ent. Soc., XXIIII: 264/268.
Describes: *Thylochromus* Barber (p. 264); *T. nitidulus* Barber (California, p. 265); *Ozophora depicturata* Barber (Arizona, California, p. 266).

1932. Three New Species of *Exptochiomera* from the United States. Journ. N. Y. Ent. Soc., XL: 357/363.
Describes: *Exptochiomera intercisa* Barber (Cuba, "Florida," p. 357); *E. arizonensis* Barber (Arizona, New Mexico, p. 359); *E. nana* Barber (Massachusetts, p. 361).

1935. New *Geocoris* from the United States with Key to Species. Journ. N. Y. Ent. Soc., XLIII: 131/137.
Describes: *Geocoris omani* Barber (Arizona, p. 131); *G. beameri* Barber (Arizona, p. 132); *G. davisi* Barber (Nevada, p. 133); *G. nanus* Barber (Arizona, Colorado, p. 134).

1937. Description of Six New Species of *Blissus*. Proc. Ent. Soc. Wash., XXXIX: 81/86.
Describes: *Blissus omani* Barber (Arizona, p. 81); *B. nanus* Barber (Kansas, p. 82); *B. planarius* Barber (Wyoming, Colorado, p. 83); *B. villosus* Barber (California, p. 84); *B. mixtus* Barber (California, p. 85); *B. breviusculus* Barber (Maine, Massachusetts, p. 85).

1938. A New Species of *Cistalia*. Proc. Ent. Soc. Wash., XL: 87/88.
Describes: *Cistalia explanata* Barber (Texas, Kansas, p. 88).

1938. A Review of the Genus *Crophius* Stål, with Description of Three New Species. Journ. N. Y. Ent. Soc., XLVI: 313/319.
Describes: *Crophius ramosus* Barber (Utah, Indiana, p. 315); *C. albidus* Barber (Utah, p. 316); *C. convexus* Barber (Perú, p. 316).

1939. A New Species of Heteroptera from the Southern Part of the United States. Proc. Ent. Soc. Wash., XLI: 173/174.
Describes: *Heterogaster flavicosta* Barber (Texas, Louisiana, p. 173).

Blatchley, W. S. 1925. Some Additional New Species of Heteroptera from the Southern United States, with Characterization of a New Genus. Ent. News, XXXVI: 45/52.
Describes: *Ischnodemus pusillus* Blatchley (Florida, p. 45); *Malacopus longicornis* Blatchley (Florida, p. 46); *Physopleurella floridana* Blatchley (Florida, p. 47); *Microvelia parallela* Blatchley (Florida, p. 48); genus *Glossoaspis* (p. 50); *G. brunnea* (Florida, p. 51).

(Note.—*Ischnodemus pusillus* was later found to be preoccupied, and the author changed it to *I. minutus* n.n., in Ent. News, XXXVI: 245; *Microvelia parallela* Blatch. is a straight synonym of *M. austrina* T.-B., as Blatchley points out in Het. No. Am., p. 992.)

Bruner, S. C. 1932. A New *Pamphantus* from Cuba. Bul. Bklyn. Ent. Soc., XXVII: 141/144.
Describes: *Pamphantus vittatus* Bruner (Cuba, p. 141).

Parshley, H. M. 1922. Report on a Collection of Hemiptera-Heteroptera from South Dakota. Tech. Bul. no. 2, S. Dak. St. Coll.
Describes: *Ischnodemus brevicornis* Parshley (South Dakota, p. 8).

(N.B.—This name is preoccupied; and the author changed it to *Ischnodemus hesperius* n.n., in Bul. Bklyn. Ent. Soc., XVII, for October 1922.)

Torre-Bueno, J. R. de la. 1943. Remarks on the Genus *Geocoris* Fallén 1814. Bul. Bklyn. Ent. Soc., XXXVIII: 25/27.
Describes: *Geocoris guatemaltecus* Torre-Bueno (Guatemala, p. 27).

1946. A North American *Dienches*. Bul. Bklyn. Ent. Soc., XLI: 125.
Describes: *Dienches occidentalis* Torre-Bueno (Arizona, p. 125).

Usinger, R. L. 1933. A New Species of *Gastrodes* from California. Pan. Pac. Ent., IX: 127/128.
Describes: *Gastrodes conicola* Usinger (California, p. 127).

1938. Review of the Genus *Gastrodes*. Proc. Calif. Acad. Sci., XXIII: 289/301.
Describes: *Gastrodes intermedius* Usinger (British Columbia, p. 297); *G. arizonensis* Usinger (Arizona, p. 297); *G. conicola* Usinger (California, p. 299); *G. walleyi* Usinger (Ontario, Canada, p. 301).

Van Duzee, E. P. 1928. Our First *Rhyparochromus*. Pan. Pac. Ent., V : 47.
Names (no description) : var. *californicus* Van Duzee, of *Rhyparochromus chiragra* Fabricius (California, p. 47).
1928. Two Interesting Additions to the Hemipterous Fauna of California. Pan. Pac. Ent., IV : 190/191.
Describes: *Hypogeocoris slevini* Van Duzee (California, p. 190) ; *Ischnodemus badius* Van Duzee (California, p. 191).
1931. A New *Ischnorhynchus*. Pan. Pac. Ent., VII : 110.
Describes : *Ischnorhynchus obovatus* Van Duzee (California, p. 110).

Family XI. **LYGAEIDAE** Schilling 1929

Key to Subfamilies

1. Suture between ventral segments III and IV usually curved anteriorily and not reaching the lateral margins of the abdomen; head generally with two setae near the eyes; (anterior femora swollen and armed with teeth).
   8. *Rhyparochrominae* Stål 1862
   All ventral sutures, when present, straight and reaching the lateral margins of the abdomen; head generally *without* setae near the eyes 2
2. At least *three* of the ventral segments fused, with no evidence of incisures ..... 9. *Pamphantinae* Barber 1933
   All ventral segments set off by incisures 3
3. *All* the abdominal spiracles dorsal; entire posterior margin of the pronotum, at least before the scutellum, turned down convexly ; anterior femora not much swollen as compared to the others, seldom armed beneath with spines or teeth 4
   All the abdominal spiracles *not* dorsal, at least those of segment VI ventral; posterior margin of the pronotum, at least before the scutellum, ordinarily not turned down convexly; anterior femora more or less shortened and swollen as compared to the others, either with or without teeth 5
4. Posterior margin of the pronotum between the scutellum and the lateral angles more or less distinctly impressed or depressed; hemelytra, pronotum, scutellum and usually the head, *impunctate;* the two inner veins of the membrane usually joined near the base by a transverse vein, (areola of membrane with two veins arising therefrom).
   2. *Lygaeinae* Stål 1862

Posterior margin of the pronotum *not* distinctly impressed or depressed between the scutellum and the lateral angles; hemelytra, head, pronotum and scutellum *distinctly punctate;* the two inner veins of the membrane *not* connected by a crossvein near the base; (hemelytra dilated and wider than the abdomen) ..... 2. *Cyminae* Stål 1862

5. All the abdominal spiracles ventral; anterior femora more or less swollen and armed with one or more spines 7

All abdominal spiracles *not* ventral, at most only the apical three pairs; anterior femora moderately incrassate and generally unarmed (except in some species of *Ischnodemus*) 6

6. Head always narrower than the posterior margin of the pronotum; tylus not sulcate; hemelytra not convex and almost or quite impunctate; clavus not narrowing posteriorly; commissure distinct, at least as long as the scutellum; anterior femora sometimes much swollen(in *Ischnodemus*); (anterior acetabula excised from disc of prosternum, remote from its posterior margin) ..... 3. *Blissinae* Stål 1862

Head very broad across eyes, as wide as or wider than the posterior margin of the pronotum; tylus usually sulcate; hemelytra convex and plainly punctate; clavus commonly not narrowing posteriorly; commissure usually absent or very short; anterior femora moderately incrassate and unarmed; (membrane without a basal areole).
4. *Geocorinae* Stål 1862

7. Anterior femora much swollen and armed beneath with one or more teeth; outer vein of the corium not parallel with the margin; corium not wider than the abdomen; bucculae short, restricted to the front of the head; posterior coxae not widely separated 8

Anterior femora *not* much swollen, less so than in the preceding, and armed with a *single* tooth; corium expanded, wider than the abdomen; outer vein subparallel to the margin of the corium; bucculae extended the length of the head; antennae inserted close to the bucculae; posterior coxae widely separated ..... 7. *Oxycareninae* Stål 1862

8. Membrane with the two inner veins connected anteriorly by transverse veins; posterior margins of the pronotum very concave before the scutellum; anterior femora *not* armed with numerous teeth ..... 5. *Heterogastrinae* Stål 1872

Membrane with the two inner veins *not* connected anteriorly by

a transverse vein; all veins running to the base, sometimes reticulated posteriorly; posterior margin of the pronotum straight before the scutellum; anterior femora much swollen and armed with *numerous* teeth; (anterior tibiae in male curved) ..... 6. *Pachygronthinae* Stål 1865

Subfamily 1. **Lygaeinae** Stål 1862

Key to Tribes

A. Apical margin of the corium straight, not sinuate inwardly; exterior apical angles of the antennal tubercles obtuse or subobtuse; dorsal segment VI of male truncate; male genital segment not foveate ..... Tribe 1. *Lygaeini* Stål 1872

B. Apical margin of the corium sinuate; apical angles of the antennal tubercles prominent, acute or subacute; dorsal segment VI of male rounded; male genital segment foveate; (scutellum near base with a more or less distinct transverse ridge, the base depressed before this, and longitudinally carinate behind this ridge) ..... Tribe 2. *Orsillini* Stål 1872

Tribe 1. *LYGAEINI* Stål 1872

Key to Genera

A. Posterior margin of the pronotum before the scutellum *sinuate,* carinate anteriorly in the middle; scutellum more or less tumid and carinate apically.

Genus I. *Oncopeltus* Stål 1868

B. Posterior margin of the pronotum *truncate, without* a median keel, or with a median keel *not reaching* to the anterior margin; scutellum not tumid, with a longitudinal keel, commonly joined to a transverse keel at the base.

Genus II. *Lygaeus* Fabricius 1794

Genus I. *Oncopeltus* Stål 1868

Key to Subgenera and Species

1. Head and pronotum *with* long hairs; posterior margins of the pronotum distinctly depressed, explanate and dilated, especially at the scutellum, which makes the posterior margin distinctly sinuate before the scutellum; rostral segment II frequently distinctly longer than III (s.g. *Oncopeltus* Stål 1874) 2

Head and pronotum *without* long hairs, or very short pilose; posterior margin of the pronotum before the scutellum

straight or slightly sinuate posterior margin narrowly depressed, hardly or obsoletely subampliate; rostral segment II subequal to or shorter than III; (ventral segment II produced backward at the middle of the apex in some females) (s.g. *Erythrischius* Stål 1874) 5

2. (s.g. *Oncopeltus*). Membrane with a *transverse white spot* before the middle of the disc 3

Membrane *wholly black* seldom marked with pale spots in the basal margin; rostrum not extended beyond ventral segment I; length, 14–16 mm.; width, 4–5 mm.

varicolor Fabricius 1794

California, Mexico, Colombia, British Guiana, Perú, Brazil.

3. Smaller species (11–13 mm. long) abdomen mostly black 4

Larger species (over 13 mm. long); abdomen mostly black; (pronotum with a black median line; rostral segment III distinctly longer than II; propleura not fasciate with black); length, 13 mm.; width, 3 mm.

gutta Herrich-Schaeffer 1844

Texas, Arizona, California; Sonora, Mexico; Guatemala; on purple milkweed.

4. Ground color flavescent; length, 11–13 mm.; width, 3.5–4.5 mm. ..... *sexmaculatus* Stål 1874

Mexico, Central America.

Ground color sangineous; (narrow and elongated; sides of pronotum straight, terete, median carina prominent across depressed area, posterior margin each side of the scutellum compressed and foliaceous; scutellum strongly convex and carinate; rostral segment II distinctly longer than III); length, 11–13 mm. ..... *sanguinolentus* Van Duzee 1914

California; Sonora and Lower California, Mexico; on milkweed flowers.

5. (s.g. *Erythrischius*). Lateral margins of the pronotum behind the middle, or the base more or less broadly black or fuscous; rostrum slightly, if at all, extended beyond the posterior coxae, segments II and III equal or subequal 6

Lateral margins of the pronotum wholly flavescent or rufotestaceous, sometimes obviously narrowed posteriorly 7

6. Hemelytra *without* black margins; head more or less rufescent; antennal segment IV longer than II; length, 10–12 mm.; width, 3.5–4 mm. ..... *cingulifer* Stål 1874

Mexico, Dominica, B. W. I.; Canal Zone, Colombia.

Hemelytra *with* black margins; head black; antennal segments

II and IV subequal; length, 11–13 mm.; width, 3–3.5 mm. ..... *cayensis* Torre-Bueno 1944
Florida.

7. Smaller species (10 mm. long); actual length, 8–10 mm.; width, 2.5–3 mm. ..... *sandarachatus* Say 1832
California, Mexico, Jamaica (Neotropical).

Larger species (over 10 mm. long); actual length, 13–18 mm. ..... *fasciatus* Dallas 1851
North and South America, widespread; on *Asclepias syriaca, A. verticillata,* and *Metastelma scopiarum,* feeding on the pods and seeds; parasitized by *Herpetomonas elmassiani;* preyed upon by *Phymata* sp., *Sinea diadema, Nabis ferus* and *N. roseipennis.*

Genus II. *Lygaeus* Fabricius 1794

Key to Species

1. Pronotum black, with a postmedian transverse red band or three red spots, remote from the posterior margin; large species, 10–12 mm. long; [vertex or head with a red spot or dot, which may be obsolete in some specimens and very small in some species, or with a red vertical vitta, anteriorly forked in some species; venter usually with a black fascia or spot on the anterior angles of segments II to IV, or, exceptionally, wholly black (in *formosus*), as well as the genital segment, which may be rufescent in some species; ostioles black; (sec. Stål—pronotum black behind middle with a fascia or 3 spots rufous or flavescent, remote from the base, the fascia anteriorly bisinuate or black-bimaculate, the spots frequently confluent; a wide lateral margin or the sides of the propleura, rufous or flavescent behind the middle)]; (subgenus *Lygaeus* Fabricius 1794 = *Graptolomus* Stål 1874) 2

Pronotum *without* a transverse postmedian red or flavescent fascia; less than 10 mm. long 8

2. Clavus black, pale flavescent on the inner side along its entire length to the apex of the commissure, and without a subapical opaque black spot; apical margin of the corium and the venter wholly black; posterior black spots of the pronotum somewhat distant from its basal margin, which is rufescent or flavescent; (membrane pale hyaline; length 10–12 mm., width, 3.67 mm.) ..... *formosus* Blanchard 1840
(= *elatus* Stål 1862)

Florida, (Mexico, West Indies, Central and South America).

Clavus *not* pale-margined, sometimes entirely or posteriorly black or fuscous, with an opaque black median spot at the level of the apex of the scutellum; apical margin of the corium hardly black; venter rufous or flavescent, black-spotted; the black spots or fascia of the pronotum reaching its base 3

3. All pleura more or less broadly pale fusco-reddish posteriorly, the propleura anteriorly also, at times; acetabula and bucculae pale fusco-reddish, sometimes obscurely so or pale; membrane in great part pale with fuscous veins; length, 10 mm., width, 3 mm. ..... *truculentus* Stål 1862
Arizona, California, (Mexico); on Asclepias.

All pleura *not* pale-margined anteriorly or posteriorly; acetabula and bucculae black; membrane wholly black or very commonly pale-margined, with or without white discal spots, or with a twinned white discal spot divided by a black vein 4

4. Corium with a small round free or nearly free opaque black spot, which is hardly or else not broadly attached to the larger oblong costal spot; membrane without a discal spot; basal red spot of the head short, wide, more or less pyriform, at its apex with a small round spot at each side touching it, which produces the effect of an incised apex (not with extended arms, as in *turcicus*); length, 10–10.5 mm., width, 3 mm. ..... *trux* Stål 1862
Arizona, (Mexico).

Corium without a small round free or nearly free opaque black spot, the latter broadly attached to the somewhat, or quite, large irregularly triangular or subtriangular black spot which touches the costal margins and is more or less extended on the disc 5

5. Hemelytra *with* a black percurrent median fascia widened on both sides; length, 9 mm., width, 2.67 mm. *ruficeps* Stål 1862
(Sonora, Mexico).

Hemelytra *without* a median fascia between the costal spots of the corium 6

6. Membrane wholly black, *without* pale margins or white spots; head with an anteriorly forked red fascia, with its arms extended between the antennal tubercles and the eyes;

(clavus anteriorly red; rostrum reaching posterior coxae; length, 10–11.5 mm.) ..... *turcicus* Fabricius 1803
(= *trimaculatus* Dallas 1852)

Atlantic States, south to Virginia; west to Colorado, Missouri, Oklahoma, New Mexico, Arizona; on *Ceanothus*.

Membrane pale-margined and with or without white discal spots; clavus wholly black or anteriorly red; basal fascia of the head *not* forked, frequently very small 7

7. Clavus *wholly black;* white margins of the membrane either narrow or wide; discal spot faint or conspicuous; length, 10–12 mm. ..... *kalmii* Stål 1874

Country wide, from British Columbia and Quebec into Mexico; on *Asclepias* spp. and blueberry.

Clavus *anteriorly red;* membrane narrowly white margined, discal white spots reduced, sometimes absent; length, 11 mm. ..... *reclivatus* Say 1825
(var. *enotus* Say 1825
= *costalis* Herrich-Schaeffer 1844)

Oregon, Washington, the Dakotas, New Mexico, Missouri, Texas, Colorado, Utah, California, Arizona; on climbing milkweed and on *Asclepias* spp.

8. Pronotum entirely black; head with a red basal spot, sometimes obscured or absent; corium and clavus *bright red;* membrane very narrowly and evenly white-margined; ventral segments VI and the genital black; (subgenus *Melanopleurus* Stål 1874) 9

Pronotum *seldom* entirely black, if wholly black, then the ostioles are pale; usually with a pronotal margins red or pale, the lateral margin at least in part, and the posterior margin sometimes trimaculate with red 10

9. *Larger species,* 8–9 mm. long; bucculae variable, usually high and noticeably semicircular, rather broadly and conspicuously pale, as are also the acetabula, the anterior margins of the propleura, and the posterior margins of the meso- and metapleura (these pale margins are variable, and sometimes absent); length, 8 mm., width, 5.5–6 mm.
belfragei Stål 1874

Texas, New Mexico, Arizona, California.

Smaller species, 5–6 mm. long; bucculae usually low and not semicircular, with the margins inconspicuously pale-mar-

gined, as well as the margins of the pleura and the acetabula; length, 5.5–6 mm. ..... *bistriangularis* Say 1832
(= *vicinus* Dallas 1852)
(var. *marginellus* Dallas 1852)
Texas, Colorado, Arizona, California, (Mexico, Neotropical).

10. All margins of the pronotum and the hemelytra conspicuously margined with, a vitta behind the middle of the pronotum, *red* or *yellow;* ostioles *black;* head *with* a red or rufous basal spot; bucculae, acetabula, the anterior margin of the propleura and the posterior margin of *all* the pleura, broadly pale or yellow; ventral segment VI and the genital *black* (subgenus *Craspeduchus* Stål 1874) 11

Margins of the pronotum and of the hemelytra seldom wholly red- or pale-bordered, in the latter case the venter is wholly black- or red-margined, or the head has no basal spot 12

11. Margins of insect elliptical; bucculae ? posteriorly; anterior margin of the pronotum and median, slightly depressed transverse area, distinctly punctured, the posterior lobe not (?) punctured; spot on vertex rufotestaceous or subsanguineous; length, 9 mm., width 3 mm. ... *uhleri* Stål 1874
Texas, Arizona, (Mexico, Neotropical).

Margin of insect straight; bucculae narrowing posteriorly; broad anterior margin of the pronotum and median depressed transverse area coarsely punctured, obsoletely so on the posterior lobe; spot of vertex rufous; length, 8 mm. *defessus* Van Duzee 1929
(Lower California, Mexico).

12. Head with a red or pale spot at base; ostiole pale (or black in *foederatus*); ventral colors variable, either wholly black or margined with red or pale, or with only ventral segment VI and the genital black; (subgenus *Ochrostomus* Stål 1874) 13

Head wholly black; ostioles black, seldom pale (in *mimulus* which has the bases of the legs and the apices of the femora pale); venter generally entirely black or narrowly red-margined (exceptionally mostly red in *bicrucis*); (membrane with or without a white discal spot) 18

13. Venter red, sometimes more or less infuscated, ventral segment VI and the genital black; pronotum black; hemelytra red, more or less infuscated, apical margin pale, membrane broadly white along the outer lateral margin; (antennae

stout; rostrum reaching upon the posterior coxae; scutellum depressed behind middle, apex carinate, acute) length 6–6.5 mm., width, 2 mm. ..... *pyrrhopterus* Stål 1874
(& var. *melanopleurus* Uhler 1893)
Texas, Colorado, Utah, Arizona, California; on cedar.

Venter wholly black or fuscous, or sometimes pale- or red-margined; pronotum entirely reddish or with the posterior margin trimaculate with red 14

14. Membrane embrowned, *not* white-margined; corium fuscous, *only the spical angles red;* venter entirely fuscous; (antennal segment I short, going one-third of its own length beyond the apex of the head, II about three times the length of I and slightly longer than III; apex of rostrum reaching posterior coxae, segments I and II subequal, III one-third longer than II); length, 6–7 mm. ... *tripligatus* Barber 1914
Florida.

Membrane white-margined; corium either fuscous, margined with red, or mostly reddish; venter black or fuscous, the margins pale red, and sometimes the disc 15

15. Pronotum wholly ochraceous-red, with four short, premedian (?black) impressions; corium ochraceous-red, more or less infuscated, apical margin yellow; membrane in the brachypterous narrowly pale-margined; (basal spot of the head often obscure; bucculae rather low, not extended much beyond the middle of the head; apex of the rostrum reaching between the posterior coxae; pronotum impunctate, the median longitudinal carina *faintly* indicated); length, 5–6 mm. ..... *rubricatus* Barber 1921
Arizona.

Pronotum posteriorly trimaculate with red; corium fuscous or red, its costal, commissural and apical margins as well as the apical carina of the scutellum red or pale; membrane white-margined 16

16. Anterior margin of the pronotum red or pale, the fuscous markings forming a T-shaped fascia on each side of the median line; membrane rather narrowly and evenly white-margined; acetabula, bucculae, anterior and lateral margins and the posterior angles of the prosternum broadly ochraceous-red; length, 4.3–6 mm. ..... *lineola* Dallas 1852
Virginia, Georgia, Florida, Texas, New Mexico; on flowers of thistles.

Anterior margin of the pronotum *not* red, except the collum

sometimes narrowly tinged with red (in *carnosulus*); membrane somewhat broadly edged with white; bucculae and acetabula white or whitish; anterior margin of the prosternum broadly yellowish or white 17

17. Apical margin of the corium with a broad white border; pleura black except the narrow posterior margins white or pale, sometimes obsoletely so; outer margin of the propleura pale sanguineous; apical half of the scutellum pale, continued on the carina to the commissure; ostiole pale at apex; length, 4–6.5 mm. ..... *carnosulus* Van Duzee 1914

Arizona, California, (Lower California); on goldenrod.

Apical margin of the corium concolorous, (the clavus sometimes fuscescent); propleura posteriorly broadly red; pleura black, except the pale posterior margins of the pro- and metapleura; apical one-third of the scutellum red; ostioles black; (trochanters whitish); (collum slender but strongly raised; four transverse lines between the lobes deep; antennal segment II slightly longer than III; bucculae attaining basal third of the gula; rostrum reaching hind coxae, segment I passing base of head); length, 7 mm.

foederatus Van Duzee 1929

Arizona, Nevada.

18. Small (5 mm. or less long), heavily pilose species; membrane with a median white discoidal spot, or *variegated* with white (subgenus *Lygaeospilus* Barber 1921) 19

Larger (over 5 mm. long), entirely nude or lightly pilose; membrane *without* a discoidal spot, entirely fuscous, or pale margined, or rarely milky-white with fuscous or black veins (in *nigrinervis*); (subgenus *Melanocoryphus* Stål 1872) 20

19. Membrane fuscous, pale-margined and with a rather cleancut *transverse* median white spot, often prolonged and continuous to the middle of the base of the membrane; hemelytra red, often more or less infuscated; venter wholly fuscous or sometimes margined with red; (rostrum reaching *behind* middle coxae; humeri tubercular); length, 4.5 mm., width, 1.5 mm. ..... *pusio* Stål 1874

(= *albulus* Distant 1893
= *Lygaeosoma solida* Uhler 1893)

Arizona, California.

Membrane fuscous, variegated with white, the discal spot more

or less confused with the pale variegations, not pale-margined, with a triangular pale fascia at the outer basal angles; hemelytra generally entirely fuscous or fusco-rufescent, seldom pale-margined; venter with the lateral margins sometimes red or pale; length, 3.1–5 mm., width, 2 mm. ..... *tripunctatus* Dallas 1852
(= *albulus* auctt., nec Distant
= *obscuripennis* Stål 1874)

Maine and New York south to Florida and west to Texas and Arizona.

20. Posterior lobe of the pronotum, the corium, the venter, except the genital segments and small vittae, red; anterior margin of the pronotum, the clavus, the posterior margins of the corium, bucculae, acetabula, anterior margin of the prosternum and the posterior margins of all pleura conspicuously white or pale yellow; (ocelli far from each other and close to the eyes; antennal segments III and IV subequal, II one-third longer; rostrum passing intermediate coxae); length, 7.5–9 mm. ..... *bicrucis* Say 1825

Maine, New York and New Jersey south to Florida, Louisiana; Missouri, Michigan, Kansas, Colorado, Texas, New Mexico, Utah, British Columbia, California, Arizona, (& south to Brazil); on flowers of *Senecio* and of *Mesadenia atriplicifolia;* on huckleberry in Maine.

Posterior lobe of the pronotum, the corium, the clavus and the venter wholly or mostly fuscous 21

21. Anterior lobe of the pronotum, the head between the eyes, and the tylus, ochraceous; posterior lobe of the pronotum fuscous or black bivittate, or with two large subquadrate spots; (costal, apical and commissural margins of the hemelytra, the apical carina of the scutellum, the lateral margins and the disc of the venter pale yellow; the bucculae, antennal tubercules beneath, acetabula, the prosternum in large part, and the posterior margins of the pleura, pale yellow); ostioles, bases of the legs and the apices of the femora pale; (the membrane hardly pale marginally; rostrum reaching onto metasternum; antennal segments III and IV subequal, II longer); length, 5.5–6 mm. ..... *mimulus* Stål 1874

Virginia to Florida, Alabama, Texas; on thistles in damp places.

Anterior and posterior lobes of the pronotum concolorous fuscous, or sometimes with the anterior and posterior margin

red, or the posterior margin trimaculate with red, or sometimes with the lateral margins bordered with red; ostioles, legs and venter black, the latter sometimes red- or pale-margined 22

22. Membrane milky-white with prominent fuscous or black veins and a spot near the outer basal angle; length, 6 mm., width, 2 mm. ..... *nigrinervis* Stål 1874
Colorado, Arizona, (Mexico, Neotropical).

Membrane wholly fuscous or black, or more usually margined with white, sometimes with a white basal spot (in *lateralis*) 23

23. Corium *wholly* fuscous or *black*, never margined with red or yellow; membrane hardly pale margined; anterior and humeral angles of the pronotum and sometimes a posterior median fascia, red; (venter *not* red-margined; antennae stout, segment II long, about equal to IV, III short, a little longer than I; rostrum reaching posterior coxae; hemelytra with the veins of the corium and the claval boundary thick and very prominent—Uhler); length, 5.5.–8 mm., width, 2–3 mm. ..... *rubicollis* Uhler 1894
Arizona, California, (Lower California, Mexico).

Corium with *at least* the costal margins bordered with red or yellow; anterior and humeral margins of the pronotum sometimes, and a posterior fascia, red or yellow 24

24. Humeral red fascia *not* extended anteriorly *beyond* the middle of the pronotum; anterior margin of the prosternum, the bucculae and the acetabula *very obscurely* pale; apical carina of the scutellum *not* red; membrane white-margined; venter entirely fuscous or red-margined 25

Humeral red fascia extended beyond middle, or the entire margin of the pronotum reddish; anterior margin of the prosternum, bucculae and sometimes the acetabula prominently and broadly pale or yellow; apical carina of the scutellum red or yellow; membrane with or without white margins; margin of the venter red 26

25. Costal margin of the hemelytra red; sunken disc of the pronotum on both sides of the median ridge coarsely and closely punctate; margins of the venter seldom red; (membrane with or without a lunate white spot near the base; thorax rugose with a strong transverse ridge a little before the middle and a raised line down the middle of the posterior part); length, 7.3–8 mm. ..... *lateralis* Dallas 1852
(= ? *californicus* Walker 1872)

Texas, Colorado, Utah, Arizona, California, (Mexico); on dewberry.

Costal, apical, commissural and inner claval margins of the hemelytra red, and sometimes the entire apical angle of the corium; disc of the pronotum on both sides of the post-median ridge finely or obscurely punctate; (antennae very stout, almost as thick as the tylus, segment I extending very little beyond the apex of the tylus, II about equal to IV, III hardly more than two-thirds as long as either; rostrum reaching posterior coxae; pronotum with a few shallow punctures behind the transverse ridge, the median ridge quite distinct; posterior margin of the corium arcuated—sinuated at the middle—Uhler); length, 4.5–6 mm., width, 1.8 mm. ..... *admirabilis* Uhler 1872
Maryland, Florida, Kansas, New Mexico, Colorado, Nevada, California, Arizona, Texas (south into Mexico).

26. Costal margin of the hemelytra *prominently,* and sometimes the commissural and inner claval margins *very narrowly* red or yellow; membrane very obscurely narrowly white-margined; (antennal segments I, III, and IV subequal, II longer; rostrum reaching the metasternum); length, 7–10 mm., width, 2.5 mm. ..... *facetus* Say 1832
(= *rubriger* Stål 1862)
New Jersey, Pennsylvania, Maryland, South Carolina, Georgia, Florida, Louisiana, Texas, Colorado, New Mexico, Arizona, California; (Lower California, Mexico); on yucca.

Costal, apical, commissural and inner claval margins of the hemelytra *plainly* red; membrane plainly white-margined; length, 9 mm., width, 3 mm. ..... *circumlitus* Stål 1862
?Colorado, Arizona, (Mexico, Neotropical).

Tribe 2. *ORSILLINI* Stål 1872

Key to Genera

1. Antennal segment I *surpassing* the apex of the tylus; head moderately elongate, not as long as broad; rostrum short, hardly reaching the abdomen 2

Antennal segment I *not reaching* the apex of the tylus; head longer than broad; rostrum long, reaching to or beyond the middle of the venter, segment I as long as the head 3

2. Costal margins of the hemelytra straight throughout, parallel or converging posteriorly; eyes prominent, the exposed area

back of the eyes greater than half the width of the eyes; bucculae less than one-half the length of the gular area; apex of the ostioles prominently auriculated outwardly.

Genus I. *Ortholomus* Stål 1872

Costal margins of the hemelytra straight at base only, if at all; eyes not so prominent; bucculae variable; apex of the ostioles suddenly abbreviated, rarely subauriculate; (anterior femora unarmed) ..... Genus II. *Nysius* Dallas 1852

3. Head much elongated, subacute; anterior femora very stout, with one large tooth; (tylus narrow, projecting forward; antennae about half as long as the body; base of venter triangularly produced against the sternum).

Genus III. *Belonochilus* Uhler 1871

Head a little longer than broad; anterior femora slightly enlarged, unarmed; (pronotum wider than long).

Genus IV. *Orsillacis* Barber 1914

Genus I. *Ortholomus* Stål 1872

Key to Species

1. Transverse line of the pronotum sometimes reduced to a shining black fovea midway on each side of the pronotum; width of head across eyes : anterior margin of the pronotum : posterior margin of the pronotum : length of pronotum :: 9.25 : 7.25 : 11.5 : 8.5; head, including eyes as wide as long; median carina of scutellum wide, obtuse, prominent throughout; apex of rostrum reaching onto ventral segment II; length, 5–6 mm. ..... *scolopax* Say 1832

(? var. *uhleri* Baker 1906)

(= *saintcyri* Provancher 1872)

Quebec and Maine south to Florida, west to Michigan, Indiana, Kansas, Wisconsin and southwest to Texas and California; on sage brush.

Transverse line normal, extending straight across the middle of the pronotum, sharply but obtusely angled at the sides, the rest gently curved 2

2. Ocelli as near, or nearer, to the median line of the head as to the eyes; punctation of the pronotum sparse and rather fine; large species, with body as a whole parallel-sided 3

Ocelli distinctly nearer to the eyes than to the median line; punctation of the pronotum coarse and thick; small species, with the body as a whole distinctly widened posteriorly;

width of head across the eyes : anterior margin of the pronotum : posterior margin of the pronotum : length of pronotum :: 7.75 : 6.5 : 9.75 : 6.75; head including eyes as wide as long; length, 3.75–4 mm.

arphnoides Baker 1906

Southern California; on black sage.

3. Pronotum distinctly longer than wide at the anterior margin, strongly narrowed anteriorly; anterior margin a little more than one-half width of posterior margin; (antennal segment IV as long as or longer than II, and longer than III); width of head : anterior margin of pronotum : posterior margin of pronotum : length of pronotum :: 10 : 7.5 : 13 : 9.5; length of head a little less than width across eyes; pale form (*longiceps*) with sparse, short, golden pubescence; dark form (var. *cookii*), pubescence white and dense, especially on the scutellum; length, 4.5–5.75 mm.; width, 1.5 mm. ..... *longiceps* Stål 1874

& var. *cookii* Baker 1906

Eastern United States to California and Mexico; Wisconsin, Indiana, Pennsylvania.

Pronotum hardly longer than wide at the anterior margin, not strongly narrowed anteriorly; head width across eyes : anterior margin of the pronotum : posterior margin of the pronotum : length of pronotum :: 12 : 9.25 : 13.5 : 9.5; head markedly shorter than wide; length, 4.5–5.5 mm.

nevadensis Baker 1906

Nevada, California.

Genus II. *Nysius* Dallas 1852

Key to Species

1. Bucculae abbreviated, distinctly narrowed and evanescent posteriorly, hardly reaching beyond the middle of the eyes; rostral segment I extending much beyond bucculae; costal margins of the corium straight at base for a distance less than one-half the length of the scutellum, thence abruptly narrowly expanded, and straight and parallel to the apex 2

Bucculae more than half the length of the gula, almost or quite reaching the base of the head, low but distinct throughout; rostral segment I not, or but slightly extending beyond the bucculae; costal margin of the corium straight along the

basal one-third or one-quarter, thence gradually expanded and curved at the apex 3

2. Antennal segment I *distinctly* surpassing the apex of the tylus; pronotum *without* a raised calloused spot at each side of the middle; (scutellum with the apex of the median carina pale); length, 4.7–5.6 mm. ..... *californicus* Stål 1859
(= *providus* Baker 1906
= *sordidus* Stål 1859)
var. *alabamensis* Baker 1906
var. *inaequalis* Uhler 1894

Apparently all over the United States; on *Viburnum, Atriplex, Rosa, Salsola pestifera.*

Antennal segment I hardly reaching the apex of the tylus; pronotum *with* a short elevated callous on each side of the middle; (antennal segments III and IV subequal, II longer than III or IV; male genital plate with a small rounded fovea); length, 3.5–4.5 mm. ..... *basalis* Dallas 1852
(= *inaequalis* Blatchley 1926
nec Uhler 1894)

Florida, (West Indies, Mexico, Brazil).

3. Rostral segment I not extending beyond bucculae 4

Rostral segment I extending *slightly* beyond bucculae; (length, 3.2–3.5 mm. ..... *groenlandicus* Zetterstedt 1840

Iceland, Greenland, Labrador, Hudson's Bay, Alaska.

4. Antennal segment I *distinctly* passing the apex of the tylus; eyes very prominent; width of head through the eyes equal to the width of the posterior margin of the pronotum; (ventral segment VI in the male obtusely rounded at apex; pronotum with a subtriangular fovea at the end of the transverse impression, posterior margin one-third to one-half wider than length, transverse anteapical line oblique and anteriorly curved at the ends, interrupted at middle; vertex at middle *without* an impunctate pale basal spot); length, 3.7–4.7 mm. ..... *thymi* Wolff 1804
(= *ericae* Flor 1860
= *punctipennis* Thomson 1870
= *maculatus* Douglas & Scott 1870
= *groenlandicus* Provancher 1872
= *angustatus* Van Duzee 1905)

Quebec, New England and New York west and north to British Columbia, Alaska, Utah, Nevada.

Antennal segment I hardly surpassing the apex of the tylus;

eyes not very prominent; width of head through eyes *less* than the posterior margin of the pronotum 5

5. Bucculae narrowed anteriorly and more or less evenly diminishing posteriorly, running out to a point; margin of the corium straight basally for about three-quarters of the length of the scutellum, very gradually and gently curved thence to the apex; (form oblong-elliptical, sides at the middle nearly parallel; pronotum slightly convex, not foveolate, quite transverse, posterior margin twice or nearly twice its length; black anteapical line of the pronotum parallel to anterior margin, not interrupted at middle and with a branchlet posteriorly; vertex with an impunctate pale spot; length, 2.1–4.5 mm.).

ericae Schilling 1829
(= *maculatus* Fieber 1861
= *albidus* Jakowlev 1867
= *gracilis* Scott 1870
= *angustatus* Uhler 1872
= *rhaphanus* Howard 1872
= *destructor* Riley 1873)
var. *minutus* Uhler 1895
var. *niger* Baker 1906

All over the United States and Canada; on almost all small vegetation, injurious to field and garden crops.

Bucculae broad throughout, strongly so anteriorly, posteriorly very obtuse or sometimes broadened, in rare cases the tip very slightly excurrent, but never surpassing gula; margin of the corium straight basally for nearly the whole length of the scutellum, thence strongly curved to apex 6

6. Sides of pronotum nearly straight; (form a little shorter and more curved on the sides of the corium; pronotum wider than long, deeply punctured in confluent rows, lateral margin slenderly reflexed; scutellum with a raised Y-shaped line; costal margins of the hemelytra strongly reflexed); length, 2.75–3.5 mm. ..... *strigosus* Uhler 1894
(= *senecionis* Baker 1906)

Florida, New Mexico, Colorado, Nevada, Utah, Arizona, California, Oregon, (Lower California).

Sides of pronotum strongly incurved; (straight basal part of the corium nearly the length of the scutellum; sides of pronotum unusually incurved, width through eyes nearly one-third greater than the anterior margin of the pro-

notum; length of the pronotum about equal to width of the anterior margin); length 3.5–4.5 mm.

coloradensis Baker 1906
var. *grandis* Baker 1906

Colorado.

Genus III. *Belonochilus* Uhler 1871

Key to Species

A. Anterior femora beneath at apical one-fourth, with or *without* a small spine; pronotum with only a trace of a pale median line; male genital segment with a *small tubercle;* (antennal segment III subequal to IV, or one-fifth shorter; rostrum *variable* in length, sometimes reaching the genital plate; transverse impression of the pronotum deep, anterior lobe one-half as long as posterior, which is higher and convex); length 5.3–6 mm. ..... *numenius* Say 1832
(= *mexicanus* Distant 1893)

Massachusetts and New York to Maryland, west to Indiana, Arizona, California; on golden rod; on the ripened fruit and seed-heads of sycamore (*Platanus occidentalis* and *P. wrightii*), in winter under the bark.

B. Anterior femora unarmed; median pale line of the pronotum entire; male genital segment with a *fovea;* (tylus exceeding juga by at least its own width; antennal segment II hardly longer than III); length, 4.8–5 mm.

koreshanus Van Duzee 1909

Florida; "on a hairy labiate plant" (Van Duzee).

Genus IV. *Orsillacis* Barber 1914

The Key to Genera of this Tribe gives all the structures found in Barber's characterization of the genus. Thus far, it has only one described species.

O. producta Barber 1914

The structures stated for this species in the original description are:

Provided with very fine hairs; head triangular, a little longer than wide (a generic character?), very finely punctured; ocelli set close to the eyes; antennal tubercles truncate and diverging, reaching about one-third of the way to the apex of the head; tylus bluntly projecting a little way beyond the apices

of the lateral lobes; antennal segment I slightly enlarged, segment II longest, slightly swollen at the apex, III two-thirds the length of II and nearly four times as long as I, IV nearly subequal to III and slightly incrassate; head obscurely punctured beneath; rostral segment I reaching base of the head, II about one-third longer, III one-third longer than II, IV a little shorter than II; pronotum obtusely impressed before the middle, wider than long, coarsely punctured, the region of the cicatrix and the posterior margin smooth, the cicatrices making a broadly crescentic furrow scooped out, behind this a median pale ridge running from the anterior and disappearing before the posterior margin, where there is a transverse raised ridge running between the slightly higher humeri; scutellum transversely elevated at base, with a median carina, the rest of the surface coarsely punctured; sternum coarsely and irregularly puctured; anterior femora slightly enlarged, unarmed; corium with a depressed fine golden pubescence; length, 6 mm.
Arizona (Huachuca Mountains, on the Mexican border).

Subfamily 2. **Cyminae** Stål 1862

Key to Tribes

A. Head *without* a curved longitudinal sulcus before each ocellus, apical angle of the antenniferous tubercles *not* prominent; antennal segment I surpassing the apex of the tylus, IV longer than III (subequal to or slightly longer—Blatchley); bucculae percurrent, low behind the middle; scutellum equilateral, with the commissure shorter than the scutellum; hemelytra hyaline, with few punctures, sides of clavus parallel; ostioles exteriorly extended and produced into a tooth at apex ..... 1. *Ischnorrhynchini* Stål 1872

B. Head *with* a curved longitudinal sulcus before each ocellus; apical angles of the antenniferous tubercles prominent, acute; antennal segment I stout, not surpassing the apex of the tylus (or sometimes surpassing it, as in *Cymodema*), IV shorter than III; bucculae short, quite elevated; scutellum broader than long, longitudinally obtusely carinate; base of pronotum rounded, posterior margin narrowly depressed at each side; clavus widened posteriorly, comissure much longer than the scutellum; hemelytra *not* hyaline, strongly and densely punctured, apical angle of the corium extended nearly to or beyond the apex of the abdomen ..... 2. *Cymini* Stål 1872

Tribe 1. *ISCHNORHYNCHINI* Stål 1872

Key to Genera

A. Head porrect, not abruptly deflexed in front; eyes nearly in contact with the anterior margin of the pronotum; width of head across the eyes not much more than one-half the width of the posterior margin of the pronotum; sides of the clavus parallel; costal margin of the corium convexly arcuated ..... I. *Ischnorhynchus* Fieber 1861

B. Head deflexed in front, almost vertical, tumid behind the eyes, eyes distant from the anterior margin of the pronotum; width of head across the eyes subequal to the width of the posterior margin of the pronotum; clavus widened posteriorly; costal margin of the corium concave toward base ..... II. *Cymoninus* Breddin 1907
(= *Ninus* Distant 1882, nec Stål 1859)

Genus I. *Ischnorhynchus* Fieber 1861

= *Kleidocerus* Westwood 1842

No key is offered for this genus of brownish, glassy-winged little bugs. In order to make possible approximate recognition of our species, available original descriptions follow, with exact citation. The species are arranged in strict alphabetical order. For synonymies and like data, refer to the Van Duzee Catalogue.

Fieber set up the genus (Eur. Hem., pp. 51 and 199) on the characters set forth in his original description following, in the original German.

> "Körper länglich-eiförmig, niedergedrückt, kahl. Fühlerwurzel wenig über den kopf ragend; Glied 2 nicht doppelt so lang; Glied 3 etwa $\frac{3}{4}$ von 2; beide stäbformig; Glied 4 spindelig, spitz, so lang als Glied 2. Pronotum nach vorn sehr zusammengezogen, v : h = 3 : 7; 1 : h = 5 : 7. Schild gleichzeitig dreieckig. Hinterfuss wurzel so lang als Glied 2 und 3 zusammen. Körper, Pronotum und Schild tief eingestocken punctirt; in jedem der Stichpuncte ein goldgelbes Bortschen. Halbdecken viel breiter als der Leib, die Corium ecke fast an das Hinterleibende reichend. Membran gross, weit über den Hinterleib ragend."

(It should be noted that the above is the way Fieber spelt the generic name; subsequent emenders made it "*Ischnorrhynchus,* for reasons of Greek grammar.)

The descriptions of species follow alphabetically, and without consideration of synonymies.

Ishnorhynchus championi Distant 1882. (Biol. Centr. Am. Rhynchota I: 193, pl. XIX, fig. 3)

"Head and pronotum pale ochraceous, thickly covered with dark punctures; head with apex, four short basal streaks, and eyes blackish. Antennae with the basal joint shortest, incrassated and fuscous, third and fourth ochraceous, with their bases and apices fuscous; fourth thickened and fuscous, with the basal third ochraceous. Pronotum with two short, waved, transverse fuscous fasciae near anterior margin. Scutellum pale ochraceous, thickly, coarsely, and darkly punctured at base, a few coarse dark punctures along the lateral margins, and a central elongate fuscous spot. Corium pale ochraceous and semihyaline, with two fuscous spots on disk and four along apical margin. Underside of body pale fuscous, thickly and coarsely punctate, with an elongate black spot situated on lateral margins of pro-, meso-, and metasternum, and a series of black spots along abdominal margin. Metasternum very pale luteous and impunctate. Femora and apices of tibiae castaneous, tibiae and apices of the femora pale ochraceous, apices of tarsi pitchy. Long $2\frac{1}{2}$ millim.

"Guatemala, Rio Naranjo (Champion)."

Florida, Texas, California.

Ischnorhynchus didymus Zetterstedt 1819. Act. Holm. 71

Original description not available. Distribution as its supposed synonym, *I. geminatus* Say.

Ischnorhynchus franciscanus Stål 1859. (Eugenies Resa, 252) (= *Cymus franciscanus*)

"Flavo-testaceus, punctatus, antennis pedibusque subobscurioribus, illarum articulo secundo et tertio apice quatorque toto fuscescentibus; corii macula minuta media anguloque imo apicali fuscis; subtus ferruginescens, pectore abdomineque basin versus fuscis. Long. $3\frac{1}{2}$, lat. $1\frac{2}{3}$ millim.

"Patria: California (St. Francisco).

"Statura, colore et magnitudine *C. didymi,* thorace posteriur angustiore. Caput testaceum, punctatum. Antennae corporis dimidio aequilongae, flavescente-testaceae, articulis secundo et tertio apice quatorque toto fuscis. Rostrum flavescente-testa-

ceum. Thorax antice quam postice dimidio angustior, latitudine postica quarta parte brevior, flavo-testaceus, punctulatus, ruga indistincta longitudinali instructus, impressione transversa antemedium interdum fusca. Scutellum testaceum, punctatum. Hemelytra flavo-testacea, parce punctata, macula minuta interdum obsolete anguloque imo apicali corii fuscis; membrana subsordide hyalina. Subtus ferruginescens, pectore et interdum abdomine basin versus fuscis, ille punctato. Pedes dilute flavo-testacei."

Ischnorhynchus geminatus Say 1832. (Heterop. N. Am., p. 14; Compl. Writings I: 330)

"Hemelytra with two small central spots, and four on the posterior edge of the membrane.

"Inhabits Indiana and Missouri.

"Body dull greenish-yellow; head dull fulvous, blackish each side behind; antennae obscure rufous; first joint, incisures and terminal joint black: rostrum extending a little beyond the origin of the posterior feet: thorax with the transverse impression rather deep and blackish: scutel dull fulvous, blackish on the basal margin: hemelytra on the corium tinged with yellowish, almost hyaline, and having on the middle two approximate, abbreviated fuscous lines and on the posterior edge four or three fuscous small dots; membrane pellucid: beneath blackpiceous; a white line over the insertion of the posterior pairs of feet, and a honey-yellow line over the anterior pair: feet honey-yellow, immaculate; tarsi blackish.

"Length three-twentieths of an inch."

The additional distribution, according to Van Duzee, is: Quebec, Massachusetts, New York, District of Columbia, Florida; on *Spirea van houteni, Betula nigra.*

Ischnorhynchus geminatus Fieber 1861. (Eur. Hem. 203)

The original German description is:

"Fühler gelb, Wurzelglied am Grunde und das Endglied braunschwartz. Graulich, braunpunctirt. Kopf rostroth, weissbereift wie das vorn in dem Quereindruck braungelbe Pronotum; in welchem nur die queren ~-förmigen Fürchen schwarz. Schild bräunlichgelb. Halbdecken braungelblich punctirt, die Puncte auf der Corium-Mitte und an der Membrannaht braungelb, in Innenwinkel des Corium ein Strich weiss. Mas., fem, $1\frac{1}{2}'''$, mit Membran $2'''$. Im mittleren und Südlichen Europa."

Ischnorhynchus obovatus Van Duzee 1931. (Pan Pac. Ent. VII: 110)

"Distinct from all our other species by its longer head and ovate elytra. Length, 4 mm.

"Male. Head distinctly more produced than in *resedae,* sides nearly rectilinear before the eyes; vertex regularly shallowly punctate; bucculae very narrow, scarcely elevated anteriorly. Rostrum attaining apex of fourth ventral segment; segment I surpassing base of head. Pronotum strongly punctate; broadly depressed just before the middle, sides sinuate, anterior margin one-half the posterior; callosities forming a smooth impressed arc either side; humeri prominent; scutellum coarsely punctate. Elytra broad, subhyaline, obscurely punctate on the median area, with a row of fine punctures on the basal half of the radial vein and next the claval suture; clavus with marginal and one median row of close punctures; costa ovately arcuate and reflexed, apex distinctly bent at radial vein; membrane nearly hyaline. Antennal segment I not attaining apex of tylus; II and IV slightly longer than III.

"Color rufo-castaneous; tip of tylus, gula, segments I and IV of antennae, and base and apex of II and III, black, tip of IV paler. Pronotum pale posteriorly, arcuate lines and hind margin blackish; scutellum castaneous. Elytra brownish subhyaline; dot at tip and a geminate dash on disk blackish. Beneath mostly blackish, varied with castaneous on the propleura; acetabulae and orifices pale; pale margin of metapleura strongly produced at outer angle. Legs castaneous, knees and apex of tarsi black."

California.

Ischnorhynchus resedae Panzer 1797. (Faun. Germ. XL, f. 20)

"*Lygaeus resedae* (Die Reseda-Wanze).

"*Lygaeus resedae:* flavus, capite, scutello pedibusque sanguineis, elytris punctis duobus nigris.

"Habitat in *Reseda odorata* L. Norimb.

"Antennae flavae, articulo primo, reliquis apice nigris. Caput sanguineum lineis duabus elevatis, punctisque plurimis impressum. Oculi globosi prominuli albo marginati. Thorax flavus punctis plurimis impressis nigris irroratus. Scutellum triangulum sanguineum nigropunctatum. Elytra flava punctata, medio punctis duobus maioribus, et margine postico, punctis minoribus tribus, notata. Alae fuscae apice hyalinae.

Corpus subtus atrum, ano rubro, pectore albo nigropunctato. Pedes sanguinei. Rostrum atrum, apice rufum."

Ischnorhynchus salvini Distant 1882. (Biol. Centr.-Am. Rhyn. I: 194, pl. XIX, fig. 2)

"General shape and size of the preceding species (*godmani*). Head luteous, with coarse brown punctures, eyes castaneous; antennae luteous, first joint shortest and incrassated, second and third longest and subequal, fourth a little shorter than third, thickened, and with the apical half fuscous. Pronotum luteous, coarsely punctate, with rather more than basal half much shaded with pale fuscous. Scutellum pale luteous, with a few coarse dark punctures along basal and lateral margins, and a very large blackish spot near apex. Clavus pale fuscous, punctured as in *L. godmani*. Corium pale luteous and semihyaline, punctured and marked with fuscous, as in the preceding species, but with the spot on the disk connected with the continuation of the subquadrate apical spot. Membrane pale hyaline. Underside of head and pro- and mesosternum luteous, thickly punctured with fuscous; metasternum very pale luteous and impunctate, more or less spotted and suffused with pale fuscous. Abdomen pale fuscous, with the lateral margins broadly luteous. Legs luteous, femora fuscous near base. Long. 4 millim., lat. 2 millim.

"Guatemala, Cerro Zunil (Champion)."

Texas.

Genus II. *Cymoninus* Breddin 1907

(= *Ninus* Distant 1893, nec Stål 1859)

This genus was erected by Breddin (Berytiden und Myodochiden von Ceylon—Deutsch. Ent. Zeit.) to cover Distant's species following, which the latter had placed in *Ninus* Stål, in error, as it turned out. The generic structural characters combined from Blatchley's and Distant's descriptions are:

Elongate slender species having the head strongly deflexed between the antennae and not inserted in the thorax to the exserted eyes; antennal segment I not or hardly passing the apex; costal margin of the hemelytra deeply emarginated toward the base, corium hyaline, narrow, with a single median row of punctures.

Later, in 1918, Bergroth, in his "Studies in Philippine Heteroptera" (Phil. Journ. Sci. XIII: 64), thus redefined the genus:

"Head narrower than the base of the pronotum; eyes rather large, sessile, set longitudinally, scarcely converging forward; ocelli scarcely or slightly more distant from the eyes than from each other; rostrum extending to the middle of the mesosternum, first joint reaching the base of the head."

Thus far there is only one American species of *Cymoninus* known, the others being Oriental:

C. notabilis Distant 1882

The structural chaarcters of the species, as abstracted from Distant's original description, and from Blatchley's redescription are:

Head, pronotum and scutellum pubescent with scattered erect hairs; antennal segment II about one-half longer than III, which is subequal to IV; head beneath and sternum coarsely punctured; eyes strongly exserted and slightly directed backward; pronotum gradually widened posteriorly and somewhat gibbous near the humeri, which are broadly rounded; head subequal to the posterior margin of the pronotum; rostrum reaching the middle coxae; bucculae short, evanescent posteriorly, not reaching the base of the head; pronotum densely punctured, constricted near the apex, the basal lobe strongly convex; length, 3–3.5 mm.

Florida, common; the species was described from Panajachel, Guatemala, Central America.

Tribe 2. *CYMINI* Stål 1872

Key to Genera

1. Antennal segment I long, greatly exceeding the apex of the head, and equal to II, which is slightly thicker than III; tylus not produced; rostral sulcus in head and prosternum distinct ..... III. *Cymodema* Spinola 1837

   Antennal segment I short, shorter than II; head behind the bucculae and the pronotum hardly or only slightly longitudinally impressed 2

2. Tylus much produced before the bucculae; rostrum short, hardly reaching the middle of the mesosternum, segment II extended but little beyond the *antrior margin of the prosternum;* mesosternum very distinctly sulcate.
   I. *Arphnus* Stål 1874

   Tylus not or very slightly prominent beyond the bucculae; rostrum longer, extending to or beyond the *intermediate*

coxae, segment II reaching, or nearly reaching, the *anterior coxae;* mesosternum *not* distinctly sulcate.

II. *Cymus* Hahn 1831

Note.—*Cymodema* is included in the key, although presumably not an American genus, in order to differentiate more closely the American species of *Cymus.*

Genus I. *Arphnus* Stål 1876

Key to Species

1. Tylus short, produced before the bucculae for a distance hardly more than one-half the bucculae, (its apex reaching the basal third of antennal segment II; sides of pronotum straight, *not* obviously carinate anteriorly; lower half of the head densely sericeous pubescent; anterior femora strongly incrassate, abruptly narrowed at base; vertex minutely but obviously transversely rugulose, with a few scattered punctures; length, 4–4.75 mm.).

tristis Van Duzee 1929

Utah, Nevada.

Tylus longer, produced before the bucculae for a distance fully equal to the length of the bucculae 2

2. Tylus reaching middle of antennal segment II; median carina of the pronotum obsolete behind the middle; length, 4–4.75 mm. ..... *coriacipennis* Stål 1859

Oregon, California, Utah, Idaho.

Tylus reaching apical one-third of antennal regment II; median carina of the pronotum percurrent or nearly so; (sides of pronotum feebly bisinuate, obtusely carinate anteriorly; lower side of the head and the pleura in part, with short white pubescence); length, 4–5 mm.

profectus Van Duzee 1929

California.

Genus II. *Cymus* Hahn 1831

Key to Species

1. Antennal segment I extended well beyond the apex of the tylus, half or more than half the length of II 2

Antennal segment I sometimes reaching but hardly passing the apex of the tylus, less than one-half the length of II 3

2. Antennal segment I slender, at least three times as long as wide, extending more than one-half its length beyond the apex of

the tylus, concolorous, segment III more than twice the length of II; lateral margins of the pronotum quite evidently impressed anteriorly; length, 4–4.5 mm.

virescens Fabricius 1794
(= *breviceps* Stål 1874
= *tabida* Uhler 1876—[Cymodema]
= *exiguum* Horváth 1908)

New Jersey, south along Atlantic Coast; Missouri, Indiana, Colorado, Utah, Texas, California.

Antennal segment I short and stout, twice as long as wide, extended for one-half its length beyond the apex of the tylus, black, apex pale, III one-half or more longer than II; lateral margins of the pronotum *not* impressed; length, 3–3.2 mm. ..... *bellus* Van Duzee 1909

Florida.

3. Antennal segment II at least one-third shorter than III; lateral margins of the pronotum not impressed; median longitudinal carina generally inconspicuous 4

Antennal segment II very nearly equal to III; lateral margins of the pronotum quite evidently impressed or carinate; median longitudinal carina sometimes short but quite evidently elevated 5

4. Tylus plainly well extended beyond the apex of antennal segment I; rostral segment III not shorter than II or IV; corium quite evidently contracted at base, the costal margin more arcuate; length, 3.8–4.5 mm. ..... *angustatus* Stål 1874

U. S. west of the Rocky Mountains; on *Carex* and *Juncus*.

Tylus *very slightly* extended beyond the apex of antennal segment I; rostral segment III shorter than either II or IV; corium obsoletely or not at all contracted at base; costal margin more nearly parallel; length, 3.3–3.8 mm.

reductus Barber 1924

Arizona.

5. Antennal segment II a very little longer than III, which is subequal to IV; tylus not so strongly projecting beyond apices of juga; length, 3.2–3.5 mm. ..... *discors* Horváth 1908
(= *clavulus* Uhler 1878
= *claviculus* Van Duzee 1889)

Nova Scotia to Pennsylvania and west to Michigan and Indiana; on *Scirpus cyperinus* and *Scirpus polyphyllus*.

Antennal segment II subequal to III, which is plainly longer than IV; tylus more strongly projecting beyond the apices of the juga; species over 4.5 mm. in length 6

6. Form slender; head and pronotum each about one-fifth wider than long; pronotal punctures fine; median longitudinal carina quite evident from the anterior margin to beyond the disc of the pronotum; length, 5 mm., width, 1.67 mm. ..... *luridus* Stål 1874

Form robust; head and pronotum each about one-third wider than long; pronotal punctures coarse, median longitudinal carina of the pronotum short, commonly not reaching the middle of the disc; length, 4.5–4.7 mm., width, 1.65–1.87 mm. ..... *robustus* Barber 1824
New York, Michigan, Indiana; on seed-heads of *Scirpus polyphyllus.*

Note to *C. reductus* Barber.—"This is probably what Van Duzee has recorded as *guatemalanus* from Arizona." (Barber)

Subfamily 3. **Blissinae** Stål 1862

Key to Genera

A. Body elongate, abdomen *over* twice as long as head and thorax taken together; apical margin of the corium straight; anterior coxal cavities closed behind, along the posterior margin of the prosternum; antennae longer than the head, thorax and scutellum taken together; rostrum relatively shorter, its apex not reaching past the middle coxae; scutellum subequilateral ..... I. *Ischnodemus* Fieber 1836

B. Body short, narrow-oval or oblong; abdomen *less* than twice the length of the head and thorax taken together; apical margin of the corium not straight but sinuate before the apex of the clavus; coxal cavities open along the posterior margin of the prosternum; width of the head across the eyes about one-half the width of the posterior margin of the pronotum; antennae about equal to the length of the head, pronotum and scutellum taken together; rostrum long, reaching past the middle coxae; scutellum wider than long ..... II. *Blissus* Burmeister 1835

Genus I. *Ischnodemus* Fieber 1836

Key to Species

1. Rostrum *not* or *hardly* passing base of *prosternum* 2
Rostrum reaching almost to, or behind, middle of mesosternum 9

2. Antennal segment II longest 3
   Antennal segment II *not* longest 4
3. Posterior lobe of the pronotum *not* punctured; scutellum with a short carina; (rostral segment II *not* reaching base of head; antennal segment III a little shorter than II or IV); length, 3.8–5.3 mm. ..... *falicus* Say 1832
   Massachusetts and Connecticut west to Dakotas, and south and west to Texas.
   Posterior lobe of the pronotum coarsely punctured; scutellum impunctate and without a carina; length 4.8 mm. *intermedius* Blatchley 1926
   Pennsylvania, Indiana, Florida.
4. Antennal segment I *not* reaching apex of tylus, shortest, (II, III and IV nearly equal; rostral segment I just passing anterior coxae; length, 4–5 mm.) ..... *praecultus* Distant 1882
   Arizona.
   Antennal segment I reaching to or *passing* the apex of the tylus 5
5. Anterior femora with a short sharp tooth at the apical one-fourth; (antennal segment I reaching apex of tylus, III a little shorter than II; rostral segment IV not longer than II; length, 4–6 mm.) ..... *macer* Van Duzee 1921
   Arizona.
   Anterior femora *without* a tooth 6
6. Pronotum *not or very feebly* constricted at basal one-third and without a distinct median groove; antennae slender, segment I distinctly longer than thick 7
   Pronotum *distinctly and widely* constricted at basal one-third, anteriorly with a broad shallow median longitudinal groove; antennae stout, segment I oval, nearly as thick as long; length, 6–8 mm. ..... *robustus* Blatchley 1926
   Florida.
7. Antennal segment I passing apex of tylus by *one-half* of its own length, (II and IV subequal; length, 6 mm.). *atramedius* Blatchley 1926
   Florida.
   Antennal segment I *only slightly* passing apex of tylus 8
8. Rostral segment II passing the base of the head by one-half its own length; antennal segment III distinctly shorter than II and IV, which are subequal; (second inner vein of the membrane angularly bent inward at its basal one-third); length, 5–5.2 mm. ..... *rufipes* Van Duzee 1909
   Florida.

Rostral segment II *not quite reaching* the base of the head; antennal segment III longest; length, 3.5–5 mm.
hesperius Parshley 1922
(= *brevicornis* Parshley 1922)
South Dakota.

9. Antennal segment I passing apex of tylus 10
Antennal segment I *not* passing apex of tylus 11

10. Antennal segment I passing apex of tylus by *one-half* its own length, II and IV subequal, III hardly shorter; length, 7–9 mm. ..... *conicus* Van Duzee 1909
Texas.
Antennal segment I passing apex of tylus by *one-third* its own length, II and IV subequal, III shorter; (rostral segment II passing base of head by nearly one-half its own length; length, 5–7 mm.) ..... *badius* Van Duzee 1909
Florida.

11. Pronotum *with* a velvety black bar across the base; antennal segment IV one-half longer than II, III shorter than IV; length, 3–3.2 mm. ..... *minutus* Blatchley 1926
(= *pusillus* Blatchley 1925)
Florida; from grass roots.
Pronotum *without* a velvety black bar across the base 12

12. Antennae slender, segment I much longer than thick; length, 4.5–5.2 mm. ..... *slossoni* Van Duzee 1909
North Carolina, Florida.
Antennae stout, I *slightly* longer than thick; (segment IV subequal to II, III shorter than either, III two-thirds of IV; rostral segment II surpassing base of head by one-half its own length; length, 5–6 mm.) ..... *lobatus* Van Duzee 1909
Florida.

Genus II. *Blissus* Burmeister 1835

Key to Species

1. Antennal segment IV *equal to* or *longer than* II and III taken together 2
Antennal segment IV *shorter* than II and III taken together 4

2. Scutellum with only the depressed basal part sparsely punctured; (narrow, elongate, parallel-sided; head about one-quarter broader than long; antennae relatively short, segment II less than twice I, III slightly shorter than II, IV twice as long as II; rostrum reaching base of intermediate coxae, segment I slightly shorter than II, III more than

one-half length of II, IV one-third of itself shorter than II; pronotum distinctly wider than long, widest across the middle, thence very gently rounded to the anterior margin, parallel-sided behind middle; scutellum two-fifths wider than long, only the depressed basal part sparsely punctured; length, 2.8 mm.) ..... *nanus* Barber 1937
Kansas.

Scutellum *wholly* and coarsely punctured 3

3. Apex of rostrum reaching metasternum; (sparsely clothed with greyish pubescence; antennal segment IV equal to lengths of II and III taken together; rostrum reaching metasternum; pronotum subquadrate, sides slightly sinuate on basal one-third, thence broadly rounded to apex, the disc, except the nodulose humeri, closely and coarsely punctured throughout; scutellum coarsely punctured, with an evident but faint apical carina); length, 4.7 mm.
validus Blatchley 1926
Indiana.

Apex of rostrum passing the posterior coxae; (antennal segment IV more than twice III); length, 2.8–3.1 mm.
iowensis André 1937
Iowa, Kansas.

4. Antennal segment IV about twice the length of III 5
Antennal segment IV *less* than twice the length of III 9

5. Antennal segment IV about one and one-third times as long as II; (antennal segment IV shorter than II, which is longer than III, I shortest; thickly clothed with fine appressed pubescence; pronotum broadly rounded anteriorly, sides not sinuate, disc minutely subobsoletely punctured; scutellum finely sparsely punctured, without an evident carina; length, 3.67–4.2 mm.) ..... *leucopterus* Say 1837
Canada and United States, widespread; an injurious pest on wheat and grasses.

Antennal segment IV about one and two-thirds length of II 6

6. Apex of rostrum reaching to *intermediate* coxae 7
Apex of rostrum reaching to or beyond *posterior* coxae 8

7. Rostral segment II longest, III and IV equal; (form ovate; head about one-fifth wider than long; antennal segment I shortest, II nearly twice I and about one-seventh of itself longer than III, IV nearly twice III; rostrum reaching to apex of intermediate coxae, segment I four-fifths of II, II two-fifths longer than III or IV, which are equal; pronotum

nearly one-third wider than long, sparsely covered with greyish white hairs, those along the margin longer, disc of anterior lobe finely punctured, posterior one-third nearly nude, lateral margins straight and parallel posteriorly, anterior one-quarter strongly rounded to anterior margin, posterior margin nearly straight; scutellum much wider than long, with a few fine discal punctures on each side of the middle; length, 3.12 mm.) ..... *mixtus* Barber 1937
California.

Rostral segment II equal to I, III *shorter* than IV; (form narrow-elongate, parallel-sided posteriorly; head one-fifth wider than long; antennal segment I less than one-half II, II one and one-seventh longer than III, which is a little more than one-half the length of IV; rostrum extending to the middle of the intermediate coxae, segments I, II and IV equal, III four-fifths of any one of the others; pronotum one-fifth longer than wide, widest just before the middle, thence rather strongly rounded anteriorly, disc finely punctured before middle, posterior one-third impunctate; scutellum two-fifths wider than long, with a few fine scattered discal punctures; abdomen parallel-sided; length, 3.2 mm.) ..... *omani* Barber 1937
Arizona (Huachuca Mountains).

8. Rostral segment I *longer* than IV, III equal to IV; (form narrow-elongate; head about one-fifth wider than long, tylus shining black; antennal segment I one-half length of II, II less than one-fifth of itself longer than III, which is slightly more than one-half the length of IV; rostrum relatively long, apex reaching to or slightly beyond the posterior coxae, segment I more than two-thirds of II, and two-fifths of itself longer than III or IV, which are equal; pronotum nearly one-third wider than long, anterior pruinose area finely punctured, posterior piceous part nearly denuded and more sparsely punctured, sides not parallel, widest across humeri, the margins distinctly converging anteriorly, more abruptly at anterior fourth; scutellum one-quarter wider than long, with fine scattered punctures over the disc and a submarginal row of coarse punctures; length, 3.28 mm.) ..... *planarius* Barber 1837
Wyoming, Kansas, Colorado.

Rostral segment I *equal* to IV, III longer than IV; (head one-third wider than long, covered with dense matted pubescence except for the tylus; antennae short and robust, seg-

ment I one-half of II, II one-sixth of itself longer than III, which in turn is one-half of IV; rostrum reaching to posterior coxae, segments I and IV equal, II one-third longer than I, and one-eighth of itself longer than III; pronotum finely punctured and densely covered with pale pubescence, almost one-third wider than long, greatest diameter across the middle area, posterior margin lightly concavely arcuate; scutellum over twice as wide as long, a few coarse punctures along the lateral margins; length, 2.4 mm.).

breviusculus Barber 1837

Maine, Massachusetts.

9. Rostrum reaching to *intermediate* coxae; (form elongate-oval, rather densely long-pilose, shaggy; head one-fifth wider than long, with scattered, mostly erect, whitish hairs; antennae rather densely pilose, segment I less than one-half of II, II slightly longer than III, and two-thirds the length of IV; rostrum extending to apices of intermediate coxae, segment I about one-seventh of itself shorter than II, which is more than one-half longer than III or IV, which are equal; pronotum about one-third wider than long, rather densely long-pilose, somewhat shaggy, posterior two-thirds parallel-sided, posterior margin nearly truncate, the large plumbeous areas on either side of the middle finely punctured; scutellum much wider than long, with a few fine scattered punctures and a few fine erect hairs; length, 3.2 mm.) ..... *villosus* Barber 1937

California.

Rostrum reaching between *posterior* coxae; (head short and broad, much deflexed anteriorly; antennal segment II one-third longer than III, IV about one-third longer than II; apex of rostrum reaching between the posterior coxae, segment I slightly passing base of head, a little shorter than II, which is almost subequal to III; length, 3 mm.).

occiduus Barber 1918

Colorado, New Mexico.

Note.—*Blissus leucopterus* Say 1832 appears to break up into four recognizable varieties or forms, so much so, that one of them (*hirtus* Montandon 1893) was described as a full species, and so continued to be regarded until Barber evaluated it in 1918. The key following to these forms has been constructed from the descriptions as published, and from discussions of characters.

(*To be continued*)

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A SYNOPSIS OF THE HEMIPTERA-HETEROPTERA OF AMERICA NORTH OF MEXICO

BY J. R. DE LA TORRE-BUENO

Family XI—Lygaeidae

(*Cintinued from vol. XXVI, no. 1, p. 40*)

KEY TO VARIETIES of *Blissus leucopterus*

1. Anterior half of the pronotum clothed with a prostrate silvery-grey pubescence, this contrasting strongly with the deep velvety-black of the posterior area; corium and membrane with whitish veins, concolorous with the disc; ("shorter and narrower than the typical *B. leucopterus* Say"—Barber) ..... var. *insularis* Barber 1918
   Florida, (Puerto Rico).

   Pronotum *not* prominently and abruptly silvery-grey in front of middle; corium and membrane with the veins straw-yellow 2
2. Pubescence of the pronotum and the sides of the abdomen in great part long, erect and tawny-yellow.
   var. *hirtus* Montandon 1893
   Maine, New York, Pennsylvania.

   Pubescence of pronotum *not* long, erect, and tawny-yellow 3
3. Antennae with apical half of segment III and all of IV black; apical part of the corium piceous.
   var. *leucopterus* Say 1831 (typ)
   Distribution as species.

Antennae with segments I, II and III, and base of IV, black; apical dot of the corium paler or brown.
var. *arenarius* Barber 1918

New York, New Jersey.

Subfamily 4. **Geocorinae** Stål 1862

Key to Genera

A. Rostral segment I *subequal to or shorter than II;* part of head bearing the eyes constricted so that the eye appears almost stylate and wholly to the side of the head and pronotum, the inner margin of the eyes strongly converging throughout, *not in contact* with the anterolateral margin of the pronotum; ocelli usually set midway between the inner margin of the eye and the middle line of the vertex; head smooth, impunctate, not rugulose; antennal segment II *subequal* to IV, both longer than III; pronotum much narrowed in front, callosities of the pronotum continuous or interrupted by a few scattered punctures; scutellum noticeably longer than wide, almost flat, uniformly but sparsely punctured; clavus definitely narrowed behind, commissure short ..... I. *Hypogeocoris* Montandon 1913
(= *Isthmocoris* McAtee 1914)

B. Rostral segment I *distinctly longer than II;* eyes not so prominent, not obviously pedunculate, and usually *contiguous* to the anterolateral margins of the pronotum, their inner margins, at least anteriorly, more usually subparallel; ocelli in most cases set closer to the inner margin of the eyes than to the middle of the vertex (except in *punctipes* Stål and *flavilineus* Stål); head more or less punctate or rugulose, or smooth; antennal segment II *longer* than IV, which is subequal to III; clavus narrowed behind; commissure absent? ..... II. *Geocoris* Fallén 1814
(= *Salda* Latreille 1825
= *Ophthalmicus* Schilling 1829)

Tribe 1. *GEOCORINI* Montandon 1913

Genus I. *Hypogeocoris* Montandon 1913

(= *Isthmocoris* McAtee 1914)

Discussion

In this genus of the Geocorinae there are four recognized species, namely: *Hypogeocoris piceus* Say 1832, from the Eastern United

States; *H. tristis* Stål 1854, from California; *H. imperialis* Distant 1882, described from one specimen from Dueñas, Guatemala, and later recorded by McAtee from Texas, Louisiana and California; and *H. slevini* Van Duzee 1928, described from one specimen from California. How many specimens the older describers had before them is hard to say. The first species, on the basis of its description, is wholly black, except the eyes, legs, etc., and more or less shining. The other three are black and luteous or griseous or stramineous, variously clouded with the darker color, and with dark (black) abdomen.

McAtee has pointed out (1914, Proc. Biol. Soc. Wash., XXVII: 125), that color in the Geocorini as a whole is unstable and variable, from which condition have come many redescriptions of some species on the basis of color, giving rise to much confusion in the matter of validity or actuality of species. This is particularly true of *Hypogeocoris imperialis* and *H. slevini*, which are difficult to separate on color alone, but may be separated by a sifting of the few seemingly real structural characters in the descriptions.

Key to Species

1. Punctation of the hemelytra more or less linear, *including on the disc* 2
   Punctation of the hemelytra scattered and sparse on the disc 3
2. Pronotum and scutellum with a few large coarse scattered punctures, which are absent on the large transverse area including the callosities, the scutellum equilateral with an obscure longitudinal line; median length of the pronotum two-thirds the width of the posterior margin; (antennal segment II a little shorter than IV, I three-quarters length of III; hemelytra polished, with a few obscure punctures along the veins, membrane hyaline, veins indistinct; beneath black, polished, coarsely punctured on the pleura; length, male, 4 mm.) ..... *slevini* Van Duzee 1928 California.
   Pronotum *densely* punctured, shining, except the two deplanate transverse rugae before the middle, which are impunctate, median length twice the width of the anterior margin; scutellum densely punctured, longitudinally subsmooth; (corium behind the middle punctured in rows, clavus distinct, with three rows of punctures parallel to the scutellum; hemelytra griseo-flavescent, membrane whitish-hyaline; length, 3 mm., width, 1.5 mm.) ..... *tristis* Stål 1854 California.

3. *Wholly black,* shining species, except red head; pronotum not much elongated; corium sparsely and irregularly punctured over the whole disc; length, 4–4.2 mm. ..... *piceus* Say 1832
Maine and New York to Wisconsin and Colorado, south to Florida; on *Potentilla canadensis.*

Particolored species; pronotum with a double row of coarse punctures near the anterior margin, and the basal half strongly punctured, less so on the lateral margins; scutellum coarsely punctured, (?) no median smooth longitudinal line; hemelytra with three longitudinal rows of punctures at the claval area, and a number of large scattered punctures on the disc of the corium; membrane black, veins absent or obsolete; length, 3.5–4 mm.
imperialis Distant 1882
Florida, Louisiana, Texas, (Lower California); (described from Guatemala, Central America).

Genus II. *Geocoris* Fallén 1814

Discussion

The key following is frankly based on Stål's, McAtee's and Barber's. The additional structural characters given are those used by these authors in their keys and in their definitions of species.

It should be specifically pointed out that the closet naturalists of other times described species in this genus from a totally inadequate number of examples and without an acquaintance with the forms in the vast numbers in which they are found in the field; they revelled in the least nuances of color, in a group which is as variegated in this respect as the offspring of ranging tomcats. In consequence, their equally closet-bound successors, likewise with an insufficient number of specimens before them and seemingly with the same absence of the corrective of close observation in the field, have perpetuated these unstable color-forms as varieties, and keyed them out. These varieties are mentioned under the respective species in the key; those that wish to name them in their collections are referred to these keys as published, in which they appear.

The key following is structural; where color is mentioned, it appears to be less unstable, and is given merely as a supporting characteristic. For instance, the calli are either light-colored in varicolored forms; or concolorous in dark forms, a quality easily perceived and fairly stable. But as this is found to be the case in similarly colored aggregates, it hardly ranks as a definite specific

character. It should also be stated that the dimensions are as far as possible those given in the descriptions.

Key to Species

1. Head smooth, polished, *not at all* granulose or rugulose 2
   Head wholly or in part finely granulose or rugulose 7
2. Head *with* a fine longitudinal sulcus or indented line extending from the sulcus of the tylus through the vertex; pronotum and scutellum *without* a median smooth flavescent line 3
   Head *without* a fine sulcus from the sulcus of the tylus through the vertex; pronotum and scutellum *with* a percurrent median impuctate flavescent line or vitta; (black, shining; length, 4 mm., width, 1.67 mm.) ..... *flavilineus* Stål 1874
   Guatemala (Distant), Colombia (Stål).
3. Head *with* a distinct transverse arcuate sulcus behind the tylus, which does not reach the eyes; (basal angles of the scutellum with distinct pale calloused areas or spots or dots); (feet yellowish with numerous black points—Say); (anterior angles of the pronotum evenly rounded; length, 3.5–5 mm.) ..... *punctipes* Say 1832
   New Jersey to Florida, Alabama, Louisiana, Colorado, Oklahoma, Arizona, California, Texas (Guatemala).
   Head *without* a transverse arcuate sulcus behind the tylus 4
4. Scutellum *without* basal calli or spots, unicolorous black; anterior angles of the pronotum usually truncate or angularly rounded 5
   Scutellum *with* basal spots or a subtransverse calloused area not extended down the sides, nearly connecting with a carinate line which becomes obsolete just before the apex, with punctures segregated at base; (callosities of the pronotum distinct, almost or quite attaining the anterolateral angles; impressed median line of the vertex continued nearly to the base of the head); length, 4–5 mm.
   sonoraensis Van Duzee 1923
   (Lower California; on *Atriplex*).
5. Head through the eyes hardly wider than the pronotum at base; (eyes in contact with the abruptly rounded anterior angles of the pronotum, which is almost twice as wide as long; scutellum *not* carinate at apex; head short and broad, longitudinal sulcus continued nearly to the base; scutellum slightly wider than long; venter finely pilose in the

center; length, 3.7 mm., width, 1.6 mm.); form relatively broad ..... *beameri* Barber 1935
Arizona.

Head through the eyes plainly wider than the pronotum; form relatively narrow 6

6. Eyes *not* in contact with the pronotum; pronotum gently symmetrically rounded anterolaterally, bicolorous; scutellum *not* carinate apically, strongly convex (in brachypterous); (eyes apparently stylate, not in contact with the rounded anterior angles of the pronotum, which is nearly twice as wide as long, with the extreme margins finely but distinctly carinate); length, 3.5 mm., width (at humeri), 1.44 mm. ..... *omani* Barber 1935
Arizona.

Eyes in contrast with the pronotum, which is more abruptly rounded anterolaterally and distinctly narrowed anteriorly, very distinctly and somewhat densely punctured, black; scutellum *distinctly* carinate apically, punctate and with a smoothish median line; (head almost smooth, with a sharply impressed line running from near the apex of the tylus well up on to the vertex); length, 3.5 mm. (4 mm., width, 1.5 mm.—Stål) ..... *scudderi* Stål 1874
Texas.

7. Anterior angles of the pronotum *distinctly* angulated; (species mostly black or griseous with prominent fuscous markings) 8

Anterior angles of the pronotum either rounded, or *not distinctly* angulated; (species pale testaceous, or griseous, with or without prominent fuscous or black markings) 14

8. Scutellum obviously longer than wide, strongly convex or in part elevated, (almost always bicolored) 9

Scutellum about equilateral, or subequilateral, smoothly low convex or almost flat; (almost always unicolored) : (head granular or rugulose, impressed line, when present, broader, less distinct, and interrupted at the base of the tylus) 10

9. Upper surface depressed; pronotum little convex, sometimes sunken in the middle behind the callosities; scutellum *not* evenly and strongly convex, either low convex with a median smooth raised line, making it somewhat roof-shaped, or sometimes elevated at or near the base, or with a Y-shaped raised area; ground color more grayish; length,

2.75–4.5 mm.; (with numerous obvious dusky impressed punctures; head rather wider than body; thorax with two *small* transverse impunctured spots before the middle; scutellum with a slightly carinate line and each side of the middle with a longitudinal dull yellowish spot; hemelytra with deep punctures—Say) ..... *bullatus* Say 1832

(= *griseus* Dallas 1852)

(and color varieties *borealis* Dallas 1852, *discopterus* Stål 1874, *obscuratus* Montandon 1908, and *floridanus* Blatchley 1926)

Maine west to Minnesota, Quebec, Ontario, New York and New Jersey south to Florida and Alabama, Dakotas, Manitoba, Colorado, Utah, California, Labrador, (Guatemala—Distant).

Upper surface convex, pronotum rounded, sometimes subdepressed; scutellum very convex, evenly rounded, median line hardly elevated, or with an elevated Y-shaped area sometimes present; ground color more yellowish; length, 3–4 mm. ..... *pallens* Stål 1854

(= *decoratus* Uhler 1877)

(and varieties *solutus* Montandon 1908, and *decoratus* Uhler 1877)

Kansas, New Mexico, Colorado, Utah, California, Arizona, Texas, British Columbia, (Lower California); predacious on *Nysius ericae* and other small insects; taken on *Chenopodium, Atriplex, Vaseyanthus insularis,* sugar beet (Uhler record).

10. Median smooth line of the pronotum well-defined, percurrent or nearly so, and slightly carinate; length, 2.8 mm.; (scutellum equilateral, smoothly low-convex, closely punctured except for a slightly elevated, smooth line traversing the posterior two-thirds; head granular with a median sulcus interrupted by a knob at the base of the tylus, sulcus faint above this point; anterior angles of the pronotum almost evenly rounded, pronotum closely dark-punctured except the posterior angles, very transverse; head with the eyes wider than the broad pronotum at base, wider than the body at the widest part; sides of the hemelytra converging rapidly, corium with two rows of closely set punctures near the clavus, posterior two-thirds sparsely punctured, even on the disc; male type only known).

carinatus McAtee 1914

California.

Median smooth line of the pronotum poorly defined, usually incomplete and not at all carinate 11

11. Scutellum *not* equilateral, narrowed 12
Scutellum strictly equilateral 13

12. Form narrow, nearly parallel-sided; pronotum elongate, margin concolorous, evenly punctured to margins; piceous, shining, with a steely bluish glint, the pale margins of the hemelytra absent or narrow; (punctation less dense); length, 3.5–4 mm. ..... *atricolor* Montandon 1908
Colorado to Washington, Wyoming, Utah, California, Texas, British Columbia.

Form oval; pronotum transverse, anteriorly slightly narrowed, its margins broadly white, smooth, with a few distinct, scattered punctures; black, hemelytra complete, griseous, (disc of corium smooth, posteriorly punctured and with two series of punctures at claval suture; clavus distinct); length, 4 mm., width, 1.33 mm. ..... *lividipennis* Stål 1862
New Mexico, British Columbia(?), (Mexico, Stål).

13. Form oval, more or less broad; pronotum transverse, (disc thickly and rather coarsely punctured, the nodules over the humeri and a transverse elongated spot on each side smooth; corium with a submarginal and two inner rows of punctures, and with some punctures scattered near the apex, the disc in greater part smooth); color dark or piceous, *not* shining, *without* a steely bluish glint; margins of the hemelytra more or less broadly pale; length, 3–4 mm. ..... *uliginosus* Say 1832
(= *niger* Dallas 1852)
(and color varieties *limbatus* Stål 1874, *speculator* Montandon 1908, *howardi* Montandon 1908, *uliginosus* Say 1932, *lateralis* Fieber 1861).
Country-wide, except the Pacific States and Arizona; on *Eupatorium* and other Compositae, and on *Solanum carolinense.*

Form not broadly oval; corium transparent grayish-yellow, smooth, very feebly punctured toward the apical angle; membrane well developed, reaching the apex of the abdomen, smoky; abdomen wholly brilliant black; (tylus very feebly grooved, vertex with a transverse dull spot posteriorly and laterally near the eyes; pronotal calli quite

narrow and little prominent, smooth, as well as the disc); length, 3.5 mm. ..... *duzeei* Montandon 1908
Colorado.

14. Posterior margin of the corium evenly symmetrically rounded, hemelytra rather evenly and closely shallowly punctured all over, except very narrowly on costal margins, no smooth area on disc; brachypterous; (eyes not in contact with the anterolateral angles of the pronotum, which are abruptly obtusely angulated; cicatrices of the pronotum almost contiguous; scutellum shorter than the pronotum—equal to pronotum, according to the original description—, as wide as long, closely and evenly punctured on each side of the delicate median callous streak, basal area more closely punctured; head very finely wrinkled; pronotum almost twice as long as wide, lateral margins parallel, evenly and rather closely punctured to extreme anterior and lateral margins, very narrowly impunctate along the posterior margin, anteriorly with a faint median calloused pale streak separating the two transverse orbicular smooth callosities; length, 3.15 mm., width, 1.1 mm.).
frisoni Barber 1926

Indiana, Illinois, Texas.

Posterior margin of the corium at least outwardly truncate, straight in both brachypterous and macropterous forms 15

15. Sides of pronotum parallel, anterolateral angles *abruptly* rounded, posterior margin slightly concave before the scutellum; (eyes touching the pronotum; cicatrices of the pronotum remote from each other; head and cicatrices castaneous red or ochraceous red; head wider than the pronotum at the humeri, very finely granulose; eyes almost or quite in contact with the anterior angles of the pronotum, which is finely pilose anteriorly; scutellum finely pilose; tergum finely pilose; pleura and venter pilose; length, 3 mm.) ..... *nanus* Barber 1935
(= *bullatus* var. *bullatus* McAtee 1914)

Arizona, Colorado.

Sides of pronotum *not* parallel, posterior margin truncate before the scutellum; (head and pronotal cicatrices concolorous) 16

16. Lateral margins of the pronotum evenly rounded anteriorly

from just before the middle point; eyes touching the anterolateral angles of the pronotum; (scutellum with vestiges only of the basal calli, almost uniformly punctured; not pilose; length, 3 mm.) ..... *paulus* McAtee 1914
California.

Anterolateral *angles only* of the pronotum rounded; eyes not touching the anterolateral angles of the pronotum 17

17. Anterolateral *margins* of the pronotum abruptly subangularly rounded; (eyes touching the pronotum; head, pronotum and scutellum finely sparsely pilose; head granulose; pronotum not twice as wide as long; length, 3.7 mm., width, 1.4 mm.) ..... *davisi* Barber 1935
Nevada; on *Dondia nigra* and *Atriplex garrettii.*

Anterolateral angles of the pronotum gently rounded, not subangular 18

18. Head with eyes *narrower* than the width of the pronotum at humeri; anterior tibiae apically quite thickened, with an *obvious* apical or subapical spur or spine, and about one-half the length of the posterior tibiae; pronotum with the discal punctures coarse, except near the anterior margin, where they are finer, and with a small impunctate spot at the middle of the base; veins of the membrane evident; length, 3.6 mm., width, 2.1 mm.

guatemaltecus Torre-Bueno 1943
(= *thoracicus* Distant 1882,
nec Fieber 1861)

(Guatemala.)

Head with eyes *wider* than the pronotum at humeri; anterior tibiae somewhat thickened apically, *without* an apical spur or spine, and *more* than one-half the length of the posterior tibiae; discal punctures of the pronotum fine, reaching the base, which has *no* basal impunctate spot, the anterior punctures coarser; veins of the membrane absent or obsolete; length, 3.1 mm., width, 2 mm.

thoracicus Fieber 1861
(Distant 1882)

(Guatemala.)

Subfamily 5. **Heterogastrinae** Stål 1872

This subfamily is represented to this time in America by only one of its genera.

Genus I. *Heterogaster* Schilling 1829

(= *Phygas* Fieber 1860 = *Phygadicus* Fieber 1860)

Barber in his keys defines the genus as follows:

Body oblong; lateral margins of the pronotum lightly marginate, posterior margin strongly concave; anterior femora armed with a tooth or spine toward the apex.

Key to Species

A. Head strongly transversely convex above and closely and coarsely punctured, not quite twice as long as wide, with long sparse pile; antennal segments II and IV slightly longer than III; (pronotum one-third wider than long, coarsely and closely punctured, with pile long and sparse, shallowly impressed dorsally and laterally just behind the middle, the lateral margins very narrowly impressed; scutellum nearly twice as wide as long; corium pilose, coarsely but sparingly punctured between the veins); venter finely and closely punctate; length, 6–7 mm. *flavicosta* Barber 1939

Louisiana, Texas; under bark.

B. Head very convex, not so closely and coarsely punctured; antennal segment II longest, III and IV equal; (rostrum reaching behind the anterior coxae; pronotum moderately flat, closely, rather coarsely punctured, less closely so behind, lateral margins moderately sinuate, posterior margin broadly sinuate; beneath opaque black, densely hoary pubescent; scutellum densely and finely punctured basally, more remotely and coarsely apically; punctures of corium remote, moderately coarse); venter dull black minutely densely punctured and shagreened; length, 7–7.5 mm., width, 1.75–2 mm. ..... *behrensii* Uhler 1876

California, Utah.

Subfamily 6. **Pachygronthinae** Stål 1865

Key to Genera

1. Antennae short, segment I shortest, hardly reaching the apex of the head, II about twice or slightly more than twice as long as I; head strongly declivous, outer margin of juga not at all elevated; ocelli quite far apart; body subsquamosericeous, somewhat large; pronotum somewhat convex; scutellum subequilateral; apical margin of the corium more

or less sinuate toward the apex of the clavus, rounded toward the outer apical angle; anterior legs moderate; levigate line of pronotum absent or obsolete; rostral segment II extending wholly or in greater part beyond the apex of the prosternum; (head wider, between the eyes and the apex of the antennal tubercles somewhat narrowed; eyes strongly prominent; rostral segment I not reaching the base of the head; segment I of posterior tarsi short, about as long as II and III taken together) ..... I. *Phlegyas* Stål 1865
(= *Helonotus* Uhler 1876
= *Peliopelta* Uhler 1886)

Antennal segment I long, usually very long, exceeding the apex of the head, clavate or noticeably incrassate toward apex; head subporrect or slightly declivous; ocelli not, or slightly more, distant from each other than from the eyes; body somewhat depressed, nude above; scutellum frequently distinctly longer than wide; apical margin of the corium straight; pronotum with a levigate subcallous percurrent or abbreviated longitudinal line; rostral segment II not or very slightly extended beyond the apex of the prosternum 2

2. Scutellum *without* a median longitudinal pale line; (outer margin of juga acute, more or less distinctly ampliate and reflexed) ..... II. *Oedancala* Amyot & Serville 1843

Scutellum *with* a median longitudinal pale levigate line.
III. *Pachygrontha* Amyot & Serville 1843

Genus I. *Phlegyas* Stål 1865

(= *Helonotus* Uhler 1876 = *Peliopelta* Uhler 1886
= *Helonotocoris* Lethierry & Severin 1888)

Key to Species

1. Antennal segment II twice the length of I; pronotum *without* a median carina; (median carina of scutellum fine but *entire;* length, 4.5–5 mm., width, 1.33–1.5 mm.).
annulicrus Stål 1869
New Jersey to Florida, Kansas, Utah, Texas, Arizona, California, (Sonora, Mexico).

Antennal segment II about three times the length of I; pronotum *with* a median carina 2

2. Median carina of the pronotum *very* narrow, obsolete toward

base; (rostrum reaching or nearly reaching intermediate coxae); length, 5.25, width, 1.5–2 mm.

abbreviatus Uhler 1877

Quebec, Ontario, Maine south to Georgia, Michigan, Illinois, Missouri, Nebraska, Colorado.

Median carina of pronotum narrow, percurrent, entire; (scutellum with a fine levigate median carina; antennal segment I *not* passing tylus); length, 5 mm.

tropicalis Distant 1893

"Texas" (Banks); (Mexico).

Genus II. *Oedancala* Amyot & Serville 1843

Key to Species

1. Antennal segment I *longer than* II plus III, and equal to the length of the head and pronotum taken together; levigate line of the pronotum going up into the head and abbreviated posteriorly; (anterior femora strongly incrassated, beneath with four or five large spines, and behind the middle with several smaller ones); length, 9 mm., width, 2 mm. ..... *cubana* Stål 1874

Cuba.

Antennal segment I *subequal to or shorter* than II and III taken together, *not* longer than the head and pronotum taken together; levigate median line of pronotum not extending onto the head 2

2. Antennal segment I (as long as pronotum), nearly as long as II and III taken together, II, III and IV subequal; median levigate line of the pronotum percurrent, disc finely and closely punctured; (anterior femora very strongly swollen and armed beneath with *two* rows of very short irregular teeth); length, 6.5–7 mm. ... *dorsilinea* Amot & Serville 1843

New York to Florida and Texas.

Antennal segment I *much shorter* than I and III taken together (two-thirds as long), segments II, III and IV subequal; median levigate line of the pronotum not reaching either the basal or the anterior margin, disc coarsely, somewhat sparsely, punctured; length, 6–6.3 mm. ... *dorsalis* Say 1832

Quebec and New England to South Dakota and Colorado, south and southwest to South Carolina, Oklahoma, Texas; on *Carex vulpinoides, Cyperus* sp.

Note.—According to Van Duzee, *Oedancala crassimana* Fabricius 1803 has not been recognized since described; it may eventually turn out to be one or the other of the continental species.

Here is another instance of a species often mentioned *by name only,* but never redescribed nor even seen by anyone since 1803. In Hemiptera Fabriciana, p. 122, Stål merely lists a bare name and sets it generically (Fabrician number 145), in the genus *Oedancala,* without any comment whatsoever, subsequent authors doing the same, except for the Van Duzee comment above cited. Stål, however, seems to have seen *something* he discusses in Enumeratio Hemipterorum IV: 139; or else he decided for unexpressed reasons, that *Pamera dorsalis* Say (*Oedancala*) was identical with *crassimana* Fabricius. It might seem to introduce less confusion to omit from the key preceding, in all its statuses, *O. crassimana* Fabricius. For the consideration of archaeoentomologists is appended a copy of the original Latin description of Fabricius, together with the present writer's exact translation, the former lined as in the original work, Fabricius, Systema Rhyngotorum, 1803, p. 233.

145. L. griseus thorace linea dorsali alba, femoribus anticis incrassatis. *crassimanus*

Habitat in Carolina. Mus. Dom. Bosc.

Statura L. chiragrae. Antennae omnino filiformes, obscurae. Caput et thorax punctata, grisea: linea dorsali albida, quae tamen nec apicem capitis, nec basin thoracis attingit. Elytra punctata, grisea. Alae albae. Corpus nigricans linea laterali albida. Pedes pallidi femoribus anticis valde incrassatis at inermibus.

Translation of preceding:

145. L. griseous thorax dorsal line white, anterior femora incrassate.

Inhabits Carolina. Mus. Dom. Bosc.

Size of L. chiragra. Antennae wholly filiform, dark; Head and thorax punctured, griseous: dorsal line white, which however does not reach the apex of the head nor the base of the thorax. Elytra punctured, griseous. Wings white. Feet pale, anterior femora quite incrassate yet unarmed.

Genus III. *Pachygrontha* Germar 1837

The subjoined key to the species of this genus is hopeful in character, although it will probably work in practice. The descriptions

by Distant of his two Central American species, herein keyed, are given in full in the key, except the color-pattern. How it is possible to omit all reference to the basic characters developed by Stål, in what purport to be adequate descriptions of new species, is a phenomenon of descriptive entomology, a phenomenon still with us, we must reluctantly admit.

Such meager works as this referred to, form the justification of the proponents of the notion that without the type specimen a species is unknown and unknowable. Talleyrand said: "Language was given to man to conceal thought." Descriptive entomologists ancient (excusably) and modern (inexcusably) seem to have made this idea their lode-star.

Key to Species

1. Large species, normally averaging 6.5 mm. or over in length 2
   Smaller species, less than 6 mm. in length 3
2. Antennal segments II and III equal, I as long as pronotum; pronotum subtransverse, margins very slightly rounded before middle, with a percurrent longitudinal levigate line extended through the scutellum; length, 7 mm., width, 2 mm. ..... *oedancalodes* Stål 1874
   Mexico.

   Antennae slender, segment II about one-quarter longer than III, segment I longer than the pronotum; pronotum nearly as long as wide at the truncate base, margins straight, longitudinal line evanescent behind the middle; length, 9 mm., width, 2 mm. ..... *longiceps* Stål 1874
   Colombia, S. A.
3. Length, 5.5 mm.; (antennal segment II a little shorter than III; levigate line on anterior half of pronotum only, not reaching the anterior margin) ..... *bimaculata* Distant 1893
   ?Texas (Banks), (Panamá, Distant).

   Length, 5 mm.; (length of pronotum more than half the length of the corium) ..... *compacta* Distant 1893
   Guatemala, Panamá.

Subfamily 7. **Oxycareninae** Stål 1862

Key to Genera

A. Veins of corium and of membrane distinct, evident, corium coarsely but sparsely punctate; head, pronotum and hemelytra *without* fine erect hairs; head, pronotum, scutellum

and body beneath *not* polished ..... I. *Crophius* Stål 1874

B. Veins of corium and of membrane indistinct, *not* evident, general surface of corium impunctate; head, pronotum and hemelytra *with* fine erect hairs; head, pronotum, scutellum and body beneath polished ..... II. *Dycoderus* Uhler 1901

Genus I. *Crophius* Stål 1874

Key to Species

1. Rostrum passing middle of the *metasternum,* or reaching its base 2

   Rostrum not reaching base of *mesosternum* 3

2. Antennal segment I exceeding the tylus by *less than* one-third of its own length, segment IV longer than II, and about twice the length of III; bucculae ending abruptly some distance from the base of the head; pronotal callosities slightly raised; (claval punctures few and irregular between the submarginal rows, hardly forming a third row; head black or piceous; pronotum black, sometimes ferruginous brown posteriorly, anterior margin abruptly whiter, posterior margin obscurely paler; corium sordid white to gray, disc distinctly punctate with fuscous, veins distinctly elevated, infuscated, membrane hyaline, dark-veined); length, 4 mm. ..... *bohemani* Stål 1859
   California to Vancouver Island, Idaho, Utah.

   Antennal segment I exceeding tylus by one-third of its own length, IV subequal to II; bucculae low; pronotal callosities inconspicuous, finely punctured, as is the anterior lobe; (metasternum hardly sulcate; anterior margin of the pronotum concolorous or nearly so; membrane infuscated, apical margin broadly pellucid, clavus and broad apex of the corium black, basal angle of the membrane with a white spot; membrane about as long as the corium; hemelytra only moderately convex, costal margin slightly convex from base to apex, commissure about as long as the scutellum); length, 3.5 mm. ..... *scabrosus* Uhler 1904
   Nebraska, Idaho, New Mexico, Colorado, Nevada, Utah, Arizona, California.

3. Apex of antennal segment I not or hardly passing tylus, (segment IV slightly longer than III; pronotal callosities little raised, punctured like the adjacent surface; metasternum deeply sulcate in anterior half; tooth of anterior femora obsolete; claval punctures hardly arranged in rows; hem-

elytra minutely and obscurely punctured; anterior margin of the pronotum concolorous or nearly so; membrane infuscated, apical margin broadly pellucid and dotted, clavus and corium cream-white, immaculate; length, 5.5 mm.) ..... *heidemanni* Van Duzee 1910
Arizona.

Apex of antennal segment I *much* surpassing tylus 4

4. Veins of membrane complete, simple 5
Veins of membrane branched or irregular 7

5. Metasternum *distinctly* sulcate; (claval punctures in three regular rows; antennal segment IV equal to or longer than II; anterior femora spined; anterior margin of the pronotum black, concolorous or nearly so; hemelytra whitish to testaceous, sparsely fusco-punctate, wide margin of the membrane immaculate, its disc and the discal veins of the corium fuscous; length, 3–3.75 mm.) ..... *disconotus* Say 1832
Canada and Eastern United States, to Missouri and Alabama, Colorado, Utah, California, (Mexico); on golden rod and *Pinus ponderosa*.

Metasternum hardly or obsoletely sulcate 6

6. Anterior femora spined; (antennal segment I surpassing the tylus by one-third of its own length, IV shorter than II; pronotal callosities strongly elevated, almost impunctate, forming a sinuated transverse ridge at the middle of the pronotum; claval punctures confused; membrane very large, the inner vein almost obsolete, infuscated, apical margin pallucid, clavus and broad apex of the corium black, basal angle of the membrane with a white spot; anterior margin of the pronotum concolorous or nearly so); length, 3.5–4 mm. ..... *schwarzi* Van Duzee 1910
Arizona.

Anterior femora unarmed; (antennal segment I exceeding the tylus by one-third its own length, II and IV nearly equal; pronotum with a transverse shallow impression; head black or piceous; pronotum fusco-castaneous behind the broadly white anterior margin, with a triangular white spot posteriorly; entire corium unicolorous, white, disc sparsely and faintly punctate, veins hardly elevated, membrane hyaline with uncolored or slightly darkened veins); length, 3–3.5 mm. ..... *albidus* Barber 1938
Utah.

7. Pronotum *as long as wide;* (antennal segment I much exceed-

ing the tylus, IV shorter than II; pronotal callosities prominent, finely punctured, hardly connected; claval punctures few, forming three imperfect rows; metasternum *without* a distinct sulcus; anterior margin of the pronotum with a distinct pale collar; head ferruginous; veins of membrane branched; length, 3–3.5 mm.).

angustatus Van Duzee 1910

California, Utah.

Pronotum *wider than long* 8

8. Antennal segment I *slightly* exceeding the tylus, (IV slightly longer than II); veins of the membrane irregularly branched, often incomplete and broken; costal margin very slightly expanded, gently convexly rounded from base to apex; (head dull black; anterior lobe of the pronotum dull black, pale medially at anterior margin, posterior lobe light, infuscated or cinereous with an indistinct median pale line; corium cinereous, punctate and clouded with fuscous; membrane sordid white, opaque, with heavily infuscated veins and spots); length, 2.5–3 mm. ..... *ramosus* Barber 1938

Idaho, Utah; on *Atriplex* and *Norta altissima.*

Antennal segment I *greatly* exceeding the tylus; veins of the membrane branched apically; costal margin of the corium distinctly expanded and nearly straight from base to apex; (pronotal callosities conspicuous, hardly coalescent, almost impunctate; claval punctures with row 2 absent or incomplete; metasternum without a sulcus; pronotum ferruginous-brown with a black band across the callosities and five obscure pale vittae posteriorly, the posterior lobe distinctly impressed on the middle and before each humeral angle, anterior margin paler, becoming whitish at the median line); length, 3.5 mm. ..... *impressus* Van Duzee 1910

California.

Genus II. *Dycoderus* Uhler 1901

Additional to the characters in the generic division preceding are the following, as given by Uhler in his original description of the genus (Some New Genera and Species of North American Hemiptera—Proc. Ent. Soc. Wash., IV: 507/508):

"Head thick sub-conical, hairy and including the eyes, about as wide as the anterior lobe of the pronotum; antennae very thick, the apical joint thicker than the others, about twice as long as the third, the second longest, thinnest, tapering

towards the base, the basal joint stout, shorter than the front, subfusiform; eyes globular, placed before the line of the convex front, the front broad, tumidly convex in union with the vertex, cheeks short, tylus long and narrow, the rostrum slender, geniculate, reaching upon the middle coxae, the basal joint longest, moderately thick, second almost as long, reaching upon the anterior coxae, the third much shorter; gula swollen, the bucculae slender, long. Pronotum subcampanulate, deeply constricted at about two-thirds of the length posteriorly, the groove carried down continuously to the sternum, anterior lobe about twice as long as the posterior one, sub-quadrangular, a little convex, having the lateral border curved, bent down, and the edge very narrowly reflexed, posterior lobe broad, very short, with the lateral margins oblique, elevated on the posterior border, and sloping down to the sulcated line; posterior middle of the prosternum deeply excavated, and bounded behind by a callous ridge. Anterior femora stout, sub-fusiform, hardly longer than the tibiae. Scutellum tumid near the tip. Abdomen expanding posteriorly in a curve, wider than the pronotum. Corium narrow, triangular at base, curving wider behind the middle, the membrane barely extending beyond the tergum, the apical curve oval, veins indistinct, not apparently continuous, underside of body highly polished."

Uhler set the genus in "Div. Myodochina" (i.e., Myodochini); and says "closely related to *Ptochiomera* Say." But in the course of his important and profound revisional work on Lygaeidae, H. G. Barber, in 1917, places the genus as here, in Oxycareninae.

The one species thus far recorded in the genus is *D. picturatus* Uhler 1901.

The original description and Uhler's comment, run as follows:

"Oblong subovate, piceous-black, more or less rufous beneath, covered above with grey, erect bristles, and coarsely punctate; head thick and nutant, impressed across the middle and at base, coarsely punctate in a lunate depression; antennae rufo-testaceous, the apical joint and outer end of the third black; rostrum rufo-testaceous, darker at base and tip. Pronotum polished, the anterior margin arcuated and with one or more transverse lines of punctures behind it, the humeral angles callous, a little elevated, bounded behind by a short, grooved line. Scutellum black, deeply punctate. Hemelytra flat, dull black, finely punctate in the sutures, base with a triangular

whitish spot and apex with a narrow, transverse spot of the same color, costal margin acutely reflexed; membrane convex, dusky posteriorly and with a pale border. Legs pale rufopiceous, the tibiae testaceous, piceous at tip, tarsi mostly piceous.

"The female is a little wider than the male. Length to tip of abdomen male $2\frac{1}{2}$, female 3 mm., width of pronotum $1\frac{1}{8}$ mm.

"A pair male female, collected near Phoenix, Arizona, belong to Mr. E. D. Ball, and another from near Denver, Colorado, is in my own collection."

These types should now be in the United States National Museum, in the Ball and Uhler collections. Apparently, so far as records go, the species has not since been collected in either state.

Subfamily 8. **Rhyparochrominae** Stål 1862

Key to Tribes

1. Rostral segments I and II taken together not as long as or hardly longer than, the head, segment III longest; (posterior glandular opaque spot of ventral segment IV remote from the apical margin of the segment); ocelli very widely separated ..... 1. *Cleradini* Stål 1874

   Rostral segments I and II taken together much longer than the head, (and longer than segment III—Stål), I nearly as long as the head or as long, (II wholly or mostly extended behind the base of the head—Stål); ocelli *not* very widely separated 2

2. The two lateral opaque spots on ventral segment IV widely separated, the posterior spot closer to the posterior margin of the segment than to the anterior spot 3

   Posterior glandular opaque spot of ventral segment IV set closer to the anterior spot and very remote from the posterior margin of the segment, sometimes with a *third* spot set posteriorly; (lateral margin of the pronotum generally expanded and frequently foliaceous between the lobes. 6. *Lethaeini* Stål 1872

3. Pronotum with the lateral margins of the anterior lobe obtuse, terete, not calloused, carinate or expanded, nor longitudinally impressed within the lateral margin of the propleura, generally strongly constricted transversely, at or behind the middle, to form two distinct lobes, and generally provided with a constricted ring-like collar; if the

collar is absent, the head is not, or only very slightly exserted; body much depressed, more narrowly elongated.

2. *Myodochini* Stål 1872

Pronotum seldom strongly constricted transversely, with the lateral margins of the anterior lobe neither obtuse nor terete, either calloused or, if constricted, with the lateral margins carinate or expanded, or with the lateral emarginations filled in by a foliaceous expansion, or furnished with a series of punctures within the lateral margin or with a lateral impression on the propleura within the lateral margin, seldom with a constricted ring-like collar, unless the head is strongly exserted, at most with only a depressed series of punctures within the anterior margin; body generally broad, with the head almost or quite immersed to the eyes 4

4. Lateral margins of the pronotum not at all or less entirely laminate-expanded, generally either carinate or longitudinally impressed within the lateral margin of the propleura; pronotum entirely black or ferruginous or castaneous, the posterior lobe seldom paler, black punctate; head seldom strongly exserted, if exserted, with a constricted anterior collar on the pronotum (*Ozophora*); posterior tibiae generally *without* rigid bristles only, usually pilose.

3. *Rhyparochromini* Stål 1872

Entire lateral margin and the costa of the hemelytra more or less laminately expanded (in U. S. genera) and usually pale in part, this margin seldom keeled only (in certain exotic genera), if keeled only, with antennal segment I extended far beyond the apex of the head and with the male genital segment tuberculate; pronotum including the margin seldom entirely black, the posterior lobe generally pale or pale-variegated; posterior tibiae with long rigid subspiniform setae or bristles 5

5. Antennae nude or with a short pubescence, segment I sometimes with a few short setae; narrowly expanded margin of the pronotum not punctate, or rarely sparsely punctate; anterior disc of the pronotum usually smooth or sparsely punctate, sometimes densely so ..... 4. *Beosini* Stål 1872

Antennal segments I, II and III with rigid setose bristles; broadly expanded lateral margins of the pronotum and of the corium usually profusely punctate; clavus irregularly punctate; dorsum usually pale and thickly punctate.

5. *Gonianotini* Stål 1872

Tribe 1. *CLERADINI* Stål 1874

Genus I. *Clerada* Signoret 1863

This genus was erected by Signoret in Maillard (Notes sur l'Ile de la Réunion, Insèctes, p. 28, plate 20, fig. 8) to contain the one species therein described. Subsequently, Stål (1865, Hemiptera Africana II: 155) recharacterized the genus; and in his key to Cleradaria (Enum. IV: 143), he offered further differentiation. The following generic description is a combination of these two.

> Body narrow ovate, depressed; thorax transverse, trapezoidal, anteriorly quite narrowed, not constricted, lateral margins acute, slightly dilated, slightly reflexed, subsinuate at middle, apex not quite suddenly rounded, basal margin straight; anterior margin of the pronotum narrowly depressed; head not immersed to the eyes, porrect, slightly longer than the thorax, postocular part very short, cylindrical, bearing on each side the ocelli behind the eyes; hemelytra complete, costal margin slightly rounded, apical margin of the corium much shorter than the claval suture; body without hairs or long setae; head and pronotum subequal in length; feet mediocre, femora unarmed, the anterior hardly incrassate, segment I of the posterior tarsi slightly longer than the two apical taken together; rostrum slender, reaching intermediate coxae, segment II slightly shorter than I, slightly extended beyond the eyes and nearly equal to the length of the head, segments I and II taken together subequal to III; antennal segment I shorter than head, which it exceeds by one-half its own length, II hardly twice as long as I, III subequal to I, IV slightly shorter than II; head somewhat exserted, not narrowed behind the eyes; ocelli set further apart than the eyes and behind them, on the lateral margin of the head; scutellum triangular, subequilateral, nearly equal in length to the commissure; gula not sulcate, bucculae very slightly elevated anteriorly; eyes closer to each other below than above; clavus posteriorly subampliate.

According to Horváth (Spec. gen. Lygaeidarum *Clerada* Sign., Ann. Mus. Nat. Hung. VII: 622/625, 1909) there are seven species in the genus, as of then, five of which he keys out. Six of them are from Malaysia, Australasia and the Pacific and African Islands; one only is also American in distribution, namely,

C. apicicornis Signoret 1863.

There seems to be no other description of this than the original,

not at hand; and the following brief characterization is derived from Horváth (op. cit., p. 622).

> Head as long as wide, or slightly longer than wide, postocular part with the sides rounded, ocelli contiguous to the eyes; antennal segment I hardly or slightly exceeding the apex of the head; length, 6–7 mm., width, 2.5–3 mm.

The United States record of this is California. Otherwise, it appears to be from the African and Pacific Islands, including Samoa and Hawaii; from the West Indies; and from Mexico, Venezuela and Brazil.

The insect is haematophagous and has probably been carried on small unclean ships all over—or so it might seem. Da Costa Lima (Insetos do Brasil—II—Hemípteros, p. 109) says:

> "Recentemente Castro Ferreira e Dean (1938) observaram no Pará, vivendo em paredes de cabanas feitas de palha de ubussú (*Manicaria saccifera* Gaertn.), um pequeno Hemíptero que verifiquei se a *Clerada apicicornis* Signoret, 1863 (subfam. Rhyparochrominae). (Fig. 325.) Segundo aqueles observadores, jovens e adultos deste inseto comportam-se como os Hemípteros hematófagos da subfamilia Triatominae (Fam. Rediviidae), pois sugan sangue do homen e de animals de laboratorio.
>
> "Confirmam-se assim, as observaçaos de Bergroth (1914) e de Illingworth (1917), relativas ao hematofagismo em *Clerada.*"

Translated as follows:

> "Recently Castro Ferreira and Dean (1938) observed in Para, living in the walls of cabins made from the straw of 'ubussú' (*Manicaria saccifera* Gaertn.), a small hemipteron, which I determined as *Clerada apicicornis* Signoret 1863 (subfam. Rhyparochrominae). (Fig. 325.) According to these observers, young and adults of this insect acted like the haematophagous Hemiptera of the subfamily Triatominae (Fam. Reduviidae), because they suck the blood of men and of laboratory animals.
>
> "This confirms the observations of Bergroth (1914) and of Ilingworth (1917), as to haematophagism in *Clerada.*"

Some work has been done in Brazil on the species as a possible vector of *Schizotrypanum cruzi.*

Tribe 2. *MYODOCHINI* Stål 1874

Key to Genera

1. Head greatly exserted, drawn out into a long cylindrical neck behind the eyes, which neck is longer than the pronotum;

(anterior and posterior lobes of the pronotum subequal; body narrow, elongate; posterior tibiae with long setose hairs; posterior tarsal segment I about three times as long as II and III taken together; macropterous forms only known) ..... I. *Myodocha* Latreille 1807

Head exserted or not, but *not* produced into a long cylindrical neck; (collar seldom absent) 2

2. Anterior lobe of the pronotum in all macropterous and most brachypterous forms never or seldom more than twice as long as the posterior lobe, when or if more than twice as long, the head is *not* exserted (in the brachypterous of certain *Ptochiomera*), transverse constriction of the pronotum at or a little behind the middle 3

Anterior lobe of the pronotum three or four times as long as the posterior lobe, the transverse constriction usually shallow and obtuse, or ill-defined; (head distinctly exserted, the postocular space subequal to the space between antenna and eye, usually not abruptly contracted back of the eyes; anterior tibiae in the male with a submedian tooth; antennae elongate, the apex of the head not reaching the middle of segment I, which is subequal to rostral segment I; posterior tarsal segment I two or three times as long as segments II and III taken together; membrane not wholly absent in the brachypterous) 17

3. Head more or less distinctly exserted; pronotum *with* a distinct ring-like collar; body more or less elongate 4

Head not at all or hardly exserted, generally immersed to the eyes; pronotum *without* a constricted ring-like collar, at most with the anterior margin depressed or furnished with three rows of punctures 10

4. Head strongly exserted, forming a short neck at the base, the postocular space about four times as long as the distance from the eye to the antenna; (eyes set at about the middle of the head; hind tibiae with fine rigid bristles; posterior tarsal segment I about equal to II and III taken together; macropterous and brachypterous) ... II. *Heraeus* Stål 1862

Head *not* strongly exserted, generally strongly contracted back of the eyes, postocular space usually subequal to or shorter than the distance between the base of the antenna and the eye 5

5. Anterior lobe of the pronotum, especially in the brachypterous, globose, almost the diameter and about twice the length

of the posterior lobe; (postocular space subequal to the distance between the antenna and the eye; scutellum much wider than long; head and pronotum shining; posterior tibiae with rigid bristles); posterior tarsal segment I nearly three times as long as II and III taken together; (macropterous and brachypterous).

III. *Sphaerobius* Uhler 1893

Anterior lobe of the pronotum *not* very evidently globose, *narrower* than the posterior lobe; head and thorax seldom shining; posterior tarsal segment I generally *not more* than twice II and III taken together, if three times II and III taken together, then the posterior tibiae have long rigid bristles 6

6. Anteocular space to the base of the antenna about three times as long as the postocular space; head *not* strongly contracted back of the eyes, apex of tylus not reaching middle of antennal segment I, which is incrassate and elongate and a little longer than rostral segment I, antennal segment II very elongate, *over* twice as long as III and IV taken together; anterior lobe of the pronotum as long as the posterior lobe, collar set off by a depressed series of punctures; (anterior femora with *two* rows of spines, the outer confined to the subapex; posterior tibiae with a few scattered setose hairs similar to those of the antennae; posterior tarsal segment I about twice as long as II and III taken together; only macropterous females known).

IV. *Caenopamera* Barber 1918

Anteocular space to base of antenna *not more* than twice the postocular space, generally subequal to it; head strongly contracted back of the eyes, apex extending to or beyond middle of antennal segment I, which is very evidently shorter than rostral segment I, antennal segment II much shorter than III and IV taken together; pronotal collar usually set off by an impressed line 7

7. The two lobes of the pronotum usually separated by a *deep,* clean-cut transverse constriction; rostral segment I usually *not* reaching base of head; (postocular space of the head usually subequal to, or sometimes a little shorter than, the space between the antenna and the eye; posterior tibiae usually with short bristles) 8

The two lobes of the pronotum usually separated by a *shallow* obtuse transverse constriction; rostral segment I usually reaching the base of the head 9

8. Abdominal segments II and III *with* two very finely strigose opaque lunate vittae ..... V. *Ligyrocoris* Stål 1872

Abdominal segments II and III without such vittae.

VI. *Orthoea* Dallas 1851
(to include s.g. *Paromius* Fieber 1861)

9. Posterior tarsal segment I *fully* three times as long as II and III taken together; posterior tibiae with long rigid bristles only; antennae nearly nude; body narrow, elongate; legs fairly long; (scutellum carinate for its entire length).

VII. *Zeridoneus* Barber 1918

Posterior tarsal segment I *not more* than twice segments II and III taken together; posterior tibiae with long setose hairs, as on the antennae, and with a few rigid bristles apically; body oval; legs fairly short.

VIII. *Perigenes* Distant 1893

10. Scutellum much longer than wide and distinctly carinate posteriorly; pronotum strongly constricted to form two lobes, both of which are punctate, disc of anterior lobe sometimes more sparsely so; posterior tarsal segment I subequal in length to II and III taken together; species seldom pilose 11

Scutellum subequilateral, *not* distinctly carinate posteriorly; pronotum *not* finely punctate anteriorly and *not* strongly constricted to form two lobes, or very pilose and obsoletely punctate anteriorly and strongly and obtusely constricted to form two lobes; posterior tarsal segment I decidedly longer than II and III taken together; species *not* or *very faintly* shining 16

11. Antennal segment I long, exceeding apex of the tylus by one-half its own length; anterior margin of the pronotum depressed, punctate; disc of scutellum depressed basally anterior to the premedian transverse or crescentic ridge, behind this carinate 12

Antennal segment I short, hardly exceeding the apex of the tylus; anterior margin of the pronotum *not* depressed; scutellum depressed basally and with a longitudinal carina from the depression to the apex; anterior femora incrassate, with two or three preapical teeth, one of which is frequently larger than the others; membrane in brachypterous shortened only, the clavus always deflected to the corium; very shining species.

XVI. *Kolenetrus* Barber 1918

12. Antennae rather stout, segments III and IV *not* or but slightly thicker than II; anterior lobe of the pronotum convex, transverse, nearly as wide as the posterior lobe; scutellum *without* a premedian transverse ridge.
IX. *Tomopelta* Uhler 1893

Antennal segments III and IV, or at least IV, much thicker than II; anterior lobe of the pronotum subcylindrical or subglobose, distinctly narrower than the posterior lobe; scutellum with a premedian transverse or crescentic ridge; anterior femora with several small teeth, anterior tibiae in male sometimes with a median tooth; in the brachypterous, the membrane nearly or quite absent, the clavus flat and not deflected to the corium, and the anterior lobe of the pronotum swollen and more than twice the length of the posterior lobe; species not, or slightly, shining 13

13. Antennae relatively long and slender, segments II and III filiform, II longer than III; anterior tibiae in male nearly straight, with a small preapical tooth, or unarmed.
XIII. *Exptochiomera* Barber 1928

Antennae relatively short, more or less incrassate, sometimes clavate 14

14. Antennae hardly clavate, with short erect hairs; insect nude, subshining; pronotum strongly constricted between the two lobes, anterior lobe four times as long as posterior lobe (brachypterous); anterior femora strongly incrassate; anterior tibiae in male strongly curved, *with* a preapical tooth; generally brachypterous ..... XI. *Carpilis* Stål 1874

Antennae more or less clavate, *without* erect hairs; anterior femora more strongly incrassate; anterior tibiae in male straight, armed or unarmed 15

15. Antennal segment III *more* incrassate than IV; insect nude, subshining; pronotum strongly constricted; anterior tibiae in male unarmed ..... X. *Ptochiomera* Say 1832

Antennal segment III less incrassate than IV; insect dull fusco-ferruginous, rather densely sericeous; pronotum somewhat feebly feebly constricted; brachypterous.
XII. *Sisamnes* Distant 1893

16. Antennae and dorsum less pilose; pronotum longer than wide, strongly constricted behind middle to form two lobes, the anterior obsoletely and sparsely punctured; antennal segment I long, exceeding apex of tylus by nearly one-half its own length; costal margin of the corium gently convex;

anterior femora with two or three *minute* preapical teeth and with long setae throughout; clavus distinct and deflected to corium, membrane reaching end of abdomen; macropterous only known ..... XIV. *Valonetus* Barber 1918

Antennae and dorsum *not* or *very sparsely* pilose; pronotum subtransverse or quadrate, not strongly constricted to form two lobes, finely and distinctly punctured, anterior disc *sometimes* impunctate; antennal segment I short, barely exceeding tylus; anterior femora at the middle with two or three minute teeth tipped with long setae; in the brachypterous, the clavus connate with corium, membrane absent, and the pronotum more quadrate.

XV. *Neosuris* Barber 1924

17. Anterior lobe of the pronotum impunctate, marked off from the posterior lobe by a transverse impressed line, with a distinct ring-like collar; antennal segment I with a few setose bristles; ocelli absent; posterior tibiae with rigid bristles inwardly and outwardly; posterior tarsal segment I three times as long as II and III taken together; large species.

XVII. *Cnemodus* Herrich-Schaeffer 1853

Anterior lobe of the pronotum sparsely punctured, lobes separated by an obtuse sinus and not by an impressed line, anterior margin depressed, punctured; antennal segment I *without* setose bristles; with ocelli; tooth of male anterior tibiae set before middle, posterior tibiae with a few setose bristles inwardly; posterior tarsal segment I twice II and III taken together; small species.

XVIII. *Pseudocnemodus* Barber 1911

Genus I. *Myodocha* Latreille 1807

Key to Species

1. Anterior femora below with *two* rows of short stout spines, the longest spine near the middle, the shorter toward the apex; length, 11–12 mm. ..... *intermedia* Distant 1882 (Mexico.)

Anterior femora with a single row of spines, or only *one* long spine 2

2. Anterior femora with only *one* large spine far from middle, apically with a few smaller spines; (neck shorter than the pronotum; antennal segment I not or slightly passing apex of head, II shortest, III and IV subequal; length, 11 mm., width, 2 mm.) ..... *unispinosa* Stål 1874 (Colombia, S. A.)

Anterior femora with *two* large spines and several smaller ones 3

3. Antennal segment I exceeding apex of head by one-half its own length; (neck shorter than pronotum; anterior femora with two spines; length, 11 mm., width, 2.75 mm.).
giraffa Stål 1862
(Mexico.)

Antennal segment I not or but little passing apex of head 4

4. Anterior tibiae in male *not* spined; (neck as long as pronotum; anterior femore with *two* large spines behind the middle and several smaller ones apically; anterior male tibiae straight, unarmed; length, 10 mm., width 1.78 mm.)
longicollis Stål 1874
(Mexico.)

Anterior tibiae in male spined 5

5. Antennal segment IV slightly longer than III, (segment I slightly surpassing apex of head, II longest; anterior lobe of the pronotum impunctate, posterior with coarse sparse punctures; anterior tibiae in male slightly curved toward base, with a large, acute tooth; anterior femora with a few spines beyond the middle toward the apex); length, 8–9.5 mm. ..... *serripes* Olivier 1811
(= *opetilata* Say 1832
= *petiolata* auctt.)
New England west to Nebraska and Colorado, south and southwest to Texas (and Mexico).

Antennal segment IV subequal to III; length, 9–9.5 mm.
annulicornis Blatchley 1926
Florida.

Genus II. *Heraeus* Stål 1862

Key to Species

1. Length *over* 6 mm. 2

Length 6 mm. or less; (narrow, elongate, pilose; posterior lobe of the pronotum sparsely and finely punctured; scutellum sparsely and finely punctured, with an obtuse median line; length, 4.5–6 mm., width, 1–1.5 mm.) ..... *plebejus* Stål 1874
New York and New Jersey to Michigan, south to Texas and Arizona; at light.

2. Antennal segment I not passing apex of head, II, III and IV subequal; (head as long as or slightly longer than pronotum, punctured, tylus exceeding juga; both lobes of the

pronotum punctured, of equal length, posterior lobe with an elevated smooth longitudinal median line; scutellum punctured except on longitudinal apical raised line for two-thirds of its length; all femora and tibiae unarmed, nude; length, 9–10 mm.) ..... *eximius* Distant 1882
Arizona, (Guatemala).

Antennal segment I much exceeding apex of head, segments II, III and IV unequal in length 3

3. Head very finely and densely strigose-punctured; antennal segment I exceeding tylus by one-third of its own length; (scutellum rather sparsely coarsely and irregularly punctured, with a smooth V-shaped ridge); length, 7–8 mm.).
triguttatus Guérin 1857
Florida, (Cuba).

Head impunctate, minutely transversely wrinkled; antennal segment I exceeding tylus by one-half its own length; (antennal segment II longest, IV nearly as long as II; rostrum reaching to or between intermediate coxae; scutellum long, coarsely punctured, apex acute, with a smooth median line on apical two-thirds; posterior lobe of pronotum with a smooth median carina); length, 7–8 mm.
coquiletti Barber 1914 (June)
(= *nitens* Van Duzee 1914—Oct.)
California, Texas.

Genus III. *Sphaerobius* Uhler 1893

Key to Species

A. Head and anterior lobe of the pronotum with erect bristly hairs; antennal segments III and IV subequal; corium without dull white striae; length, 5–6 mm.; (anterior lobe of the pronotum very high and convex; head longer than wide, minutely granulated, pubescent, with a few erect long hairs; rostrum extended on intermediate coxae; antennal segments III and IV subequal, II longest, I extending slightly beyond apex of tylus, with a few long bristly hairs; pronotum polished, anterior lobe almost sphaeroconvex, very minutely scabrous and with a few long erect hairs, behind collum with a transverse, impressed punctured line, posterior lobe remotely coarsely punctured, incisure between lobes very deep; anterior femora incrassate, with about four short spines beneath, with remote long hairs; scutellum long and very acute, remotely punc-

tured; hemelytra punctured in lengthwise rows; venter finely sericeous pubescent, segment II with a geminate minute tubercle on each side of the middle in both sexes); length, 5–6 mm., width, 1–1.5 mm. ..... *insignis* Uhler 1872
Canada, Maine, New Hampshire, Minnesota, South Dakota, Nebraska, Colorado; on *Vaccinium pennsylvanicum.*

B. Head and pronotum *without* erect hairs; antennal segment IV one-quarter longer than III; corium with four dull white striae diverging from base and reaching beyond its middle; length, 7.5–8 mm.; (head and anterior lobe of the pronotum shining, impunctate; posterior lobe of the pronotum about one-third length and but slightly wider than anterior, its disc finely and rather closely punctured; apical half of the scutellum finely transversely rugose, punctured at sides, vaguely carinate). ..... *quadristriatus* Barber 1911
Quebec, New Jersey.

Genus IV. *Caenopamera* Barber 1918

(= *Pseudopamera* Distant 1895, in part)

This genus was erected by H. G. Barber (Journ. N. Y. Ent. Soc. XXVI: 45) to contain *Pseudopamera forreri* Distant 1893 (Biol. C. A., Rhynch I: 399, pl. 35, fig. 5). The distinctive generic characters established by its author are:

> Head slightly longer than wide, lightly exserted, very lightly and gradually contracted back of the eyes, sides of the head before eyes nearly parallel; antennae pilose, segment I incrassate, a little longer than rostral segment I, going more than one-half its own length beyond the tylus, II elongate, over twice as long as I, and longer than III and IV taken together, III a little shorter than IV; rostral segment I hardly reaching base of head, II longer than III; pronotum transversely angularly constricted, anterior lobe impunctate, much narrower and twice as long as the profusely punctured posterior lobe, and with a depressed series of punctures within the anterior margin; scutellum longer than wide, apically carinate; clavus with three irregular series of punctures; costal margin of the corium expanded and concave before the middle; posterior margin of the metapleura concave; incrassate anterior femora with two series of spines, the outer confined to the subapex; posterior tibiae with a few scattered setose hairs; posterior tarsal segment I about twice II and III taken together.

The one species is

Caenopamera forreri Distant 1893

Its characters, taken from the description and figure are:

> Head and anterior lobe of the pronotum impunctate, posterior lobe very coarsely punctured, less than one-half the anterior lobe in length; antennal segment I exceeding the apex of the head by more than one-half its own length; antennal segment II very long, I, III and IV subequal; scutellum very coarsely punctured on disc; corium finely punctured; anterior femora with four long spines; posterior tarsal segment I longer than II and III taken together; length, 5 mm.

Described from Mazatlán, Mexico; and recorded from Phoenix, Arizona, which is not to be wondered at, as the Mexican locality is some 300 miles away only, in the Sonoran region.

Genus V. *Ligyrocoris* Stål 1872

Key to Species

1. Head and pronotum *not* shining; antennal segment I short, much shorter than rostral segment I (subgenus *Ligyrocoris* Stål 1872) 7
   Head and pronotum shining; antennal segment I long, quite or nearly as long as rostral segment I; (males frequently with a tibial tooth) (subgenus *Neoligyrocoris* Barber 1921) 2
2. Anterior tibiae in males much curved and armed with a median tooth 3
   Anterior tibiae in males either straight or curved, but *without* a median tooth 5
3. Anterior lobe of the pronotum short, slightly wider than long and only a little longer than the posterior lobe; (tibial tooth nearer the apex than to the base; antennal segment IV *not* pale-ringed; head relatively short, front much inclined, eyes so placed that the postocular space is about equal to the space between the apex of the antenniferous tubercles and the eyes; anterior tibia in males much curved basally and with one stout tooth one-third of the distance from the apex; head and pronotum sparsely setose; anterior femora quite setose and almost throughout with a single series of scattered, unequal, relatively strong spines, the one or two in the middle largest); small species, 4–4.5 mm. long, 1.25 mm. wide ..... *nitidicollis* Stål 1874
   Texas, Arizona, (Mexico).

Anterior lobe of the pronotum long, longer than wide and two or three times as long as the posterior lobe; species over 6 mm. long 4

4. Anterior lobe of the pronotum nearly, but *never,* twice as long as the posterior lobe and plainly narrower; interocular space narrow, plainly *less than* twice the diameter of one eye; apex of the membrane with a pale spot; (antennal segment I shortest, II and III longest and subequal, IV a little longer than I; posterior lobe of the pronotum coarsely sparsely punctured; anterior femora strongly setose, beneath with strong spines, of which some five are very prominent; anterior tibiae quite curved at base, inwardly with a very strong spine at about middle, nearer to the base than to the apex and directed toward the apex); narrow, elongate; length, 9 mm.

aurivillianus Distant 1882
(= *Pseudopamera pseudoheraeus* Barber 1906)

Texas, Arizona, (Lower California; Tamaulipas, Mexico); under *Heliotropium.*

Anterior lobe of the pronotum *over* twice as long and fully as wide as the posterior lobe; interocular space *over* twice the diameter of the eye; apex of membrane triangularly pale; tibial tooth nearer the apex than the base; (usually brachypterous; anterior femora with two series of spines on apical one-third, the outer five spines widely separated moderately stout teeth, the inner about the same, those before the apex enlarged—Barber); head closely pubescent, with numerous long bristles, antenniferous tubercles stout and prominent; tylus acutely prominent; rostrum reaching between the middle coxae; base of head almost abruptly contracted; pronotum only moderately long, contracted into a narrow striated collum on the front margin, the anterior lobe subglobose but longer than wide, with a few scratched spots on the disc, set with a few erect bristles, posterior lobe much wider than anterior, remotely punctured, the humeri callose; anterior tibiae in the male slightly curved, with a stout tooth at the middle and with a few smaller teeth toward the apex; hemelytra coarsely and remotely punctured, costal margin widely reflexed; scutellum long, narrow, acute, remotely and finely punctured); length, 7.5 mm., width, 1.75 mm.

sobrius Uhler 1894

California, (Lower California).
(N.B.—This species described in *Cnemodus;* and so enumerated by Van Duzee).

5. Anterior and posterior lobes of the pronotum of nearly equal length, the anterior plainly wider than long, (sparsely setose); the anterior tibiae nearly straight; posterior tarsal segment I nearly three times as long as II and III taken together; (posterior tibiae with fine stiff bristles only; shining, very sparsely setose; antennae rather long, segment I extended beyond apex of head for less than one-half its own length, II one-third longer than III, IV only a little shorter than II; head nearly nude; pronotum deeply constricted just behind the middle, very sparsely setose, anterior lobe rather globose, a little wider than long, the posterior lobe sparsely punctured; posterior femora with a preapical band; anterior tibiae in male straight and unarmed; anterior femora with two series of spines toward the apex at least, the inner series of three stronger spines beyond the middle, between which are several smaller spines, the outer series near the apex of two or three minute teeth; length, 6 mm.) ..... *rubricatus* Barber 1921
Arizona, California.

Anterior lobe of the pronotum longer than wide, nearly twice as long as the posterior; anterior tibiae plainly curved; posterior tarsal segment I hardly twice the length of II and III taken together 6

6. Dorsum, antennae and legs rather *densely* setose; posterior tibiae with numerous long setose hairs between the stiff bristles; (membrane almost entirely pale; head plainly longer than wide, sides of the antenniferous tubercles nearly as long as the eye; antennal segment I longer, apex of tylus not reaching its middle point; pronotum with anterior lobe swollen and over twice as long as posterior, as seen from the side, the anterior more elevated; collar widened; dorsal surface relatively densely pilose); length, 6.5–7 mm. ..... *coloradensis* Barber 1921
Colorado.

Dorsum, antennae and legs sparsely setose; posterior tibiae hardly setose between the fine bristles; membrane triangu-largely pale at apex; (strongly curved anterior tibiae in male unarmed; teeth of anterior femora not set in a single row, the outer series with a few shorter teeth before the apex.

the inner with several irregular larger teeth, the first about one-third of the length of the femur from the base, between this and the apex five or six stout teeth, one or two of which near the middle, the largest, and those before the apex reduced in size; head long with erect bristly hairs, transversely wrinkled; rostrum reaching behind middle coxae; antennal segment I as long as II, IV and III much shorter, subequal; pronotum highly polished, anterior lobe much narrower than posterior, constricted, with some bristly hairs, with a punctate collum slightly produced posteriorly and bounded by a deep incised line; posterior lobe about twice as wide as the length of the anterior lobe, coarsely remotely punctured; scutellum remotely punctured, sparingly pubescent, ridged from the middle to the tip, which is acute; anterior femora very stout); length, 6.5 mm., width (at base of pronotum), 1.67 mm.

nitidulus Uhler 1893

Texas, New Mexico, Colorado(?), Arizona, California, (Lower California, Mexico).

7. Corium outwardly *without* a postmedian transverse fascia 8
   Corium outwardly *with* a postmedian transverse fascia 11
8. Anterior femora with an inner series of spines only; (corium with narrow costal margin pale) 9
   Anterior femora with an inner and outer apical series of spines; (corium broadly pale without the median vein; ventral lunate vitta sometimes obscured by a coating of fine hairs; head dull, very sparingly setose; antennal segment I exceeding apex of head by one-third of its own length, II longest, III and IV subequal; rostral segment I a little longer than antennal segment I, its apex reaching nearly to the base of the head; anterior lobe of the pronotum sparsely setose, very little wider than long, not twice as long as posterior lobe, which is rather finely and not closely punctate; anterior femora on the outer half with three widely separated larger spines, with several smaller teeth before and after the preapical spine; tibiae with stiff bristles only; posterior tarsal segment I very long, three times as long as II and III taken together); length, 7–8 mm.

latimarginatus Barber 1921

California, Oregon, Washington.

9. Ventral lunate vitta *not* obscured by a coating of fine hairs; posterior lobe of the pronotum generally wider than the anterior lobe; anteocular distance to apex of antenniferous

tubercles nearly equal to postocular space, but *never* twice as long; (membrane either streaked through middle or much mottled with pale) 10

Ventral lunate vitta *much obscured* by a coating of fine hairs; anterior and posterior lobes of the pronotum nearly equal in diameter; distance from eyes to the apex of the antenniferous tubercles nearly twice the postocular space; (outer basal angle and the basal veins of the membrane pale; body dull, sparsely setose; head sparsely long setose with a coating of fine impressed golden yellow hairs; antennae long, segment I extending beyond the apex of the head, II two and one-half times as long as I, III about one-third shorter than II and subequal to IV; pronotum sparsely setose, with transverse constriction shallowly obtusely impressed, anterior lobe a little wider than long, posterior lobe little wider, rather closely and finely punctured; scutellum carinate posteriorly, closely punctured along sides; anterior femora on the outer half with two series of spines, the inner of three larger ones, the first two of which just beyond the middle set closer together, the third midway to the apex, beyond this some three or four small teeth, the outer series of three or four minute teeth toward the apex; hind tibiae with some eleven bristles on each side; posterior tarsal segment I a little over twice II and III taken together; length, 7.5–8.5 mm.).

obscurus Barber 1921

Maryland, Illinois, Kansas.

10. Anterior lobe of the pronotum hardly setose, less transverse and plainly longer than the posterior lobe; antennae unusually long, segment II nearly two and one-half or three times as long as I; membrane broadly streaked with pale through the middle; (pronotum without setae, constricted well behind the middle, anterior lobe nearly twice as long and hardly narrower than the posterior, width in front subequal to the diameter of the constriction); length, 5–6 mm.

depictus Barber 1921

Massachusetts, Connecticut, New York, New Jersey.

Anterior lobe of the pronotum sparingly setose, very transverse, excluding the collar only slightly longer than the posterior lobe; antennal segment II about twice as long as I; membrane spotted with pale; length, 6.3 mm., width, 2 mm. ..... *litigiosus* Stål 1862

Florida, Arizona, (Mexico, Guatemala, Colombia).

11. Antennal segment IV pale ringed at base 12
Antennal segment IV *not* pale ringed at base 13

12. Anterior femora with only the inner series of spines; head and pronotum with long setose hairs; antennal segment II *over twice* as long as I; posterior tarsal segment I over twice as long as II and III taken together; (membrane much variegated with pale; pronotum constricted behind middle, posterior lobe sparsely punctured; dorsal parts, venter and femora with a sparse covering of long setose hairs; anterior femora with a single inner series of spines, two larger, the first before the middle, the second a little before the apex, between them three or four minute even teeth, before the preapical spine two small spines); length, 7–8 mm.
abdominalis Guérin 1857
(= *piligera* Stål 1862
=*constrictus* Uhler 1896, nec Say 1832)
Florida, Louisiana, Texas, (Mexico, Central America, West Indies).

Anterior femora with an inner series of strong spines and an outer series of small spines; head and pronotum with short setose hairs; antennal segment II about twice length of I; posterior tarsal segment I *not* twice II and III taken together; (membrane with interior veins pale); length 7 mm., width, 2 mm. ..... *multispinus* Stål 1874
(= *confraternus* Barber 1914)
Florida, (Mexico, Central America, Brazil, Venezuela).

13. Eyes *not* set midway in the head; anteocular distance to apex of antenniferous tubercles longer than or subequal to postocular distance; anterior lobe of the pronotum not narrow, *much more* than one-half the diameter of the posterior lobe; antennal segment I short, about one-half the length of rostral segment I; head, pronotum and anterior femora sparsely or hardly setose; anterior femora with a few spines toward apex; membrane not decolorous 14

Eyes set about midway in the head, postocular distance a little longer than the anteocular to the apex of the antennal tubercles; anterior lobe of the pronotum very narrow, narrower than the diameter of the head across the eyes, *nearly* one-half the diameter of the posterior lobe; antennal segment I *more* than one-half the length of rostral segment I; head and pronotum rather densely long setose; anterior femore profusely long-setose, with a row of strong

teeth in two irregular series for nearly their entire length; membrane nearly decolorous; (length, 4 mm., width, 1 mm.) ..... *setosus* Stål 1874
(= *Heraeus percultus* Distant 1881)
Texas, California, Arizona, (Guatemala).

14. Anterior femora with two or three strong spines on the outer half, preceding and following the preapical spine with two or three small teeth 15
Anterior femora with one, two or three minute preapical spines, which are sometimes reduced to mere tubercles; (head and pronotum quite pilose; length, 4 mm.).
delitus Distant 1882
Arizona, California, (Mexico, Guatemala).

15. Anterior lobe of the pronotum and anterior femora nearly or quite destitute of setose hairs 16
Anterior lobe of the pronotum and anterior femora sparsely pilose; (diameter of pronotum at collar more than at the constriction between the lobes, width of the pronotum across the humeri quite evidently wider than across the anterior lobe; anterior parts, particularly the pronotum, more obviously long-setose; dull black, minutely pubescent; head very minutely punctured, above with minute prostrate yellowish pubescence, the face with a few long erect hairs; pronotum with remote white pubescence and a few erect bristles, anterior lobe smooth, very convex, much narrower than the posterior lobe, which is remotely punctured, humeral angles smooth; scutellum remotely punctured, with whitish pubescence); length, 5.5–6.5 mm., width, 1.25–1.5 mm. ..... *diffusus* Uhler 1871
Canada south to North Carolina and west to California; on golden rod and ragweed.

16. Head piceous black; corium piceous black behind the middle, transverse fascia reaching to the margin; membrane with some pale veins and the apex conspicuously marked with a triangular white spot; anterior tibiae in male straight and unarmed; anterior lobe of the pronotum and the anterior femora nearly or quite without setose hairs; diameter of the pronotum at the collar subequal to the constriction between the two lobes; length, 5.5 mm.
silvestris Linné 1762
(= *contractus* Say 1832)
Quebec, Maine, New Jersey, Texas, Utah, British Columbia; (European); on *Vaccinium canadense*.

Head reddish-castaneous; corium pale stramineous with a broad irregular postmedian fascia *not* reaching to the margin; membrane *wholly* infuscate; (ocelli just back of the middle line of the eyes, and a trifle closer to the eyes than to the middle line of the head; apex of head reaching middle of antennal segment I, segment II two and one-half times as long as I, III two-thirds of II, IV almost as long as II; rostral segment I reaching base of head and subequal to II, III a little shorter; pronotum sparsely setose, margin narrowly carinate and shallowly constricted just back of the middle above, anterior lobe slightly longer than posterior; narrow collar distinct; anterior lobe of pronotum impunctate and very sparsely setose, a little longer than the posterior, which is finely, sparsely and irregularly punctured; anterior femora not much swollen, apical one-third with three fine teeth; scutellum punctured in center and along sides, leaving a V-shaped smooth callous area on the submargins); length, 6–6.5 mm.

slossoni Barber 1914

Florida.

Note.—*Ligyrocoris balteatus* Stål 1862 is not included in this key, since it is as yet apparently unrecognized.

Genus VI. *Orthoea* Dallas 1852

(= *Pamera* Say 1832 of authors = *Plociomera* Amyot & Serville 1843)

Key to Species

1. Head much exserted or gradually or less abruptly coarctate, especially behind the eyes; anterior lobe of the pronotum about twice as long as the posterior lobe; form very elongate; length over 5.5 mm.; (subgenus *Paromius* Fieber 1861); (head shorter than the pronotum; antennal segments II and IV subequal, III shorter; rostrum not of very slightly extended behind the midmesosternum, segment I not extended behind eyes; anterior femora beneath with two rows of short irregular spines); length, 5.7–6.8 mm.

longulus Dallas 1852

North Carolina to Florida, west to Texas, (Mexico, West Indies, South America).

Head hardly exserted, or abruptly coarctate behind the eyes; pronotum very distinctly constricted, anterior lobe *not*

over one and one-half times as long as the posterior lobe; form *not* very elongate; (subgenus *Orthoea* Dallas 1852); length less than 5 mm.; (antennal segment I exceeding head by more than one-half its own length, III gradually incrassate toward the apex) 2

2. Anterior lobe of the pronotum but little longer than the posterior lobe; (pronotum moderately constricted slightly behind the middle, anterior lobe slightly longer than the posterior, sides anteriorly converging, shining, posterior lobe deeply punctured; body above nude; head not as wide as the anterior part of the collar, shining, setose; antennae somewhat longer than the head and pronotum taken together, segment I subequal to III, II not quite as long as III and IV taken together; anterior femora below with two large teeth and a few small ones; length, 4.7–6.5 mm., width, 2–2.5 mm.) ..... *fracticollis* Schilling 1829

Montreal, Canada, (European).

Anterior lobe of the pronotum *fully* one-third or more longer than the posterior lobe 3

3. Anterior lobe of the pronotum much more than one-half (nearly twice) longer than the posterior lobe; (head minutely punctured, wider than the anterior margin of the pronotum, pronotum longer than wide and strongly constricted in the middle, anterior lobe somewhat globose, impunctate, posterior lobe wider than the anterior, rather finely punctured; anterior femora with two long spines; length, 5–5.3 mm.) ..... *servillei* Guérin 1857 (= *bilobata* Distant 1882)

Florida, (West Indies, Mexico).

Anterior lobe of the pronotum *not more* than one-half longer than the posterior lobe 4

4. Posterior lobe of the pronotum *finely* punctured 5

Posterior lobe of the pronotum *coarsely* punctured 7

5. Anterior lobe of the pronotum *one-half* longer than the posterior lobe, (transverse, widest at middle, almost smooth, with fine suberect pubescence, posterior lobe and the scutellum sparsely, rather finely punctured; anterior femora with several rows of spines on the apical half, of which three spines are larger; length. 4.2–6 mm., width, 2 mm.). *lurida* Hahn 1826

Montreal, Canada, (European).

Anterior lobe of the pronotum about *one-third* longer than the posterior 6

6. Anterior femora with *two rows* of small unequal teeth; (posterior lobe of the pronotum finely sparsely punctured, hardly or not more than one-half wider than the anterior; head subdepressed above and below); length, 4.8–5.3 mm.
bilobata Say 1832
North Carolina, Florida, Louisiana, Texas, (West Indies, Mexico, Argentine).

Anterior femora with several spines and numerous minute teeth; (anterior tibiae not or very slightly curved toward base; pronotal constriction very strong, posterior lobe minutely sparsely punctured); length, 2.8–3.3 mm.
vincta Say 1832
(= *parvula* Dallas 1852)
North Carolina to Florida and Texas; (Sonora, Mex.); (Old and New World tropics, Pacific Islands, West Indies).

7. Posterior lobe of the pronotum finely sparsely and evenly punctured, distinctly wider than the anterior lobe; anterior tibiae only slightly curved, except near base; (head thickly and minutely punctured; anterior femora below with two rows of unequal teeth; length, 3.8–5.2 mm.).
basalis Dallas 1852
Massachusetts and Connecticut to Florida and Texas, Ohio, Illinois, Michigan, Indiana, Nebraska, Kansas; injurious to strawberries, wheat and grasses.

Posterior lobe of the pronotum coarsely, rugosely and unevenly punctured, hardly wider than the anterior lobe at middle; anterior tibiae strongly curved; length, 3.7–4 mm., width, 1 mm. ..... *curvipes* Stål 1874
North Carolina to Florida and Texas, New Mexico, (West Indies).

Note.—*Orthoea vicina* Dallas 1852 and *O. dallasi* Distant 1882, are omitted in the preceding key, since the only records appear to be the original ones of Dallas, "N. Am." *Orthoea dallasi* Distant (= *O. lineatus* Dallas 1852 nec Fabricius), was stated to be "Presented by E. Doubleday, Esq." Doubleday collected in the Eastern United States. Hence this might seem to be one of the commoner United States species, so a possible synonym of something well known. In this, as in other lygaeid genera, there should be a thorough-going revision, with all extant types in hand.

Genus VII. *Zeridoneus* Barber 1918

This genus was separated by H. G. Barber (1918, Jour. N. Y.

Ent. Soc., XXVI: 45) to contain *Perigenes costalis* Van Duzee (1909, Can. Ent., XLI: 393). Its principal characters, from the original generic description are:

> Head gradually contracted back of the eyes; antennae almost nude, apex of tylus reaching beyond the middle of segment I; rostral segment I much longer than antennal segment I and about reaching the base of the head, II longer than III; bucculae extended to line across eyes; pronotum shallowly obtusely constricted just behind middle, with a distinct ringlike collar; scutellum much longer than wide, carinate throughout, more obscurely in front; costal margin of corium not concavely arcuated; posterior margin of the metapleura nearly straight; incrassate anterior femora with two or three subapical teeth intermixed with several smaller; posterior tibiae with long rigid bristles; posterior tarsal segment I fully three times as long as II and III taken together.

Its one species so far is:

Zeridoneus costalis Van Duzee 1909

The salient structural characters of this, taken from the original description, are:

> Head closely golden pubescent, frequently eroded; posterior lobe of the pronotum coarsely punctured; anterior femora with three stout spines and a few minute teeth; length, 6–8 mm.

The rest of the description is by color.

New York, Ohio; in general, the Northeastern United States and Canada.

Genus VIII. *Perigenes* Distant 1893

Key to Species

A. Antennal segment II *subequal to or shorter than* IV; anterior femora with one large spine; anterior and posterior lobes of the pronotum nearly equal; length, 5.4–6.5 mm.
similis Barber 1906

Missouri, Texas.

B. Antennal segment II *longer* than IV; anterior femora with one strong spine and a smaller one toward the apex; anterior lobe of the pronotum impunctate and *longer* than the posterior lobe; (antennal segment I shortest, II longest, III one-quarter shorter than II, IV a little longer than III;

rostrum reaching intermediate coxae; legs polished, densely set with long fine hairs and with a few remote spines on the tibiae; tarsal segment I about twice the length of II and III taken together); length, 5–8 mm.

constrictus Say 1832

Ontario, New York, Michigan, District of Columbia, Missouri, Texas, California.

Genus IX. *Tomopelta* Uhler 1893

This genus was described by Uhler from St. Vincent, British West Indies (Proc. Zool. Soc., p. 708), the salient structural characters he gives being:

Robust, oval, with both ends narrowed, opaque and pubescent above; head short, set in as far as to the eyes, small, narrow, acutely triangular above; antennae stout, about as long as the head, pronotum and scutellum united, segment I longer than the head, II a little longer than III and subequal to IV, all conspicuously pubescent; rostrum reaching between the middle coxae, segment I as long as the throat; pronotum with two distinct lobes, broad, the anterior lobe much wider than the head, longer than the posterior lobe, collar-like, the lateral margin reflexed following the curve of each lobe; prosternum with an uneven longitudinal ridge on each side of the middle line, pleural pieces polished, coarsely punctured; anterior femora fusiform, compressed; scutellum longer than wide, abruptly acute at the tip; hemelytra coarsely punctured, pubescent, dull, costal margin almost straight and parallel, slightly sinuate at middle, costal area wide and grooved; veins of the membrane long and curved.

Blatchley records from the United States the one species in the genus.

Tomopelta munda Uhler 1893

The structural characters given by its describer are:

Pubescent, punctured all over the upper surface and the pectus; anterior lobe of the pronotum less distinctly punctured than the posterior and with lateral margin almost straight, posterior lobe coarsely punctured, humeral angles prominent, a little rounded, the transverse line separating the lobes deep, indented at the outer ends, and with a minute pit in the middle; scutellum apically carinate; beneath polished, especially the

venter; legs hairy, punctured; hemelytra minutely pubescent, remotely punctured; length, 2–3 mm., width, 0.75 mm.
Florida (Blatchley); (St. Vincent, B. W. I.).

Genus X. *Ptochiomera* Say 1832

H. G. Barber, in his revision of the *Ptochiomera* complex, attributes only one species to this, the type genus. Say did not describe the genus; he merely indicated it as a subgenus of his inclusive *Pamera* (1832, Descriptions of New Species of Heteropterous Hemiptera of North America, Complete Writings, I: 335). At best, the only characterization of this genus is in Stål's Key (En. Hem., IV: 144), thus:

> Hemelytra strongly punctured, clavus regularly punctate in three series; body less long (than *Pamera* preceding), oblong or hardly elongate; scutellum, especially behind the middle, with a callose obtuse longitudinal carina.

The one species referred to the genus by Barber is:

Ptochiomera nodosa Say 1832 (= *clavata* Dallas 1852)

Say's complete description follows:

> "Two ultimate joints of the antennae thick; thorax constricted behind the middle. . . . Inhabits United States.
>
> "Body piceous-black; antennae yellowish, two ultimate joints equal, dilated, blackish; second joint not longer than third; thorax behind the middle constricted, particularly to the lateral edge; behind the stricture dull yellowish, punctured; scutel with a yellow carina; hemelytra shorter than the abdomen, pale yellowish, punctured; membrane obsolete; wings imperfect; rostrum and feet honey-yellow, anterior thigh a little thicker than the others, with a few small spines beneath; anterior tibiae a little ciliated at tip; a small spine on the anterior coxae.—Length about one-tenth of an inch.—Var.a. All beneath honey-yellow."
>
> Massachusetts south to Florida and west to Missouri, Kansas and Texas.

Genus XI. *Carpilis* Stål 1874

Key to Species

A. Antennal segments I to IV strongly incrassated, III one-half of I; humeral angles pale; brachypterous only; (oblong-oval; antennae relatively stout, as long as the head and

pronotum taken together, segment I stout, subcylindrical, exceeding tylus by one-half its own length, II subclavate, twice length of IV and three times III, III and the apical half of II about as stout as IV; anterior lobe of the pronotum minutely punctured, posterior lobe rather coarsely rugulose-punctured, posterior angles strongly nodulose; scutellum sparsely punctured, preapical median carina very fine; corium and clavus hardly differentiated—brachypterous; anterior femora strongly incrassate, with two rows of fine subequal teeth beneath; anterior tibiae of males at apical fifth beneath with an acute tooth); length, 2.8–3 mm. ..... *barberi* Blatchley 1924

Florida.

B. Antennal segments II and III not so strongly incrassate as I and IV, III shorter than I; humeral angles concolorous; pterygodimorphic; (head nearly as long as wide, immersed to the eyes; antennae hardly longer than half the length of the body, somewhat stout, segments I and IV of nearly equal length, II one-half longer than I and II, nearly twice as long as III; pronotum lightly constricted far behind middle, anterior lobe hardly transverse, gradually narrowed before the middle, slightly narrower apically than the head with the eyes, posterior lobe punctured; scutellum punctured, ruga behind middle levigate; clavus and corium connate—brachypterous; anterior femora somewhat long, quite incrassate, beneath with several quite large spines in two series); length, 3 mm., width, 1 mm. *ferruginea* Stål 1874

Maine, New York, Texas.

Genus XII. *Sisamnes* Distant 1893

Key to Species

A. Antennae distinctly clavate, segment II obviously shorter than III; anterior tibiae in male unarmed; only brachypterous known; (head thick, abruptly contracted at tip, closely punctate, clothed with bronze pubescence; rostrum thick, reaching between the anterior coxae; antennae pubescent, segments III and IV long, very thick, clavate, I thick, hardly longer than tylus, II much shorter, more slender, growing thicker toward the tip; pronotum thick, a little longer than wide, anterior lobe nearly as long as posterior, the two separated each side by a deeply incised line, lateral

edge reflexed, a very little curved; collum distinct, middle of posterior margin of pronotum indented, humeral angles callose; scutellum punctured, the apex with a long thick carina; hemelytra thick, opaque, coarsely punctured in somewhat longitudinal lines, the broad apex almost truncated; abdomen closely punctured, with minute bronze pubescence; connexivum wide, sharp edged; anal segment of male large and prominently convex); length, 2.5–2.8 mm., width, 0.75 mm. ..... *clavigera* Uhler 1895
New York, New Jersey, Kansas, Missouri, Nebraska, Utah, Colorado, Texas; under boards and stones.

B. Antennae *not* very distinctly clavate, segment II longer than III; anterior tibiae in male with a preapical tooth; (wholly quite densely pilose; anterior tibiae straight in male; apical segments of the antennae not incrassate; anterior lobe of the pronotum nearly twice as long as the posterior lobe, nearly wider than the head, anteriorly narrowed, posterior lobe distinctly punctate; scutellum and hemelytra somewhat obsoletely punctured; anterior femora moderately incrassate, beneath behind middle with several very distinct spines); length, 2.75 mm., width, 1 mm.
puberula Stål 1874
(= *antennata* Van Duzee 1901
= ?*Sisamnes contracta* Distant 1893)
Florida, Texas, Arizona, Colorado, (Guatemala).

Genus XIII. *Exptochiomera* Barber 1928

Key to Species

1. Anterior femora armed beneath with a single series of fourteen to fifteen minute uniform spines; antennal segment I hardly exceeding apex of head; length 2.56 mm.
nana Barber 1932
Massachusetts.

Anterior femora beneath with a single series of three or four usually unequal spines; antennal segment I much exceeding apex of head 2

2. Anterior tibiae in male unarmed, straight; head and pronotum nude, subshining; pronotum dorsally not strongly constricted between the anterior and posterior lobes; anterior femora below with a series of three or four spines 3

Anterior tibiae in male more or less curved, with *a* preapical spine; head and pronotum tomentose or sericeous; pro-

notum dorsally rather strongly contracted between the two lobes; anterior femora armed below with a double series of three or four spines 4

3. Anterior femora with a row of three short spines; antennal segment II twice III; head and pronotum each one-third wider than long; humeral angles concolorous; length, 3.25 mm., width, 1 mm. ..... *fuscicornis* Stål 1874
Texas, Arizona.

Anterior femora with a row of four short spines; antennal segment II *not* twice III; head but slightly wider than long; pronotum about three-sevenths wider than long, humeral angles pale; length, 3.6 mm. ..... *arizonensis* Barber 1932
Arizona, New Mexico.

4. Costal margin strongly concavely sinuate before middle; head and pronotum densely tomentose, with numerous long semi-erect hairs; anterior lobe of pronotum strongly inflated dorsally; length, 4 mm. ..... *formosa* Distant 1882
Texas, Arizona, (Mexico, Central America).

Costal margin slightly concave-sinuate before the middle; head and pronotum sericeous *without* long hairs; anterior lobe of the pronotum commonly not strongly inflated dorsally 5

5. Antennal segment IV but little longer than I; disc of anterior lobe of pronotum coarsely and closely punctate, lateral margins from above gently rounded; transverse stricture between lobes less obvious, nearly twice as wide as anterior margin; length, 4.4 mm. ..... *intercissa* Barber 1932
Florida, (Cuba).

Antennal segment IV longer than I; disc of anterior lobe of the pronotum sparsely finely punctate, lateral margins from above strongly rounded, transverse stricture strongly impressed, its diameter more nearly equal to that of the anterior margin 6

6. Head and pronotum sparsely sericeous, shining; pronotum one-quarter wider than long; antennae twice the length of the pronotum, I–32, II–64, III–40, IV–60 (figures are .01 mm.); length, 4.36 mm. ..... *minima* Guérin 1857
Florida, Louisiana, Texas, (Mexico, West Indies).

Head and pronotum more densely sericeous, dull; pronotum two-fifths wider than long; antennae plainly *not* twice length of pronotum, segment I–28, II–56, III–36, IV–52 (figures are .01 mm.); length 3.64 mm. ..... *oblonga* Stål 1862
Texas, (Mexico, Central America, West Indies).

Note.—This is Barber's key, slightly changed verbally and with sizes added.

Genus XIV. *Valonetus* Barber 1918

This is another monotypic genus, the chief structurel characters of which are, from Barber's original description (see Bibliography):

> Body, antennae and legs strongly pilose, not shining; head lightly exserted, a little wider than long, width across the eyes subequal to the anterior submargin of the pronotum; antennal segment I shorter than rostral segment I, well extended beyond the apex of the tylus; bucculae lightly elevated, running to base of head; rostral segment I reaching base of head; pronotum without a collar, obtusely constricted just behind the middle, lateral margins obtuse, terete, anterior lobe finely and obscurely punctate, posterior lobe wide and more coarsely and sparsely punctured; scutellum equilateral; clavus with three regular rows of punctures; anterior femora incrassate and with three or four subapical teeth, pilose throughout; posterior tibiae short-pilose, posterior tarsal segment I longer than II and III taken together.

The one species in the genus, and necessarily the type, is:

Valonetus pilosus Barber 1918

Structural characters from the original description are:

> Head triangular, eyes strongly protruding; antennal segment I extending beyond the tylus by nearly one-half of its own length and subequal to II, which is slightly shorter than II, IV subequal to III; posterior lobe of the pronotum more sparsely and coarsely punctured than anterior; scutellum sparsely punctured, apically carinate; clavus with three regular rows of punctures; commissure about one-half the length of the scutellum; corium sparsely punctured, costal margin very lightly expanded and convexly rounded; length, 3 mm.

Described from three specimens from Texas, so glued that the sex was indeterminable.

(*To be continued*)

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ENTOMOLOGICA AMERICANA

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A SYNOPSIS OF THE HEMIPTERA-HETEROPTERA OF AMERICA NORTH OF MEXICO

BY J. R. DE LA TORRE-BUENO

Family XI—Lygaeidae

(*Continued from vol. XXVI, no. 2, p. 88*)

Genus XV. *Neosuris* Barber 1924

(= *Esuris* Barber 1918, nec Stål)

KEY TO SPECIES

A. Head closely coarsely punctured; antennal segment II slightly longer than III; both lobes of the pronotum coarsely and closely punctured; incrassate anterior femora with three or four small teeth beneath; (head large, rather thickly greyish-hirsute, about as wide as the pronotum at the posterior margin, closely and coarsely punctured, anteriorly very declivous, the tylus almost vertical, with two long setae set next the eyes on the lateral margins of the head; antennae short setose, segment I reaching the apex of the head, II and IV subequal, III a trifle shorter; rostral segment I nearly reaching base of head; pronotum without a collar, anterior margin straight, whole surface coarsely and closely punctured, finely greyish hirsute, the posterior margin almost straight across, pronotum a trifle wider at the widest part than long, obtusely and very shallowly constricted one-sixth of its length from the posterior mar-

gin, anterolateral margins lightly carinated; scutellum equilateral, closely and finely punctured; hemelytra wider than the pronotum or abdomen, the very narrow lateral margins slightly *deflexed,* at least anteriorly, over the connexivum, with small closely set punctures in rows, each puncture with a minute grey hair; line of meeting of the hemelytra straight, almost twice as long as the scutellum; pleural pieces finely and rather closely punctured); length, 2 mm. ..... *castanea* Barber 1911
Colorado, Arizona; under dried cow-chips.

B. Head finely punctured; antennal segment II one-third longer than III; disc of anterior lobe of the pronotum impunctate; incrassate anterior femora with two or three *minute* teeth; (very shining; head triangular, a little wider than long, as wide across the eyes as the anterior submargin of the pronotum, finely punctured; antennae finely pilose, segment I short, shorter than rostral segment I, hardly passing tylus, II one-third longer than III, IV nearly as long as II; rostral segment I reaching base of head, II much longer, a little longer than III; pronotum a little longer than wide, parallel-sided, very lightly constricted near the posterior margin, disc of anterior lobe impunctate, posterior margin straight; scutellum wider than long, very finely punctured, *not* carinate; incrassate anterior femora with two or three minute median teeth; anterior tibiae lightly curved); length, 2 mm. ..... *fulgidus* Barber 1918
Arizona, California.

Genus XVI. *Kolenetrus* Barber 1918

This monotypic genus was set up by H. G. Barber to take in *Rhyparochromus plenus* Distant 1882 (Biol. Cent. Am., Rhynch., I: 216, pl. XIX, fig. 23). The former says that by the character of the lateral margin of the pronotum, the genus should be referred to the Tribe Myodochini, close to *Ptochiomera* Say. The following characters, additional to those in the key, are from the original description of the genus:

Shining, the punctures set with fine incumbent hairs; head lightly transverse, across the eyes wider than the anterior margin of the pronotum and subequal to the anterior rounded submargin, coarsely and closely punctured; antennae very short pilose, segment I rather short, extended but little beyond apex of tylus, II and III subequal; pronotum a little longer than

wide, strongly constricted behind the middle, margin obtuse, terete, both lobes closely punctured, disc of anterior more sparsely, anterior margin straight, without a collar, posterior margin lightly concave, humeral area nodosely elevated; scutellum longer than wide, posteriorly obtusely carinate, otherwise punctate; clavus with three regular rows of punctures; corium closely punctured, without a median vein, costal margin anteriorly lightly concave; incrassate anterior femora in the male with one stout post-median tooth, in female with two smaller teeth; anterior tibiae straight, posterior tibiae almost nude, shortly pilose apically; posterior tarsal segment I slightly longer than II and III taken together; venter finely and closely punctured, with a coating of fine incumbent hairs.

The one species is

Kolenetrus plenus Distant 1882

As always with this author, the specific description is short and largely by color. The few structural characters given are:

Pronotum coarsely punctured, more prominently on the posterior lobe; scutellum very coarsely punctured, with an impunctate central carinate line; membrane much abbreviated (the figure shows a subbrachypterous form—J. R. T.-B.), not reaching the apex of the abdomen; antennae pilose, segment II subequal to or a litte longer than IV, III longer than I, but shorter than II or IV; length, 3 mm.

From the figure cited above, we see:

Head with eyes narrower than the pronotum in front; antennal segment I not passing the apex of the head and about one-half the length of II; posterior lobe of the pronotum about one-half the length of the anterior, the pronotum at the humeri as wide as long; all femora not greatly swollen, apparently unarmed.

The last character contradicts the generic description of Barber, and is a commentary on the reliability of figures for the purpose of determining species, or as an aid in their determination.

Described from Guatemala, Central America; and recorded by Barber from Massachusetts, Connecticut, New York and Arizona, a very widespread distribution indeed.

Genus XVII. *Cnemodus* Herrich-Schaeffer 1853

(Posterior lobe of the pronotum *not* wider than anterior lobe)

1. Femora and tibiae *without* abundant long hairs, except the femora sometimes with a few scattered hairs 2

Femora and tibiae *with abundant* long erect hairs; (disc of pronotum finely and sparsely punctured; length, 7–8 mm.). *hirtipes* Blatchley 1824
Florida.

2. Rostrum reaching to *intermediate* coxae; anterior lobe of the pronotum *but little* wider at middle than the posterior lobe; length, 8–9 mm. *mavortius* Say 1832
New England west to Missouri, and south and west to Florida and Texas.

Rostrum reaching *anterior* coxae; anterior lobe of the pronotum *much* wider at middle than the posterior lobe; length, 8–9 mm. ..... *inflatus* Van Duzee 1915
North Carolina, Indiana, Missouri.

N. B.—The last is treated by Blatchley as a variety of *C. mavortius* Say, but is easily separable by the above characters, which are valid for species in other genera.

Genus XVIII. *Pseudocnemodus* Barber 1911

(= *Pterotmetus* Provancher 1886 nec Amyot & Serville 1843)

H. G. Barber characterized his genus thus (Journ. N. Y. Ent. Soc., XIX: 25) for his new species *P. bruneri* (op. cit., p. 26), which later was found by him to be *Pterotmetus canadensis* Provancher (1886, Pet. Faune Ent. Can., III: 84). Barber's generic description in full is:

> "Very similar to and with many of the characters of *Cnemodus* H. Schf., from which it chiefly differs by the presence of ocelli; postocular margins of the head more swollen; collar of the pronotum narrower and not so sharply demarked; posterior lobe of the pronotum wider than anterior; fore femora more incrassate; fore tibiae in the male above spine nearly straight, with the spine nearer the apex than the base of the tibia; middle femora of the males provided with four or five strong teeth; anterior lobe of the pronotum punctate; head and pronotum with a few long setae; posterior margin of the pronotum not so sinuated above the base of scutellum."

The one species in the genus is

Pseudocnemodus canadensis Provancher 1886 (= *bruneri* Barber 1911)

Provancher's specific description is nearly wholly by color. The following structural characters of the species are taken from Barber's dscription of *bruneri:*

Head closely punctate, not pubescent but provided with long setae, swollen postocular part distinctly wider across than the collar of the pronotum, apex almost reaching the middle of antennal segment I; antennal segment I about two-thirds length of II, III apically thickened, about three-quarters length of II, IV a trifle longer than III; rostral segment I reaching nearly to base of head; collar of pronotum short and not sharply demarked, closely punctured, anterior lobe shining with scattered punctures on disc, a little longer than wide and about two-and-one-half times longer than posterior lobe, which is more closely punctured and wider than the anterior lobe, humeral angles callosed, smooth; scutellum not closely punctured, apex acute and with apical half distinctly carinate; corium wider than abdomen, not closely punctured except without the exterior vein, not very shining, the wide costal margin strongly reflexed, impunctate; venter shining, with very fine hairs on the disc; anterior femora shining, with two rows of five or six large equidistant spines, with a few minute ones nearer apex; anterior tibial spine of male nearer apex than base of tibia; middle femora of male with three or four stout, acute teeth; precoxal tooth acute, horizontal; posterior femora unarmed; length, male, 5.5 mm., female, 6 mm.
Quebec, Ontario, British Columbia, New York, Connecticut, New Jersey, Nebraska, Kansas, North Carolina; probably widespread throughout the northern part of America.

Tribe 3. *RHYPAROCHROMINI* Stål 1872

Key to Genera

1. Anterior margin of the pronotum with a distinct ring-like collar, behind which is a depressed series of punctures, lateral margins strongly keeled or lightly expanded and reflexed, pronotum distinctly separated into two lobes by an obtuse constriction just before the middle; head not transverse, exserted, usually contracted back of the eyes, space between the antenna and the eye usually subequal to the postocular space; antennal segment I stout and long, apex of tylus not reaching the middle of the segment; rostral segment I reaching base of head, longer than antennal segment I; clavus irregularly punctured; anterior femora elongate, *not* strongly incrassate, armed below with three or four equidistant spines; posterior tibiae with short

rigid bristles; macropterous; (to include genus *Balboa* Distant) ..... I. *Ozophora* Uhler 1871

Anterior margin of the pronotum *without* a ring-like collar, at most faintly impressed or provided with a series of punctures within; head transverse, not or very slightly exserted; lateral margins of the pronotum sometimes carinate, but usually merely longitudinally impressed within the lateral margin of the propleura; posterior tibiae *without* rigid bristles 2

2. Pronotum with lateral margins strongly carinate and *reflexed,* lightly transversely impressed just behind middle, both lobes punctured, posterior margin straight; head short, wide, slightly exserted, suddenly and strongly contracted behind eyes; rostral segment I shorter than head, subequal to antennal segment I; scutellum subequilateral, equal to length of commissure; anterior femora incrassate, with numerous small teeth; anterior tibiae strongly curved; posterior tibiae nude; only macropterous known.

II. *Tempyra* Stål 1874

Lateral margins of the pronotum lightly keeled and not reflexed nor acute, or only linearly impressed within the lateral margins of the propleura; head not or very lightly exserted 3

3. Pronotum distinctly transverse; lateral margin lightly carinate; scutellum much longer than wide, a little longer than pronotum, posteriorly pale bivittate; dorsum dull, not pilose; anterior femora incrassate, with three or four strong and several smaller teeth almost for their entire length; clavus with three rows of punctures, the middle series abbreviated; macropterous only ..... III. *Peritrechus* Fieber 1861

Pronotum *not* distinctly transverse, as long as wide, or longer than wide; scutellum a little longer than wide, *not* pale bivittate 4

4. Third ventral suture straight and reaching to the lateral margin of the abdomen; head with eyes distinctly narrower than the width of the anterior margin of the pronotum; pronotum with lateral margins more or less strongly keeled, with the impunctate anterior lobe as wide as or wider than the much shorter posterior lobe; scutellum subtransverse; clavus broad, not deflected to the corium, sometimes connate with the corium, membrane usually abbreviated or wanting; only brachypterous known.

IV. *Plinthisus* Fieber 1861

Third ventral suture curved anteriorly and *not* reaching the lateral margin; head across the eyes as wide as, or usually wider than, the anterior margin of the pronotum, very frequently as wide across as the rounded submargin 5

5. Pronotum with *both* lobes very distinctly and closely punctured, lateral margins evidently carinate 6

Pronotum with the anterior lobe impunctate, or the disc of the anterior lobe only impunctate, lateral margins either very finely carinate, or with the propleura linearly impressed longitudinally; (scutellum equilateral) 8

6. Anterior femora armed; scutellum equilateral.
V. *Rhyparochromus* Curtis 1836

Anterior femora unarmed; scutellum wider than long 7

7. Lateral margins of the pronotum more strongly carinate; eyes more projecting; pronotum and hemelytra not pilose; clavus with three rows of punctures.
VI. *Acompus* Fieber 1861

Lateral margins of the pronotum narrowly carinate; eyes less projecting; pronotum and hemelytra pilose; clavus with four rows of punctures.
VII. *Stygnocoris* Douglas & Scott 1865

8. Anterior femora strongly incrassate, armed; larger species, over 3 mm. long ..... VIII. *Thylochromus* Barber 1928

Anterior femora very lightly incrassate, armed or not; very small species, less than 3 mm. long 9

9. Hardly shining; form short and broad; pronotum *not* strongly transversely constricted to form two lobes, anterior disc impunctate; lateral edge very narrowly carinate; rostral segment I (in U. S. species) shorter than antennal segment I ..... IX. *Antillocoris* Kirkaldy 1904
(= *Pygaeus* Uhler 1894)

Somewhat shining; pronotum rather strongly transversely constricted, the anterior lobe impunctate, the lateral edge linearly impressed within the lateral margin of the propleura; rostral segment I subequal to antennal segment I; (inner apical margin of the corium sinuate) (*Salacia delineata* Distant ..... X. *Cligenes* Distant 1893
(= *Salacia* Stål 1874)

Genus I. *Ozophora* Uhler 1871
(= *Davila* Distant 1893 = *Peggichisme* Kirkaldy 1904)

Key to Species

1. *At least* one pair of femora setose 2
   No femora setose 3
2. *All* femora with long erect setae; (rather narrow, elongate; head rather sparsely setose, gradually constricted behind the eyes, apex not quite reaching middle of antennal segment I; ocelli vitreous, as far from each other as from the eyes, on a line with the posterior margin of the eyes; antennal segment II one and one-half times length of I, III two-thirds of II, IV nearly as long as II; apex of rostral segment I reaching the base of the head and subequal to II, III a little shorter; pronotum sparsely setose, lateral margins narrowly carinate and shallowly constricted at middle but dorsally, anterior lobe slightly shorter than posterior lobe, narrow collar distinct, anterior lobe impunctate, posterior lobe finely and rather evenly punctured; episternum anteriorly and propleura behind the stricture punctured; legs with all femora with long setae, anterior not much swollen, with about three teeth in the apical one-third; scutellum punctured in the center and along the sides, leaving a V-shaped smooth calloused area submarginally); length, 6–7 mm. ..... *trinotata* Barber 1914
   Florida; from ferns.

   Posterior femora only with sparse setae; (from figure—antennal segment II longest, slightly longer than IV, III shorter than either; anterior and posterior femora spined, posterior and intermediate tibiae sparsely setose); length, 5–7 mm. ..... *concava* Distant 1893
   Florida, Arizona, (Mexico, Guatemala, Panamá).
3. Upper surface pubescent; (length 6–6.5 mm.). *burmeisteri* Guérin 1857
   Florida, Texas, (Cuba); on *Rhizopora mangle.*

   Upper surface glabrous 4
4. Disc of anterior lobe of pronotum impunctate 5
   Anterior lobe of pronotum more or less punctured 6
5. Antennal segment II more than twice as long as I; rostrum reaching nearly to middle of ventral segment II; pronotum with lateral margins *merely carinate;* (head one-seventh longer than wide, apex reaching nearly to middle of antennal segment I; ocelli a little over twice as far from each other as from the eyes; antennae one-fifth shorter

than the body, segment II over twice length of I, III and IV subequal, each about one-quarter shorter than II; rostrum reaching nearly to middle of ventral segment II, segments I and II subequal, III one-quarter shorter than II, IV about one-half length of III; pronotum a little shorter, than the head, one-third wider than long, rather lightly obtusely constricted before the middle, with the anterior lobe about twice the length of the posterior lobe, lateral margins merely carinate, neither expanded nor reflexed, disc of anterior lobe smooth, a line of fine punctures along the depressed anterior margin and also along the lateral margins and down the center of the disc, posterior lobe well over twice as wide as long, rather closely punctured; scutellum one-fifth longer than wide, with a double series of fine punctures along the margins, more sparsely punctured on the flattened disc, a submarginal calloused streak along each margin coalescing before the apex, which is smooth and pale; clavus with an inner and outer regular row of fine punctures, irregularly punctured within; commissure a little shorter than the scutellum; corium sparsely punctured, costal margins rather widely expanded and recurved; venter nearly smooth, anterior femora lightly incrassate, below with four equidistant small setigerous spines); length, 7.5 mm., width, 1.9 mm.

depicturata Barber 1928

Arizona, California; in *Neotoma* nests.

Antennal segment II *almost* twice the length of I; rostrum reaching intermediate coxae; lateral margins of the pronotum widely reflexed; (head impunctate; ocelli set closer to the eyes than to the middle point of the vertex; antennae nude, segment II very long, almost twice length of I, III one-third shorter than II, IV a little shorter than III; rostral segment I reaching the base of the head, and subequal to antennal segment I and a little shorter than rostral II, which in turn is one-third longer than III; pronotum with a series of punctures behind the depressed anterior margin and within the widely reflexed lateral margins, posterior lobe rather closely punctured, anterior lobe with impunctate disc; scutellum with the central disc punctured and depressed, posterior to which it is obtusely carinate; clavus broad, with numerous punctures, not in regular rows; costal margin of the corium rather widely expanded

and reflexed, its edge not concavely arcuated; anterior femora with four equidistant sharp spines on the apical half; posterior tibiae with rigid bristles; posterior tarsal segment I twice the length of II and III taken together); length, 8.5 mm., width, 3 mm. ..... *ampliata* Barber 1918
Arizona.

6. Anterior lobe of the pronotum almost impunctate; (head densely punctured on the midline, front and near eyes finely so; anterior lobe of the pronotum impunctate, collar raised, lateral margins raised, posterior lobe coarsely remotely punctured, humeral angles smooth, wider than long; scutellum remotely punctured; hemelytra punctured in oblique lines); length, 6–6.5 mm.

picturata Uhler 1871
(= *consanguinea* Distant 1893)

New England west to Indiana, and south and west to Florida, Texas, Arizona.

Anterior lobe of the pronotum finely or coarsely punctured 7

7. Anterior tibiae *without* spines or bristles; (upper surface coarsely punctured; clavus most thickly so, corium most sparingly so; anterior femora only spined; posterior and intermediate tibiae without hairs); length, 4–5.8 mm.

pallescens Distant 1893

Florida, (West Indies); from thistles, Spanish moss and ferns.

Anterior tibiae *with* spines or bristles, or both 8

8. Rostrum reaching to posterior coxae; (broader than common, almost flat on the posterior lobe of the pronotum; head short, strongly convex, with a broadly grooved middle line, the raised surface on each side bounded by an impressed line and opening more widely behind, general surface dull, indistinctly pubescent and not distinctly punctured; antennae stout, segments II and III long, subequal, IV a little shorter, I stout, closely pubescent; anterior lobe of the pronotum about one-half length of posterior, sides curving anteriorly and the margin sharply reflexed, callosities impunctate, moderately tumid, with an indented spot between and the surrounding surface punctured, collum contracted, distinct, posterior lobe distinctly not closely punctured, the lateral margins curved and expanding posteriorly, a little contracted next to the anterior lobe, edge strongly reflexed, humeral callosities long, posterior margin

a little waved; scutellum mostly impunctate, but closely punctured exteriorly; anterior femora long and straight, with but a few slender spines; anterior tibiae long, straight, slender, with long spines and bristles and with two stout spines at tip; corium punctured in lines, the clavus and the costal areole more deeply and coarsely punctured, the costal margin to beyond the middle); length, 8–8.5 mm., width, 2–2.5 mm. ..... *unicolor* Uhler 1894 California, (Mexico).

Rostrum reaching to ventral segment II; (pronotum *not* wider at base than long, strongly constricted near middle, lateral carina very obtuse, evident only on basal half, transverse convexity of anterior lobe interrupted at middle, anterior lobe narrow, subglobose, posterior lobe distinctly and deeply punctured; anterior femora with *two* preapical spines; costal margins of the corium feebly sinuate at basal one-third); length, 5–6 mm. ..... *reperta* Blatchley 1924 Florida.

Genus II. *Tempyra* Stål 1874

In this genus we have thus far one contained species, both described by Stål (En. Hemip. IV: 155). The generic characterization following is that of its author augmented from Blatchley:

Head narrower than either lobe of the pronotum; all ventral sutures distinct; anterior femora below very distinctly spined; antero-lateral margins of the pronotum strongly rounded anteriorly; pronotum entirely somewhat strongly punctured, middle lightly transversely impressed, apex with a narrow depressed collar, lateral margins wholly narrowly depressed, slightly acute, at middle lightly sinuate, posterior margin close to sides longitudinally subimpressed; prostethium densely and strongly punctured; head somewhat short; bucculae carinate-elevated and extending along the entire gula; antennal segment I slightly exceeding apex of head, somewhat shorter than III; eyes globose, somewhat small; scutellum slightly longer than wide, hardly longer than the commissure; hemelytra posteriorly subampliate, costal margin acute, reflexed; clavus with three rows of punctures, the middle one confused and not quite doubled; anterior femora incrassate, below armed with many unequal spines; rostral segment I shorter than the bucculae, subequal to antennal segment I (Stål); oblong oval; antennae short, stout, segment I slightly passing apex of head,

II twice III, IV fusiform, shorter than the others; pronotum subtrapezoidal, transverse impression feeble, anterior lobe convex, lateral margins slightly sinuate near middle; rostrum reaching mid-mesosternum, segment I subequal to antennal segment I (Blatchley).

The one species in the genus is

Tempyra biguttula Stål 1874

briefly described thus by the author:

Subshining above, sparsely setose, the hemelytra also; venter shining impunctate; head punctured; oblong oval; anterior lobe of the pronotum finely and densely punctured, posterior more sparsely and coarsely; scutellum hardly as long as the commissure, thickly punctured and with a vague carina on the apical half; length, 3–3.2 mm., width, 1 mm.

Maryland, Texas.

Genus III. *Peritrechus* Fieber 1861
(= *Passatus* Stål 1872)

Key to Species

1. Anterior lobe of the pronotum *impunctate,* pronotum almost twice as wide as long; (head transverse, as wide across eyes as the anterior margin of the pronotum; antennae finely pilose, segment I short, barely exceeding the apex of the tylus, II one-third longer than III, IV almost equal to II; rostral segment I reaching base of head, II only slightly longer than III; pronotum very transverse, almost twice as wide as long, anterior lobe impunctate, about equal in length to punctured posterior lobe, anterior margin very lightly arcuate, almost straight, lateral edge carinate, margins almost straight and gradually converging, abruptly rounded behind the eyes; scutellum longer than wide, finely and sparsely punctured on the disc behind the middle, coarsely punctured on sides of the apical part; clavus with four irregular series of punctures, the two inner confused and abbreviated; corium, except for the central discal spot and the costal margin anteriorly, rather closely and evenly punctured; anterior femora with a short median tooth, another larger midway between this and the apex, followed by two or three smaller toward the apex; anterior tibiae gently curved; posterior tibiae with two rows of short setose bristles, especially toward the apex; posterior

tarsal segment I almost equal to II and III taken together; venter very finely and closely punctured and clothed with fine incumbent hairs); length, 5 mm.

saskatchewanensis Barber 1918

Saskatchewan, California, Utah.

Anterior lobe of the pronotum punctured, pronotum much less than twice as wide as long 2

2. Anterior lobe of the pronotum noticeably narrower than width of head across eyes; (elongate-oval, with very fine pale pubescence; head subshining, remotely punctured, about as long as wide across eyes, apex reaching just beyond middle of antennal segment I; antennae rather thickly coated with fine hairs, segment II about twice as long as I, III about one-third shorter than II, IV subequal to II; apex of rostrum reaching between midcoxae; anterior lobe of the pronotum finely and very sparsely punctured, a cluster of punctures back of the collum, posterior lobe rather evenly and profusely punctured, pronotum contracted anteriorly, its width just back of the rounded anterior angles very obviously less than the width of the head across the eyes, lateral margins slightly sinuate just back of the middle point; sternum sparsely punctured; incrassate; anterior femora with a short tooth—sometimes absent—midway between which and the apex is a longer tooth; scutellum rather sparsely punctured posteriorly; venter shining black, very minutely punctured and with a rather dense coat of incumbent pale hairs; length 5–6 mm.).

paludemaris Barber 1914

Massachusetts, New York, Maryland, Florida.

Anterior lobe of pronotum not noticeably narrower than the head across eyes, widths equal or subequal, or pronotum wider 3

3. Antennal segments III and IV subequal; (elongate-oval, very slightly convex; head finely remotely punctured above and below, face pubescent, with some erect long hairs about apex; rostrum reaching beyond the mesosternum; pronotum wide, the transverse impression very ill-defined, but more distinct at the ends, lateral reflexed margin decurving anteriorly to meet the middle of the eyes, surface dull with remote prostrate pubescence, posterior lobe with remote coarse punctures; pectus dull black, the pleura remotely obscurely punctured; venter black, polished, closely

punctured, minutely pubescent; length, 5 mm. (4.3–5 mm. —Blatchley), width, 1.75 mm.) ..... *fraternus* Uhler 1871
Quebec, Ontario, Massachusetts, New York, New Jersey, North Dakota, Idaho, Kansas, New Mexico, Colorado, California, British Columbia.

Antennal segment III *shorter* than IV; (vertex, pronotum and scutellum coarsely punctured; pronotum a litle wider before than *fraternus,* the sides more nearly parallel, posterior lobe but feebly depressed and more closely punctured than the anterior lobe; throat and pleural pieces opaque, coarsely punctured, posterior edge of metapleura and the venter impunctate, the latter polished and golden pubescent; antennae hairy, segment I a little exceeding the apex of the head, II longest, III shorter than IV but considerably longer than I; rostrum reaching to the intermediate coxae; length not given in original description, but "smaller than our eastern *fraternus*"—that is, less than 5 mm.) ..... *tristis* Van Duzee 1906
Vancouver Island, Washington, California.

Genus IV. *Plinthisus* Fieber 1861

Key to Species

1. Pronotum *wider than long* 2
Pronotum *subquadrate;* (shining, sparsely pilose; head a little wider than long, impunctate, sunk to the eyes in the arcuate anterior margin of the pronotum; antennae pilose, segment I exceeding the tylus by nearly one-half its own length, II not quite twice I and one-third longer than III, which in turn is a little shorter than IV; rostral segment I shorter than II, which is much longer than III; anterior margin of the pronotum gently arcuate, punctate within, the anterior angles obtuse and extended to just beyond the posterior margins of the eyes, lateral edge strongly keeled, lightly sinuate between the two lobes, anterior lobe impunctate, a little wider than, and swollen and twice as long as, the posterior lobe, which is depressed and coarsely punctate, posterior margin broadly arcuate; scutellum about equilateral, impunctate but finely rugulose; clavus wide, not deflected to the corium, with *about* three irregular series of punctures; corium sparsely punctured; anterior femora much swollen, with a stout tooth and two smaller preapical; anterior tibiae in male strongly curved

and apically expanded; posteriorly on the abdomen several long setose hairs; length, 3–3.5 mm.).

indentatus Barber 1918

Montana.

2. Lateral margins of the pronotum parallel; (apical margin of the corium slightly concave; abdomen with about three or four long setae posteriorly on each side; subshining; head triangular, a little wider than long, impunctate, sparsely pilose in front, sunk to the eyes in the lightly arcuated anterior margin of the pronotum; antennae pilose, segment I about one-half of II, III one-quarter shorter than II; pronotum transverse, parallel-sided, hardly sinuate between the two lobes, the lateral edge narrowly carinate, anterior lobe impunctate, not elevated, nearly four times as long as the very short, sparsely punctured posterior lobe, anterior angles rounded and extended to hind margins of the eyes, posterior margin lightly and broadly arcuated; scutellum short, a little wider than long, obsoletely punctate; claval suture obsolete, clavus connate with corium; hemelytra very finely punctate, short, without membrane, posterior margin sinuate, lightly oblique, outer apical angle reaching to abdominal suture III; sides of abdomen posteriorly with three or four long slender setae, nearly as long as half the diameter of the abdomen; very much swollen anterior femora unarmed; length, 2 mm.).

longisetosus Barber 1918

(= *martini* Van Duzee 1921)

California; in nests of wood rats (Van Duzee).

Lateral margins of the pronotum *not* parallel 3

3. Claval suture present; [pronotum wider than long, anterior lobe not raised, anterior angles behind the eyes rounded; head not sunk to the eyes; scutellum finely punctured; head much narrower than front of pronotum, polished; antennae moderately slender, about one and one-half times the length of the pronotum, segment I shorter than head, II a little longer, III a little shorter, IV about equal to III; pronotum highly polished, moderately convex, lateral margins gently curving, anterior angles rounded, lateral margin slenderly recurved; scutellum scabrous before base to tip; corium minutely scabrous, sutures deeply punctured; length, 3.5 mm., width at humeri, 1 mm. (Uhler)]; [head impunctate, polished, apex of cheeks produced in a

minute spine on each side of the tylus; antennae distinctly tomentose, segment I passing the tylus by one-half its own length, II about one and one-half times I, III and IV about equal to I; rostrum reaching nearly to front line of anterior coxae, segment I reaching the prosternum, II slightly longer; pronotum but little narrowed anteriorly, sides feebly sinuate posteriorly, anterior angles abruptly rounded behind eyes, posterior lobe coarsely punctate, anterior smooth, polished, with a row of small punctures behind the anterior margin, posterior margin feebly concave; scutellum equilateral, closely punctured; hemelytra —brachypterous—polished, closely punctured, punctures more obscure on disc of corium, larger and in rows on clavus; anterior femora strongly incrassate with two short teeth below toward apex (Van Duzee, as *americanus*)]; length, 3.5–4 mm. ..... *compactus* Uhler 1904
(= *americanus* Van Duzee 1910)

Ontario, New Hampshire, Massachusetts, New Mexico, California; in nests of wood rats.

Claval suture absent, clavus connate with corium; (pronotum widened anteriorly; apical margin of the corium straight; abdomen with a few shorter setae posteriorly; shining, with fine appressed hairs; head impunctate, a little wider than long, sunk to the eyes in the rather strongly concave anterior margin of the pronotum; antennae finely pilose, segment I a little exceeding the apex of the head, II about twice as long as I, III a little shorter than II, IV subequal to III; pronotum transverse, faintly punctured in front, lateral margins gradually widening anteriorly, then for a short distance abruptly convexed to the rounded angles behind the eyes, lateral edge very narrowly carinate, *not* sinuate between the lobes, anterior lobe not raised, about four times as long as the posterior lobe, posterior margin gently arcuated; scutellum wider than long, finely punctate; clavus not differentiated, wholly connate with the corium; hemelytra finely and closely punctured, abbreviated—brachypterous, membrane absent, apical margin not sinuate, lightly oblique, outer apical angle reaching abdominal suture III; connexivum elevated; a few long setae posteriorly; incrassate anterior femora apparently unarmed); length, 1.5 mm. ..... *pallidus* Barber 1918

California; on willow.

Note.—*Plinthisus longisetosus* Barber 1918 and *Pl. martini* Van Duzee 1921 are obviously identical, on directly comparable characters in the descriptions by each author. The first named is "subshining," the second, "moderately polished"; in both the pronotum is transverse and parallel-sided, the anterior lobe impunctate, the posterior sparsely punctured; in *longisetosus* the posterior margin of the pronotum is "lightly and broadly arcuate," in *martini*, "very obsoletely sinuate posteriorly." In both, the anterior femora are much "swollen," or "dilated," and unarmed; the clavus connate with corium. The other characters as given by the describers are neither the same nor on the same basis, such as the head, antennae, rostrum, eyes, osteolar canal, abdomen and anterior tibiae, one or another of these mentioned in one description is omitted in the other. *Plinthisus martini* Van Duzee 1921 is naturally absent in Barber's 1918 monograph (see Bibliography for exact citation), in which the latter describes *Pl. longisetosus*. On the other hand, Van Duzee makes no reference to Barber's earlier work, nor does he make any comparison of his species with the 1918 species, nor with those coming even before that date.

Genus V. *Rhyparochromus* Curtis 1836

(= *Megalonotus* Fieber 1861)

The generic characters of *Rhyparochromus*, taken from Stål are:

Posterior lateral opaque spot of ventral segment IV very far from the anterior spot and close to the posterior margin of the segment; pronotum not or very obtusely constricted, lateral margins of the pronotum immarginate or carinate, not or but very little laminate explanate, lateral margins not or obtusely sinuate, with an indistinct collar or none; ventral suture III distinctly curved anteriorly; anterior femora below and behind middle or toward apex with several or many small teeth, frequently with a large spine also on the apical one-third; femora similar in both sexes, below with a large spine with a small tooth behind this.

The species reported from North America is

Rhyparochromus chiragra Fabricius 1803, var. *californicus* Van Duzee 1928 (= *sabulicola* Thomson 1870)

The specific characters for *chiragra* proper, as abstracted from the European authors are:

Black, opaque with short grey pubescence and with long black hairs on head, pronotum and scutellum, both the latter two finely punctured anteriorly and strongly posteriorly; head

not much stretched forward, somewhat tumid, hairy, punctured; antennae longer than pronotum, hairy; pronotum tumid, hairy, punctured, anteriorly rounded; anterior femora incrassate, shining, and below anteriorly with a tooth; antennae, head, pronotum, corium (?) and legs including tarsi with long setae; anterior lobe of pronotum rounded anteriorly about three times length of posterior lobe; antennal segments I and II, and II and IV each pair subequal; length, 5–6 mm.

Note.—The supposed variety *californicus* Van Duzee 1928 of *chiragra* Fabricius is no further characterized by its author than in this brief comment in his note of its occurrence (Pan Pac. Ent. V: 47): "agrees with *sabulicola* Thoms. in its color markings and with *chiragra* Fabr. in its long scutellum." In none of the descriptions consulted—Fabricius, Hahn, Fieber, Puton, Guerin & Peneau—is any mention made of the scutellum in either *sabulicola* or *chiragra*. The last named four authors consider them to be one and the same species, *sabulicola* being deemed either a full species, a variety, or a strict synonym.

In the end, "var. *californicus*" may turn out to be another of those instances in which a good American species is masked as a foreign form. However, the key and the generic and specific characterizations preceding may help in a discrimination.

Genus VI. *Acompus* Fieber 1861

The structural features of this genus are derived from the original description, thus:

Anterior femora unarmed, fusiform; bucculae broad, slightly curved; rostrum reaching nearly beyond the base of mesosternum; antennal segment II nearly twice the length of I; mesosternum flat, anteriorly with a short keel; xyphus short; metasternum rhomboid, elevated, with a middle carina, posteriorly acute (Fieber); pronotum and hemelytra wholly punctured, sides of pronotum very obsoletely carinate-marginate; antennal segment II nearly twice I; ventral suture III wholly substraight; rostral segments II, III and IV subequal (Stål); antennal segment I hardly passing base of head.

The one species in the genus recorded from the New World is

Acompus rufipes Wolff 1804

The specific description, as constructed from those of various European authors, follows:

Oblong-oval, pubescent, strongly punctured; head trans-

verse, much wider than the anterior margin of the pronotum; pronotum convex, narrowed anteriorly and sinuate at sides; anterior femora unarmed; not setose, hardly pubescent and strongly punctured; head, pronotum, scutellum and hemelytra shiny, densely punctured, punctures large; length, 4–4.7 mm. Northeastern U. S. (Blatchley), (Europe, Africa).

Genus VII. *Stygnocoris* Douglas & Scott 1865
(= *Stygnus* Fieber 1861 = *Stethotropis* Fieber 1870)

Key to Species

A. Thickly clothed above with subappressed yellow pubescence; head triangular, eyes prominent; head and pronotum densely coarsely punctured, the latter with a vague median transverse impression; length, 3–4.5 mm., width, 1.5–2 mm.
rusticus Fallén 1807
(= *incanus* Fieber 1870)
Quebec, Nova Scotia, New York, (Europe).

B. Thickly clothed above with long suberect yellowish hairs; head short, wide, eyes not very prominent; head and pronotum shining, not very densely punctured; length, 2.5–3 mm., width, 1 mm.
pedestris Fallén 1807
(= *sabulosus* Schilling 1829
= *pubescens* Curtis 1828)
Nova Scotia, New York, (Europe).

Genus VIII. *Thylochromus* Barber 1928

The following generic characters additional to those in the key are taken from Barber's original description of the genus (Bul. Bklyn. Ent. Soc. XXIII: 264).

Shining, sparsely pilose; head a little wider than long, sparsely and finely punctured, eyes not quite in contact with the anterior angles of the pronotum; ocelli minute, set rather close to the eyes; apex of head reaching to middle of antennal segment I, which is much shorter than rostral segment I; antennal segment II longest, III and IV subequal; apex of rostrum reaching behind posterior coxae, segment II longer than I, III a little shorter than II; pronotum little wider than long, margins carinate, not expanded, anterior lobe just over twice as long as posterior, constriction shallow, obtuse both laterally and dorsally, posterior lobe finely punctured, anterior margin

nearly straight, without a collar, humeral angles obtusely rounded, posterior margin rather strongly concavely arcuate; scutellum equilateral, slightly carinate apically; commissure less than half the length of the scutellum; clavus with three rows of punctures, corium coarsely punctured; anterior femora strongly incrassate, with a single large tooth preceded and followed by a single series of fine spinules, intermediate and posterior femora somewhat clavate; anterior tibiae strongly curved, all tibiae finely pilose, not long setose; posterior tarsal segment I much longer than II and III taken together; venter finely pilose, polished, incisure between segments II and III anteriorly curved, the two opaque glandular spots of segment IV set far apart, the posterior near the posterior margin of the segment.

The one species in the genus is

Thylochromus nitidulus Barber 1928

Selected characters from the original description of the species are:

Shining, sparsely pilose; head finely sparsely punctured, a trifle wider across the eyes than long, eyes not quite in contact with the anterior angles of the pronotum, apex of tylus reaching about to middle of antennal segment I; ocelli minute, rather close to eyes; antennae finely pilose, segment II twice I, III and IV subequal, each about one-third shorter than II; rostrum long, its apex reaching beyond the basal margin of abdominal segment III, segment I a little longer than the head, II one third longer than I, III a little shorter than II, IV about one-half of I; pronotum sparsely pilose, one-fourth wider than long, obtusely constricted well behind middle, anterior lobe twice as long as posterior, lateral margins lightly carinate and not at all expanded; disc smooth, faintly punctured along the anterior margin, posterior lobe somewhat wider than the anterior, sparsely finely punctured, posterior margin slightly concave-arcuate; scutellum equilateral, subshining, sparsely pilose, somewhat carinate at apex, disc and sides sparsely punctured; clavus with three rows of punctures; commissure less than one-half the length of the scutellum; corium finely pilose, coarsely but sparsely punctured posteriorly, lateral margins gently arcuate throughout; anterior femora strongly incrassate, with a strong tooth halfway between the middle point and apex, with several smaller acute spinules before and behind the larger

tooth; anterior tibiae strongly curved, unarmed; posterior tibiae finely pilose; posterior tarsal segment I longer than II and III taken together; prosternum and venter shining, the latter almost impunctate, sparsely long-pilose; length, 3.5–4 mm.

Thus far, the species seems to be recorded only from California, in dead leaves and in nests of *Neotoma*.

Genus IX. *Antillocoris* Kirkaldy 1904
(n. n. for *Pygaeus* Uhler 1894)

Key to Species

1. Anterior lobe of the pronotum *not* punctured; (long-oval, polished, minutely pubescent and feebly punctured, below, highly polished; antennal segment I as long as or longer than II, III shorter than IV; posterior lobe of the pronotum punctured, anterior lobe smooth, with a few punctures apically, the posterior margin a little deflexed; scutellum coarsely and deeply punctured; clavus punctured in lines; corium less coarsely punctured; membrane always present in macropterous and brachypterous; length, 1.75–2 mm., width, 0.75 mm.).

pallidus Uhler 1894

From Massachusetts to Florida, Texas, Indiana, Quebec.

Anterior and posterior lobes of the pronotum wholly punctured 2

2. Base of pronotum truncate (Stål); anterior lobe with two transverse levigate spots; (narrow oval or suboblong, head pilose, shiny and glossy, impunctate; antennal segments II and III subequal or equal, I much exceeding the apex of the head, III and IV equal and shorter than I or II; pronotum distinctly punctured; hemelytra distinctly, on clavus strongly, punctured, apical margin of the corium straight; membrane wholly absent in brachypterous); length, 1.8–2 mm., width, 0.75 mm.

pilosulus Stål 1874

Massachusetts, Connecticut, New York, New Jersey west to Indiana and south and west to Florida and Texas.

Base of pronotum arcuately concave, anterior lobe *without* levigate spots; (body above obscurely hirsute and somewhat coarsely punctured; head short and wide, wider than the pronotum anteriorly; antennal segment I passing apex of head by nearly one-half its own length, II a little longer than III; lateral margins of the pronotum arcuate, appar-

ently carinate, both lobes punctured, anterior lobe longer than posterior, pronotum nearly twice as wide as long; scutellum apically carinate; all femora and tibiae unarmed; posterior tarsal segment I subequal to III, II and III taken together slightly longer than I; apex of corium acute, lateral margins of the hemelytra narrowly explanate, slightly incurved at about the level of the posterior part of the scutellum); length, 2 mm.

punctatus Distant 1893

Texas, (Panamá).

Genus X. *Cligenes* Distant 1893
(= *Salacia* Stål 1874)

The generic description following is that of Stål 1874, for *Salacia* (En. Hem. IV: 156) as found in his Key to Rhyparochromaria (Rhyparochromini), translated from the original Latin:

Head moderate; antennae inserted close to the eyes, segment I exceeding head by one-half, III not or barely longer than I, often shorter; rostral segment I not longer than antennal segment I; pronotum short, transverse, base wide, nearly twice as wide as head with eyes, at middle, or slightly behind middle very obsoletely transversely impressed, lateral margins lightly sinuate at middle, margins of the anterior lobe at apex frequently strongly rounded; scutellum not or slightly longer than wide, twice or three times as long as the claval commissure; body opaque or slightly opaque.

Distant, in 1893 (Biol. Cent. Am., Rhynchota I: 405) described the new genus *Cligenes*, apparently failing to recognize the older *Salacia*, which it replaces as the name of the aggregate, since the latter turned out to be preoccupied. Distant described four species in his new genus, three of which he questioned generically. Two of these questioned species have later been found to occur in the United States, one in *Antillocoris* preceding, the other

Cligenes delineatus Distant 1893,

based on a single specimen from Panamá, which he had placed in "*Salacia*(?)," correctly, even though questioned. The species is thus described (l.c.), by color, except for the two structures mentioned in it:

"Head, pronotum, scutellum and membrane black; corium and margins of membrane ochraceous, the corium with apex and two contiguous spots extending from inner angle to lateral

margin, black. Body beneath and legs black, apices of femora and the tibiae and tarsi ochraceous; antennae fuscous, the basal and apical joints ochraceous; second and third joints subequal in length and moderately incrassated. The pronotum and scutellum are almost impunctate. . . . Long, 2 mm. . . . Hab. Panamá, Peña Blanca (Champion). . . . A single example."

From the figure (op. cit., plate 35, figure 20), the following structural characteristics emerge:

Head wider than the anterior margin of the pronotum, shorter than wide; antennal segment I shortest, II, III and IV seemingly subequal; pronotum one and one-half times as wide at base as long, anterior and posterior angles rounded, transverse impression nearer to base than to apex, posterior margin concavely arcuate, lateral margins sinuate; scutellum carinate apically; clavus and corium punctured in rows; posterior tarsal segment I slightly shorter than II and III taken together.

Texas, California, (Panamá).

Tribe 4. *BEOSINI* Stål 1872

Key to Genera

1. Lateral margins of the pronotum linearly and evenly expanded, *not* reflexed, the expansion widened between the two lobes, which are not distinctly differentiated by a transverse constriction; (pronotum transverse, *without* a depressed collar); head across the eyes about as wide as the anterior submargin of the pronotum, antenniferous tubercles seen from the side, strongly oblique, almost perpendicular; (scutellum not carinate; antennal segment I short, apical one-third extended beyond the apex of the head) 3

   Lateral margins of the pronotum widely laminately expanded and plainly reflexed; head hardly transverse; antenniferous tubercles seen from the side obliquely declivous 2

2. Head hardly transverse; antennae incrassate; posterior lobe of the pronotum depressed; clavus with three rows of punctures ..... VI. *Uhleriola* Horváth 1908

   Head *distinctly* transverse; antennae slender; posterior lobe of pronotum *not* depressed; clavus confusedly punctured. V. *Dieuches* Dohrn 1860

3. Species commonly dull or not shining; anterior margin of the pronotum nearly straight; dorsal parts not wholly black,

either the lateral explanate margin of the pronotum or commonly the posterior margin of the pronotum conspicuously, or the corium more or less, pale 4

Subshining; anterior margin of the pronotum lightly concave; (pronotum very transverse, not depressed posteriorly; rostral segment III shorter than II; anterior femora with one large preapical spine, preceded and followed by one or two smaller spines; clavus with four rows of punctures, the two middle abbreviated and confused; posterior tarsal segment I subequal to II and III taken together).

IV. *Aphanus* Laporte 1832

4. Explanate lateral margin of the pronotum neither punctured nor with setae; (scutellum rarely bivittate with pale); antennae sparsely pilose or almost nude; posterior tarsal segment I distinctly longer but not twice as long as II and III taken together 5

Explanate lateral margins of the pronotum with a few punctures set with long setae; (scutellum pale bivittate usually); antennae with numerous setose hairs; posterior tarsal segment I usually subequal to II and III taken together ..... III. *Sphragisticus* Stål 1872

5. Posterior lobe of the pronotum distinctly and rather coarsely punctate with black, pronotum narrowed in front, lateral margins gently rounded anteriorly; antennae pilose; anterior tibiae, especially in the male, curved at base.

I. *Trapezonotus* Fieber 1861

Posterior lobe of the pronotum and the anterior lobe (concolorous), not at all or obsoletely and finely punctured, (black, or at most, with the posterior margin only pale); pronotum less narrowed in front, lateral margins nearly parallel; antennae nearly nude; anterior tibiae nearly straight in both sexes ..... II. *Malezonotus* Barber 1918

Genus I. *Trapezonotus* Fieber 1861

Key to Species

1. Anterior femora *without* spines or teeth 2

Anterior femora *with* spines or teeth 3

2. Length less than 5.5 mm.; (head pilose, wider than long, with eyes not wider than the anterior margin of the pronotum; antennae pilose on segments I, II and III, I exceeding apex of head by one-half its own length, II longest, slightly

longer than, or subequal to III, IV a little longer than III; anterior lobe of pronotum subrugulose and finely punctured, posterior lobe coarsely punctured, sometimes confluently; scutellum very finely and sparingly punctured, apical margins more distinctly and coarsely punctured; corium coarsely and in some places confluently punctured, lateral margins impunctate; actual length, 4–5 mm.) ..... *caliginosus* Distant 1882
Arizona, (Guatemala, Panamá).

Length 6 mm. or more; (pronotum with disc of anterior lobe finely and sparsely punctured, the sides not so profusely, diameter of the submargin just back of the eyes only a little wider than the head across the eyes; actual length, 6–6.5 mm.) ..... *derivatus* Barber 1918
Arizona (Huachuca Mts.).

3. Anterior femora with one spine or tooth; (head wider across eyes than long, tylus passing juga and setose anteriorly; antennal segment I not passing tylus, II longest, slightly longer than IV, III more than one-half the length of II, all segments setose; pronotum anteriorly wider than the head, the margins explanate-carinate, sides sinuate, nearly twice as wide at base as long; anterior femora stout, with one stout tooth near the apex; all tibiae with long setae; all femora nude and stouter than the tibiae; posterior tarsal segment I subequal to II and III taken together; length 5.7 mm., width, 2.1 mm.) ..... *arenarius* Linné 1758
Eastern United States and Canada, (Europe).

Anterior femora with *two* or more spines or teeth 4

4. Anterior femora with two short teeth and a few minute serrations; (head as long as wide *between* the eyes, coarsely closely punctured, the punctures becoming subobsolete posteriorly, where the surface is dull and opaque; antennae stout, segment I passing the apex of the head by one-third its own length, II about twice I, III one-half longer than I, IV one-quarter longer than II; surface minutely pilose with a few longer setae; pronotum anteriorly hardly wider than the head, surface opaque, coarsely punctured, punctures subobsolete across the disc of the anterior lobe, lateral margins slenderly explanate; scutellum rather obscurely punctured; hemelytra coarsely punctured, obscurely so on disc of corium; clavus with three rows of punctures, the inner more irregular; venter polished; anterior femora

thickened, below with two short teeth and a few minute serrations; anterior tibiae moderately curved at base; posterior tibiae short pilose with a row of about six slender spines beneath; posterior tarsal segment I about as long as II and III taken together; rostrum reaching to between intermediate coxae; upper surface with sparse appressed pale hairs; length, 4 mm. ..... *vandykei* Van Duzee 1937
Colorado.

Anterior femora with five or six short teeth tipped with a seta, between which are several minute teeth or serrations; (head transverse, across eyes as wide as the anterior submargin of the pronotum just back of the eyes, finely punctured, with a coating of incumbent whitish *hairs;* antennal tubercles visible from above; antennae rather slender, finely pilose, segment I short, passing apex of tylus by about one-third its own length, II one-third longer than III, IV about one-quarter shorter than II; rostrum reaching between middle coxae, segment II a little longer than III; pronotum with a fine coating of incumbent tawny *hairs;* lateral expanded margins straight, gradually converging anteriorly, gently rounded back of eyes, posterior lobe profusely punctate, posterior margin strongly arcuate; scutellum elongate, finely and sparsely punctured, with incumbent hairs; clavus with three irregular rows of punctures, the middle one abbreviated; corium rather coarsely punctate with fuscous, clothed with incumbent hairs, costal margins impunctate, outer margins gently rounded; anterior femora incrassate, with five or six short teeth with setae at tips, between which are several most minute teeth or serrations; anterior tibiae strongly curved and expanded apically, with a short tooth inwardly; posterior tibiae with two rows of short setose bristles; posterior tarsal segment I a trifle longer than II and III taken together; venter finely and closely punctured, clothed with incumbent whitish hairs; length, 4 mm.).
diversus Barber 1918
California.

Genus II. *Malezonotus* Barber 1918
(= *Trapezonotus* Stål 1872)

Key to Species

1. Pronotum *wider* than long 2
   Pronoum *as wide as* long, or *subquadrate* 4

2. Anterior femora with more than three spines or teeth (actually five); (sparingly clothed with minute golden pubescence; head stout, very minutely densely shagreened; antennal segment I hardly more than half the length of the head, II longest, a little longer than IV, III about two-thirds as long as II; rostrum reaching middle of mesosternum, segment I a little shorter than the head, II longest, III and IV subequal; pronotum almost one-quarter wider than long, indistinctly and very minutely scabrous, lateral margins distinctly but very narrowly reflexed, feebly sinuate behind the middle, anterior angles bluntly rounded, humeral angles prominent, posterior margin sinuate; scutellum almost flat, minutely scabrous and punctured; anterior femora stout, with five small spines beneath; tibiae with bristles; length, 4 mm., width, 1.5 mm.).

sodalicius Uhler 1875

Virginia, Mississippi, Texas, Nevada, Utah, California, Oregon, Washington, Vancouver Island; on strawberry beds.

Anterior femora with three spines or *less* 3

3. Anterior femora with three spines or teeth, the middle one longest; (oblong, black; head sparsely pubescent; pronotum slightly transverse, base not much wider than the apex; scutellum with sides punctured; clavus with three rows of punctures, between the two inner distant series with punctures sparse or in a very irregular series; anterior femora below behind the middle with three teeth, the middle one the largest, the other two quite small; posterior tarsal segment I nearly twice II and III taken together; length, 4 mm., width, 1.5 mm.).

rufipes Stål 1874

New Jersey, Texas.

Anterior femora with only one or two spines or teeth, the second very minute, sometimes absent; (head transverse, embedded to the eyes, a little narrower across the eyes than the anterior submargin of the pronotum, finely punctured in front; antennae finely pilose, segment I short, exceeding tylus by one-third its own length and about one-third the length of II, II one-third longer than III, IV one-fourth longer than II; pronotum transverse, lateral margins not sinuate, subparallel for a short distance behind the eyes, where they are suddenly rounded, anterior lobe

impunctate, posterior lobe very finely punctured, posterior margin strongly concave; scutellum closely and finely punctured; clavus with three somewhat confused rows of punctures; corium finely punctured, costal edge expanded for anterior two-thirds; anterior femora with one short post-median tooth, sometimes preceded by a minute tooth; posterior tibiae with short bristles; venter very finely punctured; length, 3.5 mm.) ..... *fuscosus* Barber 1918

New York, New Jersey; under huckleberry bushes.

4. Anterior lobe of the pronotum about three times as long as the posterior lobe; (head opaque; antennae clothed with minute pale pubescence, segment I with a few stiff bristles, II three times length of I, III one-sixth shorter than II, IV very slightly longer than III—proportions, 6 : 18 : 15 : 16—; rostrum reaching base of middle coxae; pronotum as long as broad, surface shagreened, posterior lobe very obscurely punctured, about one-third length of anterior lobe; scutellum one-quarter wider than long; clavus with three regular rows of punctures with a few scattering ones between; corium irregularly punctured, punctures fine, closer in median area; anterior femora strongly incrassate, with one stout subapical tooth and one or two minute; tibiae spinose; length, 5.5–6.5 mm.).

grossus Van Duzee 1935

California, Oregon.

Anterior lobe of pronotum *not quite* twice the length of the posterior lobe; (oblong, parallel-sided; head minutely aciculate, vertex moderately convex; antennal segment I passing tylus by one-third, II nearly twice length of I, III shorter than II, IV hardly longer than III; rostrum reaching intermediate coxae, segment II longer than III; pronotum subquadrate, minutely rugulose, anterior angles moderately rounded, sides distinctly and continuously but slenderly carinated, feebly sinuate, anterior lobe hardly twice the length of the posterior lobe, posterior margin deeply arcuated; scutellum nearly flat, about equilateral; hemelytra coarsely punctured; anterior femora strongly incrassate, with about three small teeth along the anterior margin, the apical tooth larger; length, 5 mm.).

angustatus Van Duzee 1910

Utah, California, Washington, Vancouver Island, British Columbia.

Genus III. *Sphragisticus* Stål 1872

Key to Species

A. Posterior tibiae with numerous long setae in addition to the rigid bristles; head transverse, base impunctate, front finely punctured; antennae setose, segment I a little passing apex of tylus, II one-third longer than III, IV slightly longer than II; anterior lobe of the pronotum with impunctate disc, finely punctured anteriorly, posterior lobe punctured; scutellum elongate, finely punctured on disc and along margins; rostral segment I reaching base of head, II one-third longer than III; anterior femora with several irregular teeth along the outer two-thirds; posterior tibiae inwardly and outwardly with a row of short oblique bristles and a row of longer setae; posterior tarsal segment I longer than II and III taken together; length, 4 mm. *simulatus* Barber 1911

New Mexico.

B. Posterior tibiae with rigid bristles *only;* antennae setose, segment I passing the apex of the head by *about one-half,* II nearly twice I or II, which are subequal, IV shorter than II and longer than I or III; anterior lobe of the pronotum finely punctured, posterior deeply so; scutellum triangular, strongly punctured; anterior femora below anteriorly with a small spine; all tibiae setose; length, 6.3 mm., width, 2.1 mm. ..... *nebulosus* Fallén 1807

Ontario and New England west to the Pacific, Michigan, Texas, New Mexico, California, (European); on *Amaranthus* sp. (tumbleweed).

Genus IV. *Aphanus* Laporte 1832

(= *Pachymerus* Lepelletier & Serville 1825 = *Calyptonotus* Stål 1872 = *Dorachosa* Distant 1893 = *Delochilocoris* Bergroth 1893)

Key to Species

A. Anterior lobe of the pronotum, except the disc, thickly punctured, and much longer than wide; antennal segment III slightly shorter than IV, (I not reaching apex of head, II one-half the length of III); clavus with three rows of punctures; (elongate-oval, feebly shining; head across eyes wider than long, and than the anterior margin of the pronotum; posterior lobe of the pronotum wholly punctured, anterior lobe twice the length of the posterior, posterior

margin concavely arcuate; scutellum punctured, longer than wide, as long as, or longer than, the pronotum; *all* femora and tibiae *without* spines); length, 4.5–5.5 mm. *illuminatus* Distant 1893

Florida, (Mexico, Guatemala).

B. Anterior lobe of the pronotum entirely and very finely punctured, *slightly* transverse, (base one-third wider than the apex); antennal segment III *distinctly* shorter than IV; punctures of clavus confused; (somewhat shining; head extremely finely punctured, apex with some erect hairs; posterior lobe of the pronotum less finely punctured than anterior; hemelytra densely and distinctly punctured; posterior tarsal segment I more than twice II and III taken together); length, 4.75–6 mm. (6 to 7 mm.—Blatchley) ..... *umbrosus* Distant 1893

Ontario and New England west to Kansas and Colorado and south to Florida, Texas, Arizona, California, (Mexico, Guatemala, Panamá).

Note.—The second species has been variously recorded by American authors as *Microtoma carbonaria* Rossi, or *Microtoma atrata* Goeze. Barber doubts that *Microtoma* is found in North America; hence, he omits it in his key to genera, which we follow.

Genus V. *Dieuches* Dohrn 1860
(= *Ischnotarsus* Fieber 1861 p.p. = *Methocus* Scott 1874 = *Beosus* Bergroth 1893)

The valid distribution of the genus *Dieuches,* so far as known now, is in the Old World, whence some ten or twelve species are recorded. The genus likewise is so close to *Beosus* Amyot & Serville 1843, that both Stål and Bergroth synonymized the two genera and treated them as one, since there appear to be species which fit equally well into the one or the other genus.

Selected generic characters, abstracted and consolidated from various authors, are:

Antennal segment I passing the apex of the head; eyes extending a little beyond the anterior margin of the pronotum; pronotum long, more or less constricted near middle, the lateral margins carinate and laminate; legs long, anterior femora incrassate and spined below.

Head generally subequal to, or longer than wide; eyes anteriorly not, or not very, divergent; ocelli quite close to the eyes, large, distance between them and the eyes subequal to

the diameter of the ocelli; antennal tubercles seen from the side obliquely declivous or subporrect; antennae distant from the eyes, segment I much exceeding apex of head, most frequently longer than the eyes from the side, not longer than rostral segment I; base of pronotum very distinctly, and frequently much, wider than the head, not transverse, lateral margins entirely carinate or lamellate and distinctly reflexed, apex abruptly rounded.

The one species positively American is that recently described (Bul. Bklyn Ent. Soc., vol. XLI: 125):

Dieuches occidentalis Torre-Bueno 1946

Selected characters from the original description are:

Head wider than long (24:18), including eyes, no fine longitudinal median line; tylus blunt, very slightly exceeding juga; ocelli slightly more than their own diameter from the eyes. Antennal segments 21:41:30:33; I slightly thickened apically, exceeding tylus by about two-thirds its own length, II slightly curved, of equal diameter throughout, IV slightly curved, of equal diameter throughout, conically pointed at apex; antennal tubercles rounded, not prominent. Rostrum reaching to or slightly beyond posterior coxae; segments 20: 18:15:10. Pronotum nearly twice as broad as long (at humeri, 44 wide, 24 long); transverse groove about midway between apex and base, crossed at middle by a short, blunt longitudinal carina; sides moderately laminate; collar narrow; posterior lobe finely punctured, more sparsely toward base, anterior lobe impunctate. Scutellum about as wide at base as long (23:25), acute, punctured, more sparsely so toward margins. Hemelytra—clavus punctured confusedly, not in rows; longitudinal veins of corium each with a single row of punctures, impunctate between the veins; veins of the membrane simple, more or less curved, concolorous. Legs—anterior femora moderately incrassate, with four conical spines running from middle of femur apically, and behind middle, one very small spine; anterior tibiae enlarged at apex; all tibiae with two longitudinal rows of bristles; posterior tarsal segment I twice as long as II and III taken together. Venter smooth, with long sparse setae. Length, 7 mm.

Concolorous brownish, except the stramineous expanded margins of pronotum and corium; antennae and legs yellowish. Arizona; apparently a mountain species.

Genus VI. *Uhleriola* Horváth 1906

This monotypic genus, to contain *Rhyparochromus floralis* Uhler 1895 (Hem. Colo., Bul. Colo. Exp. Sta., p. 26) was erected by Dr. G. Horváth in 1908 (Ann. Mus. Nat. Hung., VI: 561/562). Horváth points out that Uhler's species does not belong in the genus in which it was described, nor even in Rhyparochromini, because the lamellate margin of the pronotum puts it in Apahanini. The original generic description, from the Latin, reads:

> "Body oblong, glabrous, variegated; head large, hardly transverse, as wide as the apex of the pronotum, arcuate-declivous toward apex, seen from side, its height is equal to its length; antennae moderate, segment I shorter than rostral segment I, segments II and III without rigid setae, segment II shorter than the width of the head, segment IV wholly black; rostrum extended behind the intermediate coxae, segment II reaching middle of anterior coxae, III distinctly shorter than the preceding segment; pronotum subquadrate, transverse, slightly wider than the head, apex nearly straight, hardly sinuate, anterior angles not produced, lateral margins wholly laminate-explanate, not set off inwardly by an impressed line, posterior angles with a distinct tubercle within the margins, anterior lobe nearly impunctate; scutellum elongate-triangular; hemelytra complete, clavus with three rows of punctures, the inner series quite remote from the series at the scutellar margin, the space between these two rows of equal width throughout, two outer series of points close together, straight, gradually converging from the base nearly to the apex and ending in an elevated callose vein attenuated toward the apex, the inner vein of the corium straight, membrane with a white discal gutta; ventral suture III distinctly sinuately curved anteriorly on both sides, posterior lateral spot of segment IV exceedingly remote from anterior spot and close to the posterior margin of the segment; feet moderate, anterior femora incrassate, beneath with many spines, one longer, posterior femora unarmed, segment I of posterior tarsus nearly twice the length of the two apical taken together."

It is to be noted that this characterization is apparently based on the macropterous form; there are also brachypterous. The single species in the genus is:

Uhleriola floralis Uhler 1895 (l.c.).

The original description of the species reads:

"Long-elliptical, rusty fulvous, minutely sericeous pubescent. Head piceous paler or rufo-fulvous at tip, subconic, nodding, smooth, shorter than the pronotum, minutely scabrous, strongly convex above, with the throat pale rufo-fulvous; antennae stout, about as long as the pronotum and corium united, dull fulvous, pale pubescent, with the fourth joint and apex of the third blackish piceous, the basal joint extending a little beyond the tip of the head, second much longer, the third about one-half longer but a little shorter than the second, the fourth about equal to the second; rostrum reaching upon the middle coxae, slender, pale fulvous, with the apical joint black. Pronotum subquadrangular, a very little wider at the base than at the tip, fulvous or rufo-fulvous, dull testaceous and punctate with black on the basal one-third, the lateral margins a little reflexed, black, slightly convexed next the apical angle, the submargin ivory white, expanding posteriorly where it abuts against a tumid black humeral spot near the inner boundary of this stripe and the anterior submargin finely punctate with black, disc not distinctly punctate, behind this a feebly raised whitish line. Scutellum very long and acute, fulvous, transversely indented on the middle, finely punctate before the middle, and coarsely punctate with black toward the tip, the middle line more or less black. Corium whitish-testaceous, with about nine slender black oblique lines (including the clavus) which are mostly composed of impressed punctures, the costal border and a transverse spot upon a wide black area, which also covers the cuneus, dull white, exteriorly reflexed edge of costal border dark brown; membrane smoke brown, with a short white spot next the tip of the cuneus, and a double fainter one at tip. Legs pale fulvous, pale on middle of tibae and base of tarsi, apices of tibiae and tarsi piceous. Pectus dark rust brown, paler anteriorly, the segments on the posterior border and a spot above each coxa pale yellow. Venter dull black, bordered above with testaceous or fulvous.

"Length to tip of venter, 6–6.5 mm. Width of pronotum, 1.75–2 mm. This seems to be a common species in Colorado, Montana, California, etc."

Fort Collins under stones, etc., in company with *Formica neoclara* Em.; also in various places in Arizona. Taken ordinarily also under small earth-hugging growth.

Tribe 5. *GONIANOTINI* Stål 1872

Key to Genera

(Head short and transverse; pronotum wider than long; scutellum as wide as pronotum.)

A. Pronotum *excised* anteriorly; space between eyes and antennae short; antenniferous tubercles obtuse, not prominent.
I. *Emblethis* Fieber 1861

B. Pronotum *straight* anteriorly; space between the eyes and antennae long; antenniferous tubercles truncate apically, their outer angles prominent.
II. *Gonianotus* Fieber 1861

Note.—The generic key above is given to make more certain the separation of *Emblethis*. This is done because *Gonianotus* has been attributed to our American fauna.

Genus I. *Emblethis* Fieber 1861

Emblethis is in general a Palaearctic genus, only one species being thus far known from America out of the 13 or 14 recognized as valid. Fieber in 1861 (Eur. Hem., 51, 197) set up the genus with the characters following:

> Rostrum reaching to middle of mesosternum; anterior margin of the pronotum sinuate nearly to the angles of the collum; head somewhat inserted into the sinuation; lateral margins of the pronotum arcuate; mesosternum angularly produced, shallowly sulcate posteriorly between the two bosses; metasternum rhombic-quadrangular, posteriorly acute, low arched, anteriorly angulate, posteriorly excised and carinate at margins; body long-oval; head short five-angled, somewhat sunk into the pronotum; antennal segments slender, segment II more than twice the incrassate I, III somewhat shorter than II and nearly as long as slenderly fusiform IV; margins of pronotum lightly arcuate; body punctured above; base of scutellum punctured.

Thus far only one American species has been recognized:

Emblethis vicarius Horváth 1908 (= *arenarius* Uhler 1872 = *griseus* auctt. am. = *Gonianotus marginepunctatus* Uhler 1878 nec Wolff 1804)

After his visit to the United States in 1907, Dr. Horváth recognized that our *Emblethis* was an undescribed species, and not the same as any of the European species under the names of which it

had had theretofore masqueraded. He thus described it (Ann. Mus. Nat. Hung. VI: 563):

> Oblong-ovate, griseous-testaceous, densely and very finely black-punctured; head distinctly shorter than its width including the eyes; antennae moderate, black setose, segment I short, ovoid, twice as long as its own width, segment II slightly longer than the diameter of the vertex and distinctly longer than segment III, segment IV fuscescent; pronotum one-half longer than the head, as long as wide at apex, base two-thirds wider than the apex, lateral margins glabrous, quite explanate, nearly straight, a little toward apex obviously arcuate, anterior margin lightly sinuate, anterior angles not very produced; costal margin of corium with close black punctures; membrane equalling or slightly exceeding apex of abdomen, griseous, fuscous veined, between the veins fusco-variegate; head and pectus beneath black, anterior and posterior margins of the prostethium, posterior limb of meso- and metastethium with spots and all the coxae, testaceous; venter fusco-ferruginous; feet testaceous, very minutely fusco-consperse, tibiae black spined, basal segment of posterior tarsi more than twice II and III taken together; female; length, 5–6 mm.

The species seems to be distribtued from the Eastern States as far as to Arizona—apparently of country-wide range, provided the western form is identical with that of the Atlantic seaboard.

Tribe 6. *LETHAEINI* Stål 1872

Key to Genera

1. Pronotum with both lobes distinctly and closely punctate, posterior lobe more coarsely so than anterior; anterior tibiae in male either strongly curved, or bent and strongly expanded apically within, and armed with one or two stout preapical teeth; ventral segment IV with the *two* anterior glandular opaque spots, but not with a third subapical spot; (lateral margins of the pronotum lightly expanded, more widely so between the lobes, slightly sinuate and generally pale in part, anterior margin without a semblance of a collar, but the area behind the margin somewhat depressed and profusely punctate; costal margins of the corium widely expanded and broadly reflexed; eyes not in contact with the anterior margin of the pronotum; anten-

nal segment I shorter than the head, but well extended beyond its apex) 2

Pronotum with the anterior lobe impunctate or *obscurely* punctate; anterior tibiae of the males not so strongly curved, or bent and expanded at the apex; ventral segment IV with or without a third spot 3

2. Body not strongly depressed or flattened; lateral margins of the pronotum not strongly converging anteriorly, anterior angles strongly and rather abruptly rounded; width of head across eyes *much narrower* than across rounded submargin of the pronotum; lamellar expansion very distinct on both lobes; antennae rather strongly pilose; mesosternum *not* longitudinally sulcate; posterior tarsal segment I distinctly longer than II and III taken together; abdominal suture III strongly curved anteriorly and not reaching lateral margin ..... I. *Drymus* Fieber 1861

Body much flattened; lateral margins of the pronotum strongly converging anteriorly, anterior angles gently rounded; width of head across eyes *subequal* to width across rounded submargin of the pronotum; lamellar lateral expansion less obvious on the anterior lobe; antennae not pilose; mesosternum *strongly* sulcate; ventral abdominal suture III almost straight and reaching the lateral margin; posterior tarsal segment I subequal to II and III taken together. II. *Gastrodes* Westwood 1840

3. Dorsum dull; anterior margin of the pronotum depressed, limited by a row of punctures behind; lateral lamellar expansion noticeably wider between the two lobes; ventral abdominal segment IV *without* the third subapical spot; hind tibiae *without* long rigid bristles, at most either with a few short setose bristles, or pilose 4

Dorsal parts shining or somewhat shining; lateral edge of the pronotum *not* obviously widened between the two lobes; both anterior angles of the pronotum furnished with a long seta; abdominal ventral segment IV ordinarily with an additional third subapical opaque spot; scutellum longer than wide; hind tibiae with rigid bristles 6

4. Pronotum much longer than wide, anterior lobe subquadrate and the disc obsoletely punctate; antennae very long, slender and nude, segment I as long as, or a little longer than the head, longer than rostral segment I, apex of head not reaching to middle point of segment I, III longer than

IV; head submerged to the eyes, and including them as wide as anterior margin of pronotum; lateral margins of pronotum and the corium widely lamellarly expanded and broadly reflexed; corium flattened dorsally, not transversely convex; scutellum longer than wide; clavus distinctly widened posteriorly, rather closely and irregularly punctate; commissure nearly as long as the scutellum; bucculae lightly elevated and extended posteriorly to meet on the middle line of the eyes; much swollen anterior femora with a single large subapical tooth followed by several small teeth to the apex; posterior tibiae with a few fine short bristles and not pilose; segment I of posterior tarsus as long as II and III taken together.

III. *Togodolentus* Barber 1918

Anterior lobe of the pronotum transverse, impunctate; antennae shorter, segment I shorter than the head, subequal to or shorter than rostral segment I and extended well beyond apex of head; head generally lightly exserted; lateral margins of the pronotum and corium less expanded; commissure distinctly shorter than the scutellum; clavus with punctures in fairly regular series; segment I of posterior tarsus never twice as long as II and III taken together 5

5. Larger species, ordinarily 6–7 mm. long; apex of tylus not reaching middle of antennal segment I; head longer than its width back of the eyes; lateral margin of the pronotum commonly more or less pilose; hind tibiae with short fine bristles or pilose ..... IV. *Eremocoris* Fieber 1861

Smaller species, ordinarily 3–4 mm. long; antennal segment I shorter, apex of tylus reaching at least to the middle of the segment; head shortened, length subequal to width back of eyes; lateral margins of the pronotum *without* long soft hairs; hind tibiae not pilose nor furnished with short bristles ..... V. *Scolopostehus* Fieber 1861

6. Lateral edge of the pronotum not definitely set off or bordered by an impressed line, much compressed or acute and below strongly impressed within the lateral margin of the propleura, lateral margins nearly straight and converging anteriorly, anterior and posterior margins straight; head across eyes a little narrower than the anterior submargin of the pronotum; rostral segment I nearly equal to antennal segment I; dorsal parts pilose 7

Narrow lateral expansion of the pronotum sharply set off, not widened between the two lobes, which are poorly differentiated, merely posteriorly lightly depressed and sparsely punctate, pronotum transverse, sides subparallel; head submerged to the eyes, width across the eyes much narrower than across anterior submargin of the pronotum, where the angles are rather abruptly rounded; antennae slender; posterior tibiae with long rigid bristles; posterior tarsal segment I a little longer than II and III taken together; anterior femora with several small subapical tubercles (to include *Trapezus* Distant).

IX. *Cryphula* Stål 1874
(= *Trapezus* Distant 1882)

7. Anterior femora with a few tubercles and numerous long setae; antennae somewhat incrassate; posterior tarsal segment I nearly twice as long as II and III taken together; posterior tibiae with strong bristles; surface not strongly shining.

VI. *Cistalia* Stål 1874

Anterior femora with several minute preapical teeth, with or without setae; antennae not incrassate, and pilose; posterior tarsal segment I a little longer than II and III taken together, but never twice as long; posterior tibiae with fine short bristles 8

8. Pronotum very transverse, nearly twice as wide as long, posterior lobe sparsely punctate; clavus deflected to corium and with three regular rows of punctures; corium finely punctured; antennae set close to eyes, antennal tubercles less than half the length of the eye; membrane reaching apex of abdomen ..... VII. *Valtissius* Barber 1918

Pronotum not very transverse, *distinctly* less than twice as wide as long, almost impunctate except behind anterior margin; clavus almost flat with four rows of punctures; corium sparsely punctate; antennae not close to the eyes, antennal tubercles only a little shorter than the eyes; membrane abbreviated in brachypterous, reaching apex of abdomen in macropterous; dorsal parts very shining.

VIII. *Xestocoris* Van Duzee 1906

Genus I. *Drymus* Fieber 1861

Key to Species

A. Anterior lobe of pronotum more finely punctured than the posterior; head finely not densely punctured; rostral groove

not reaching the base of the head; (apex of rostrum hardly reaching *intermediate* coxae); scutellum not carinate; propleura with a small and acute tooth between the anterior coxae; costal margin of the hemelytra narrowly expanded; length, 4.2–5 mm. ..... *unus* Say 1832

New England to Colorado, south and west to North Carolina and Texas.

B. Both lobes of the pronotum, and the head, densely and rather closely coarsely punctured; rostral groove between bucculae broad, reaching *posterior* coxae; scutellum subcarinate to behind the depressed disc; (pectus deeply punctured); propleura with a rounded tooth or tubercle between the anterior coxae; costal margin of the hemelytra rather widely expanded; (metapleural flaps impunctate and polished); (anterior femora much incrassated, with *one* stout tooth near apex); length, 6–7 mm.

crassus Van Duzee 1910

New England and New York west to Indiana, and south to North Carolina.

Genus II. *Gastrodes* Westwood 1840

Key to Species

1. Rostral segment I reaching to the middle of the eyes, [apex of the rostrum reaching to the intermediate coxae; head as long as wide, including the eyes; anterior femora in both sexes with a single strong subapical spine; posterior inner angles of the metapleura rounded, not conspicuously produced and not reflexed in either sex; length, 5.9–7.27 mm., width (at abdomen) 2.39–3.1 mm.].

pacificus Provancher 1889

Pacific slope; Colorado, Utah, Nevada, Nebraska.

Rostral segment I passing the posterior margin of the eyes, and reaching, or nearly reaching, the base of the head 2

2. Spine of the anterior femora in the male bifid or double at the apex; (head hardly longer than wide; rostral segment I almost reaching the base of the head; inner posterior angles of the metapleura rounded, very narrowly reflexed; length, 8.2 mm.) ..... *walleyi* Usinger 1938

(= *ferrugineus* auctt. am., nec Linné)

Ottawa, Canada; British Columbia.

Spine of the anterior femora in the male single at apex 3

3. Apex of rostrum reaching at least to the middle of ventral segment I, segment I reaching the base of the head; head *distinctly* longer than wide, including the eyes (6:5); antennal segment II about one-sixth longer than III or IV; (length, 7.3–8.5 mm., width, 2.9–3.2 mm.).
conicola Usinger 1938
California; on digger pine (*Pinus sabiniana* Dougl.).

Apex of rostrum *not* reaching ventral segment I, segment I not quite reaching the base of the head; head *slightly* longer than wide, including the eyes; antennal segment II *much less* than one-sixth longer than III or IV 4

4. Inner roundedly produced angle of the metapleura *distinctly* reflexed; anterior femora with *no* spines along the lower or inner side; length, 8.19 mm., width, 3.27 mm.
arizonensis Usinger 1938
Arizona.

Inner roundedly produced angle of the metapleura *feebly* reflexed; anterior femora with *two* rows of spines along the lower or inner side; length, 7.8 mm., width, 3 mm.
intermedius Usinger 1938
British Columbia.

Genus III. *Togodolentus* Barber 1918

The generic structures of this were given by H. G. Barber (1918. Journ. N. Y. Ent. Soc. XXVII: 64) as follows:

Dorsal parts dull; head not transverse, submerged to the eyes, as wide across the eyes as the interior margin of the pronotum; bucculae lightly elevated, meeting in an obtuse angle on a line drawn across the middle of the eyes; rostral segment I extending to base of head, II long, more than one-third longer than III, apex of IV reaching just past middle coxae; antennae very long, slender and nude, segment I long, longer than the head, the apex of the tylus not reaching its middle point, II not twice as long as I, III about one-fourth shorter than II, IV one-third shorter than III; pronotum not transverse, rather parallel-sided, the lateral edges broadly expanded and reflexed, a little widened between the two lobes, anterior lobe subquadrate, the disc obsoletely punctured, anterior margin slightly concave, submargin depressed and bounded behind by a series of punctures, posterior lobe coarsely punctured, posterior margin strongly concave; scutellum longer than wide, punctured;

clavus widened posteriorly, rather closely and irregularly punctured; commissure nearly as long as scutellum; corium flattened, closely punctured, costal margin laminately expanded, reflexed, pale; anterior femora much incrassate, with a few well-developed teeth; anterior tibiae nearly straight; posterior tibiae not pilose but with a few fine very short bristles; posterior tarsal segment I twice II and III taken together; ventral segment IV laterally with two anteriorly placed opaque spots.

The type species, described on the same page, is *Togodolentus genuinus* Barber 1918, later found to be the same as *Eremocoris wrighti* Van Duzee 1914. As indicated, the species was described in *Eremocoris* by Van Duzee (1914. Tr. San Diego Soc. Nat. Hist., II, no. 1, p. 9) and naturally was not supposed to be in quite another generic category. The principal structural characters for the species, as given by its author (l.c.) are the following:

Pronotum oblong, not narrowed anteriorly, the anterior angles depressed and rounded, the carinate margins broad, pale, the anterior lobe impunctate, posterior narrow, punctured, slightly elevated humeri bordered by the foliaceous carina; scutellum small, hardly punctured; anterior femora with the apical spur long, posterior one absent, the smaller denticulations hardly discernible; posterior tibiae smooth, tarsal segment I fully twice as long as II and III taken together; length, 6 mm.

To this may be added these structures, as given by Barber in his description of *Togodolentus genuinus*, which, according to Blatchley, is presumably the same species.

Form narrow ovate; head impunctate; antennae long, segment I exceeding the apex of the head by more than one-half its own length; pronotum longer than wide, anterior lobe subquadrate, disc finely punctured, more plainly so just within the laminate, reflexed pale lateral margins, and with a series of punctures just within the rather straight anterior margin, posterior lobe more depressed, closely and coarsely punctured, posterior margin lightly sinuate; scutellum punctate; clavus flat, level with the flattened corium and punctured in irregular series; commissure almost as long as the scutellum; costal margin expanded and reflexed, pale; venter with long setae posteriorly; anterior femora with a large subapical tooth, between which and the apex are several smaller; posterior tibiae with short bristles; posterior tarsal segment I twice as long as II and III taken together; length, 6.5 mm.

Both the species were described from California; in *Neotoma* nests.

Genus IV. *Eremocoris* Fieber 1861

Key to Species

1. *All* femora thickly setose; (anterior lobe of the pronotum thickly pilose with the setae rising from the fine sparse punctures, posterior lobe coarsely punctured; head, hemelytra, femora and tibiae thickly pilose with long erect setae; anterior tibiae in the male strongly curved, widened apically; length, 7–7.5 mm.) ..... *setosus* Blatchley 1926
   Massachusetts, New York, Virginia, District of Columbia, Georgia, Florida, Ohio, Indiana.

   All femora *not* setose, at most only one pair 2
2. Incrassate anterior femora with *two* large teeth 3

   Incrassate anterior femora with *one* large tooth 6
3. Anterior lobe of the pronotum *impunctate;* (anterior femora with *about* six small teeth, the longer apical and the shorter basal tooth both distinctly larger than the others; pronotum regularly narrowed anteriorly, anterior lobe impunctate with the usual median impressed point, collum set off by a row of deep punctures, posterior lobe flat, punctured, the punctures dragged anteriorly and near the middle; scutellum punctured, rather deeply impressed and a little wrinkled across the disc; posterior tibiae smooth except for a very minute pubescence; mesosternal groove narrow and rather deep; length, 7 mm.) ..... *inquilinus* Van Duzee 1914
   California; in wood rat (*Neotoma*) nests.

   Anterior lobe of the pronotum with a few punctures 4
4. Pronotum *parallel-sided;* (antennal segment IV one-third shorter than III; head a little longer than broad across the eyes; bucculae not reaching the base of the antennae; antennal segment I passing clypeus by two-thirds of its own length, II one-third longer than I, III two-thirds of II, IV two-thirds of III; rostrum reaching base of posterior coxae, segment I slightly passing base of head, II equal to III and IV taken together; mesosternal groove deep, the angulated raised sides forming a roughened tubercle; osteolar canal long, a little less than right-angled; pronotum large, parallel-sided, length and width subequal, constriction shallow, at basal one-fifth, anterior lobe long, unusually convex and obscurely punctured, posterior lobe flat,

coarsely punctured, collum linear, set off by a row of punctures, explanate margins straight, narrow except across the constriction, posterior margin broadly excavated; anterior femora strongly incrassate, subsulcate below, anterior edge with two large teeth, the apical the larger, and on each side of the apical, *three* smaller teeth; anterior tibiae much curved, with *three* teeth on the expanded apex, followed basally by six smaller ones; posterior tibiae with numerous long erect stiff hairs; length, 9 mm.).

semicinctus Van Duzee 1921

California.

Pronotum not parallel-sided 5

5. Rostral segment I *passing* the base of the head; (head one-quarter broader across the eyes than long, shagreened and hardly punctured, opaque at base, somewhat polished and clothed in appressed golden pubescence before the middle line of the eyes; antennal segment I surpassing clypeus by a little more than one-half of its own length, II one-half longer than I, III and IV subequal, a little shorter than II; pronotum almost one-third broader than long, regularly narrowed anteriorly, moderately constricted at basal one-third, anterior lobe flattened, nearly impunctate; collum narrow and distinct, expanded margins of the pronotum broad with a single row of distant long hairs, posterior lobe coarsely punctured, posterior margin not deeply excavated; scutellum one quarter broader than long; anterior femora in male with two strong teeth, the apical the larger, with three smaller teeth on each side of the apical tooth; anterior tibiae much curved and expanded at the apex, with two large teeth and about four smaller ones toward the base; rostrum reaching middle of posterior coxae, segment I passing base of head, II subequal to III and IV taken together; mesosternal sulcus shallow, sides nearly tumid; osteolar canal right-angled; length, 6 mm.).

opacus Van Duzee 1921

California.

Rostral segment I *not* reaching the base of the head; (head finely shagreened; antennal segment I shortest, II a little longer than III or IV, which are subequal; rostral segment I reaching almost to base of head, II longest, reaching anterior coxae, III reaching intermediate coxae; anterior lobe of the pronotum feebly impressed in the middle with

a few scattering points, posterior lobe narrow, coarsely punctured, but feebly differentiated from anterior lobe; scutellum coarsely punctured, depressed posteriorly and anteriorly, with a feeble longitudinal carina; anterior femora with two large teeth and several minute ones below; length, 6–6.5 mm.) ..... *obscurus* Van Duzee 1906
British Columbia, Vancouver Island, California.

6. Anterior lobe of the pronotum polished, impunctate; (head minutely punctured on each side beyond eyes; antennal segment II nearly twice I, III three-quarters of II, IV a little shorter than III; rostrum reaching middle of metasternum, segment I just passing base of head, II shorter than III and IV taken together; pronotum about as long as humeral width, sides parallel, anterior angles rounded, constriction near basal one-fourth, anterior lobe polished, impunctate, strongly convex, collum narrow, linear, strongly set off by a line of punctures, posterior lobe flat, coarsely punctured, expanded sides rather broad; scutellum long, depressed, remotely punctured and transversely wrinkled; prosternum carinate, posterior margin forming an angle or an obtuse carina across the base of the median tooth, which is much bent inward between the anterior coxae; mesosternum with a deep sulcus, the tuberculate sides rough; osteolar canal broad and angled, apex shorter than in allied species; anterior femora shallowly sulcate below, anterior edge with *one* large tooth and about five smaller on each side, the basal larger; posterior tibiae with irregular long hairs on the inner face, outer face nearly smooth; length, 7 mm.) ..... *dimidiatus* Van Duzee 1921
Colorado.

Anterior lobe of the pronotum more or less punctured 7

7. Form rather narrow; pronotum but little wider than long, distinctly depressed, nude and subshining; (anterior tibiae in male with a short preapical tooth, and strongly curved; anterior lobe of the pronotum finely and sparsely punctured; head finely sparsely punctured; antennal segment II about twice I, III one-quarter longer than II, IV slightly shorter than III; pronotum slightly wider than long, lateral margins strongly converging anteriorly, anterior lobe finely and sparsely punctured, nearly twice as long as the more closely and coarsely punctured posterior lobe, sinus between the lobes shallow and with a series of coarse punc-

tures, edge of narrowly explanate margins straight, humeral tubercle quite distinct; pleura finely and closely punctured; anterior femora strongly incrassate, with a large preapical tooth with a few smaller teeth to apex, before the larger tooth with a double series of quite irregular smaller teeth; anterior tibiae of the male strongly curved with a stout preapical tooth; scutellum smooth, subshining, sparsely finely punctured, carinate apically; corium finely sparsely punctured; venter shining, very finely obsoletely punctured and sparsely setose apically; length, 6–7 mm., width at humeri, 1.75 mm.)

depressus Barber 1928

New Jersey, Virginia, North Carolina, Louisiana, Mississippi; on *Pinus virginiana* and on squash.

Form relatively broader, not depressed; pronotum distinctly wider than long, dull, sparsely pilose; [anterior femora with one large tooth and several smaller ones apically; head punctured; pronotum distinctly wider than long, anterior lobe almost impunctate, lateral margins reflexed; scutellum finely but sparingly and irregularly punctured, apically with a smooth slightly elevated central line; anterior tibiae with one tooth; femora not pilose; posterior tibiae setose in both sexes; corium finely punctured; length, 5.2–6.3 mm. (Say states of his species, "length less than 3/10 of an inch," which is about 7 mm.)] ..... *ferus* Say 1832

Nova Scotia, Alberta, Minnesota, Wisconsin, Michigan, Indiana, Kansas, Missouri, Louisiana, New Mexico, Colorado, Illinois, Montana, Utah, Texas, Quebec, S. C.; in general from New York to South Corolina.

Genus V. *Scolopostethus* Fieber 1861

Key to Species

1. Anterior femora with a large median spine, with smaller spines running from it both toward the apex and the base; lateral margins of the pronotum *concave;* (elongate; head minutely sparsely punctured; anterior lobe of the pronotum minutely sparsely punctured, posterior lobe more distinctly punctured; mesosternum simple; length, 3–4 mm.).

thomsonii Reuter 1874

(= *neglectus* Saunders 1892

New England, New York, New Jersey, Newfoundland,

Alaska to Colorado, British Columbia, Indiana, California, Arizona; on willow.

Anterior femora with a large median spine, the smaller spines running *only* from the large spine to the apex; lateral margins of the pronotum straight or nearly straight 2

2. Clavus with *four* rows of punctures, the two inner confused toward the base; (pronotum, scutellum and hemelytra glabrous; antennae slender, half as long as the body; pronotum slightly shorter than its basal width, sides nearly straight, anteriorly very slightly rounded, the lateral margins laminate; anterior tibiae in male strongly curved, in female slightly; length, 2.75–4.25 mm.).

diffidens Horváth 1893

Quebec, Maine, Massachusetts, New York, New Jersey, British Columbia, Vancouver Island, Washington, California.

Clavus with *less* than four rows of punctures 3

3. Lateral edge of the pronotum carinate anteriorly only, laminate posteriorly; (head slightly wider than long, finely punctured, eyes not quite touching pronotum, apex of tylus reaching middle of antennal segment I; antennal segment II twice I, III one-third shorter than II, IV about equal to III; pronotum a little wider than long, transversely impressed through the middle, the anterior and posterior lobes subequal, disc of anterior lobe impunctate, a series of punctures within the lateral edge, which is carinate anteriorly only, expanding posteriorly, expansion widest between the lobes, behind which it suddenly ends before the elongate humeral elevation, posterior lobe more closely and coarsely punctured; scutellum with the central disc depressed and finely punctured, posteriorly obsoletely carinate; clavus with three rows of punctures, the two outer anteriorly converging into a single row; anterior half of the corium punctured along the veins, more than the posterior one-half of the corium sparsely punctured, costal margin rather widely expanded, lightly reflexed and impunctate; anterior femora with one large postmedian spine and toward the apex with four or five minute even teeth; venter shining, coated with fine incumbent hairs; length, 3.5–4.5 mm.) ..... *pacificus* Barber 1918

California.

Lateral edge of the pronotum laminate *throughout* 4

4. Length 4 mm.; (antennal segments II, III and IV subequal, I exceeding apex of head; head with eyes wider than long, punctured; anterior lobe of the pronotum finely and indistinctly punctured, posterior lobe distinctly and more coarsely so; scutellum finely and indistinctly punctured; length, 4 mm. ..... *tropicus* Distant 1882
California, (Guatemala).

Length *less than* 4 mm.; (pronotum, scutellum and hemelytra glabrous; pronotum trapezoidal, anteriorly very slightly narrowed, a little narrower than the basal width, anteriorly lightly rounded; anterior tibiae in male strongly curved; mesosternum simple); length, 3.25 mm.
atlanticus Horváth 1893
New Hampshire, Massachusetts, New York, New Jersey, British Columbia, Vancouver Island, Washington.

Genus VI. *Cistalia* Stål 1874

Key to Species

A. Antennal segment I slightly constricted toward base; lateral margins of the pronotum carinate only, not expanded; length, ? ..... *signoretii* Guérin 1857
Cuba.

B. Antennal segment I gradually enlarged from base toward apex, (all segments distinctly pilose, *without* longer scattered hairs); lateral margins of the pronotum *distinctly* expanded; (costal margin of the corium laminately expanded; clavus coarsely and irregularly punctured; anterior femora with two or three preapical spinules below); length, 5–6 mm. ..... *explanata* Barber 1938
(= *signoreti* Stål 1874, nec. Guérin)
Kansas, Louisiana, Texas; under bark and at roots of plants.

Note.—*C. signoretii* Guérin is included in the above Key because it may possibly be found in Florida; and, in any case, it will be possible to be sure of Barber's species.

Genus VII. *Valtissius* Barber 1918

This genus was erected by H. G. Barber (1918. Jour. N. Y. Ent. Soc. XXVI: 63) to contain *Petissius diversus* Distant (1893. Biol. Cent. Am., Rhynchota I: 407, pl. 35, fig. 22). Its characters, taken from the original description are:

Shining; pronotum and hemelytra sparsely pilose; head triangular, hardly transverse, width across eyes almost subequal to width of anterior margin of the pronotum, eyes touching pronotum; antennae short pilose, set close to the eyes, segment I rather long, only a little shorter than III, exceeding apex by one-third its own length, III and IV subequal; rostrum reaching to posterior coxae, segment I reaching base of head, subequal to antennal segment I, segment II longer than III; pronotum very short and transverse, without trace of a collar, almost twice as wide as long and subequal to length of scutellum, hardly separated into two lobes, disc of anterior lobe impunctate, posterior lobe sparsely punctured, anterior and posterior margins straight, the lateral margins straight and gradually converging anteriorly, edge acute and beneath on the propleura the edge is longitudinally linearly impressed; scutellum a little longer than wide; clavus with three regular rows of punctures; commissure shorter than scutellum; corium rather closely punctured; moderately incrassate anterior femora with a few minute teeth and several long setae; posterior tibiae with a few fine setose bristles; posterior tarsal segment I *much* longer than segments II and III taken together.

The one species in the genus, designated as the type by Barber, is *Valtissius diversus* Distant 1893

The structures of this, taken from the original description and the figure are:

Antennal segment II a little longer than III, III and IV subequal; pronotum with a transverse impression; corium strongly pilose; length, 3 mm.; (from fig. 22, pl. 35) posterior lobe of the pronotum coarsely punctured; hemelytra without veins; antennal segment II longest, I, III and IV apparently subequal.

Distant's whole description is a few lines of color characters.

The species is recorded from Michigan, Florida, Louisiana and Texas; originally described from Guatemala and Panamá.

Genus VIII. *Xestocoris* Van Duzee 1906

This thus far is another monotypic genus. The structural characters as given by Van Duzee (1906. Ent. News, vol. XVII, pp. 389/390) are as follows:

Ovate oblong, widest across apex of clavus, polished; head about two-thirds length of pronotum, subcylindric, horizontal, clypeus prominent, bucculae but little elevated,

forming a distinct lobe on each side of the base of the rostrum; ocelli much nearer the eyes than to the midline of the vertex; rostrum passing intermediate coxae, segment I reaching base of head, II distinctly longer than III, IV shortest; antennae stout, segment I surpassing apex of head by about one-half its own length, II and IV subequal, III shortest; pronotum broad, about three-fifths wider than long, sides feebly carinate. distinctly rounded anteriorly to the head, transverse impression weak, close to the posterior margin, humeri prominent and angular; scutellum depressed; clavus with three series of punctures; ventral suture III strongly curved anteriorly; venter laterally with three opaque spots on segment IV, the two anterior set close together; anterior femora incrassate, with four minute teeth, one longer and stouter than the others.

The one species is

Xestocoris nitens Van Duzee 1906

The principal structural characters in the original description are:

Black, highly polished, above long-setose; humeri prominent, rectangular; head and anterior lobe of pronotum impunctate, the narrow posterior margin, as well as the scutellum and hemelytra with coarse scattering punctures, in a line on the margins of the scutellum; a few coarse punctures close to the anterior margin of the pronotum and a small group near the center of the disc; length, 3–3.5 mm.

Maine, Massachusetts, New York.

This was described from the brachypterous form.

Genus IX. *Cryphula* Stål 1874
(= *Trapezus* Distant 1882)

Key to Species

1. Upper surface distinctly pilose; (head nearly as long as wide, impunctate; antennal segment I exceeding apex of tylus by one-half its own length, II longest, one-fourth longer than IV, III a trifle shorter than IV; pronotum parallel-sided, the margins rather abruptly rounded in front, with the usual setae at the rounded angle, lateral edge very narrowly carinate, posterior lobe finely and obscurely punctured, anterior margin straight; scutellum almost impunctate; incrassate anterior femora with no teeth, merely

a few tubercles and long setae; posterior tibiae with two rows of four long rigid oblique bristles on each; posterior tarsal segment I nearly twice as long as II and III taken together); length, 3.5 mm. ..... *abortiva* Barber 1918
Arizona.

Upper surface *not* pilose 2

2. Antennal segment III shorter than IV, II and IV subequal; (sides of body parallel; head remotely finely punctured; antennae remotely setose, segment I above toward apex with stouter rigid setae, II nearly twice I and subequal to IV, III shorter; pronotum transverse, not longer than head, sides parallel, straight, rounded and converging at apex, smooth, basal one-third distinctly punctured; scutellum as long as the pronotum, punctured on disc to lateral margins; hemelytra punctured on clavus and inner part of corium more distinctly so); length, 3 mm., width, 1.5 mm.
paralellograma Stål 1874
(= *immaculata* Distant 1893)
New York, New Jersey, Kansas, New Mexico, Texas.

Antennal segment III subequal to IV, II longer than IV; length, 3.5 mm. ..... *apicata* Distant 1893
Arizona, (Guatemala).

Note.—This Key is made up from descriptions. It is to be noted that the only structural character Distant gives for his *apicata* preceding lies in the antennae. His description entire (Biol. Centr. Am., Rhynchota I: 217) reads:

"2. *Trapezus apicatus*, n. sp.—closely allied to the preceding species; but scutellum with the apex only ochraceous, and antennae with the second joint distinctly longest, and third and fourth joints subequal in length; the third joint has the apex piceous.—Long. 3½ millim."

Subfamily 9. **Pamphantinae** Barber & Bruner 1933

This new subfamily was established by Barber and Bruner (1933. A New Subfamily of Lygaeidae, including a New Genus and Two Species of Pamphantus Stål—Journ. N. Y. Ent. Soc. XLI: 531–539, plates XXXIX and XL) for two American genera, namely, *Pamphantus* Stål and the new genus *Neopamphantus* Barber & Bruner. Although the keys following contain mostly Antillean species, they are offered for the reason that I should be inclined to look for them in Florida, since little by little we find more of these West Indian forms there. It is obvious from its general geologic characteristics

that Florida is akin to Cuba, and thus forms a part of this island system, except that it is attached to the mainland. Moreover, the distance between Florida and Cuba is short, and insects, as is well-known, migrate long distances over water under favorable and unpredictable conditions. Hence, such Antillean forms should be looked for intensively within our territorial limits, especially about the Gulf of Mexico.

Key to Genera

A. Eyes large, strongly projecting, substylate; vertex between the eyes smooth, depressed; head strongly inclined anteriorly; ocelli closer to each other than to the eyes; costal margins of the corium strongly expanded posteriorly.
II. *Neopamphantus* Barber & Bruner 1933

B. Eyes prominent but not substylate; vertex between the eyes either flat or slightly convex; head generally moderately inclined anteriorly; ocelli closer to the eyes than to each other; costal margins of the corium at most only slightly expanded posteriorly ..... I. *Pamphantus* Stål 1874

In the key following, all the species are included, although only *Pamphantus elegantulus* Stål appears to have been more or less doubtfully recorded from the United States.

Genus I. *Pamphantus* Stål 1874

Key to Species

1. Pronotum distinctly longer than wide, the transverse constriction well behind the middle, the anterior lobe nearly twice as long as the posterior; scutellum longer than wide, about as long as the commissure, (coarsely punctured); (head, pronotum and corium anteriorly sparsely long-pilose; antennae longer than the head and pronotum taken together, segment II subequal to IV, III one-quarter shorter than II; pro- and mesopleura coarsely and metapleura finely punctured; length, 3.7 mm.) ..... *mimeticus* Barber 1926
Cuba; with the ant *Pseudomyrma elongata* Mayr var. *cubaënsis* Forel.

Pronotum not or but little longer than wide, transverse constriction rather slight, placed just behind the middle, the anterior lobe but little longer than the posterior; scutellum nearly as wide as long 2

2. Apex of corium *not* extended posteriorly to the middle line of

the membrane; (scutellum shorter than the commissure; head and pronotum laterally with a few fine hairs; anterior lobe of the pronotum with two large impunctate spots; scutellum punctate to margin; clavus with three rows of punctures; corium punctured in rows to the claval suture and to the longitudinal vein, smooth posteriorly; abdomen smooth, shining; length 3.5 mm., width, 0.75 mm.).

elegantulus Stål 1874

"Southern States" (Uhler); Cuba.

Apex of corium extended to a point *behind* the middle of the membrane 3

3. Antennae long, very nearly one-half the length of the entire body, (segment I over one-third the length of II, III just over twice I, IV longest; ocelli nearly three times as far from each other as from the eyes; scutellum a little wider than long with a few coarse punctures, plainly shorter than the commissure; rostrum reaching to the middle of the mesosternum; ovate spot within the humeral angles smooth; length, 3.6 mm., width at humeri, 0.81 mm.).

pallidus Barber & Bruner 1933

Cuba; elevation 1000 meters (3281 feet).

Antennae short, much less than half the length of the body 4

4. Vertex *distinctly more* than twice the diameter of one eye; head moderately inclined anteriorly; ocelli only slightly further from each other than from the eyes; pronotum a little longer than wide; hemelytra with a broad fuscous stripe from the clavus to the apex of the membrane; (antennae a little longer than the head and pronotum taken together, segment II more than twice the length of I and subequal to IV; scutellum nearly as long as wide, coarsely and rather sparsely punctured); length, 3.31–3.43 mm., width at humeri, 0.71 mm. ..... *vittatus* Bruner 1932

Cuba.

Vertex *less* than twice the diameter of one eye; head strongly inclined anteriorly; ocelli much closer to the eyes than to each other, or than to the median line of the head; (pronotum about as long as wide); hemelytra *without* a stripe, membrane broadly vittate posteriorly; length, 2.8 mm., width, 0.6 mm. ..... *atrohumeralis* Barber & Bruner 1933

Haiti.

Genus II. *Neopamphantus* Barber & Bruner 1933

Key to Species

A. Head one-third the length of the pronotum, seen from above, width across the eyes equal to the width of the posterior lobe at base; vertex with a slight longitudinal median elevation; antennae somewhat longer than the head and pronotum taken together, segment II more than twice the length of I and about as long as IV; rostral segment I somewhat shorter than II, equal to III and subequal to IV; scutellum as long as wide; length, 4.37–5.37 mm., width at humeri, 0.96–1.09 mm., at hemelytra, 1.12–1.50 mm.

maculatus Barber & Bruner 1933

Cuba; elevation 3000–5000 feet.

B. Head two-fifths the length of the pronotum, slightly narrower than the posterior lobe of the pronotum; vertex smooth, disc slightly convex; antennae longer than the head, pronotum and scutellum taken together, segment II two and one-half times the length of I and subequal to IV; rostral segment I distinctly shorter than II and subequal to III and IV taken together; scutellum wider than long; length, 4.5 mm.. width at humeri 1.03, at hemelytra 1.15 mm.

calvinoi Barber & Bruner 1933

Cuba; elevation 3000–3250 feet.

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NOTES AND KEYS ON THE GENUS *BROCHYMENA* (PENTATOMIDAE, HETEROPTERA)

BY HERBERT RUCKES
NEW YORK, N. Y.

The genus *Brochymena,* established by Amyot and Serville in 1843, is a New World representative of the tribe *Halyini.* When the genus was erected there were few species known that could be placed in it. These had previously been assigned to the different genera, *Cimex, Halys,* and *Pentatoma.* Since that time a considerable number of new species have been described so that today there are twenty-four recognized ones and two varieties. Keys of various proportions and values have been made at different times for the determination of these species. The most complete keys are those published by Van Duzee in 1904 and by Bueno in his *Synopsis* in 1939. Almost as many species have been described since 1904 as had been known up till then and several new species have been added since 1939. Since the Bueno key is not all inclusive and has limitations (it was meant for the student who would already be familiar with the limits of variation of each species) it was thought best to re-write the taxonomy of this genus and add to it many comments of interest to the general entomologist. The keys that follow include those species also that occur beyond the national limits of the United States. It is hoped that the completeness of this work will be an incentive toward writing up other pentatomid genera in a similar way.

The Genus

The genus is a very unified one and forms one of the most natural subdivisions of the family Pentatomidae. The peculiar color pattern and design found on the elytral membrane led Amyot and Serville to use the name *Brochymena* (from the Greek to mean "flecked-wing") and to set this group of insects off from all others in the family. The arborescent and vermiculate dark markings on the membrane are present in all members of the genus (though they may be pale and obscure, at times, in *B. pilatei* Van D.) in contrast with the absence of them in other genera, tribes and subfamilies of New World Pentatomidae. Besides this character the genus shows individuality in the structure of the head, the length of the antennae, the presence of a midventral abdominal furrow, and in the structure of the genital cup of the male.

The head (Fig. 1) is quite elongated with straight or weakly sinuate edges. There is an obvious subapical tooth (SAT) on the lateral edge of each jugum (JUG); such a tooth may, at times, be large [*B. arborea* (Say), Fig. 22] or small (*B. lineata* Ruck., Fig. 1), acutely angled (*B. affinis* Van D., Fig. 40) or appear merely in the form of an obtuse crenulation near the apex of the head (*B. punctata* Van D., Fig. 29). For the most part the disc of the head is coplanar, though there are a few cases where it is irregularly impressed at various points giving an undulated appearance to its upper surface. Usually the ground color of the head, and that of the rest of the body as well, is some shade of yellow or brown, ranging from pale testaceous to dark fuscous; occasionally reddish tones also are present. Both the dorsal and ventral surfaces of the head and body are punctured with contrastingly darker brownish to piceous pits of various sizes. Sometimes these punctures form a definite design although more often no evident pattern is discernible. The punctures and pits are always more numerous and larger on the dorsal side of the individual.

The antennae are long and slender, always at least, as long as the head and thorax combined and usually longer; they are inserted in a crateriform pedicel on the side of the head, below its jugal border and some distance in front of the eyes. The proportionate lengths of their respective segments are, in some instances, valid characters for the segregation of species, although I have found that this is not as constant a character as could be desired.

The ventral surface of the abdomen is invariably sulcate or provided with a shallow median furrow to receive the long beak; this

longitudinal furrow is evident through, at least, the fourth visible segment and then evanescent posteriorly. The beak reaches beyond the metacoxae and beyond the middle of the third (second visible) segment. Its tip and most of the last joint are always dark fuscous to piceous.

In the male the genital cup, so called because it is partially globular like a slightly elliptical, diminutive bowl, does not have the ventral lip elongated as in the genus *Euschistus* nor is the ventral border sharply upturned as in many genera of pentatomids, such as *Thyanta*. Rather, the edge is shallowly inflexed or weakly upbent, leaving most of the contents of the segment visible from the posterior and dorsal aspects. The edge of the ventral lip is frequently provided with lateral lobes, excavations here and there, and small crenulations, so that transversely it presents a broken border. In this genus the claspers or parameres (Figs. 2–7, 15, 18, and 20) are unusually large and heavy with a stout basal arm and hook-like or lobate terminal head. In one group of species the ventral hook or ramus of the head of each clasper (Figs. 2, 15, 18, 20) overhangs the lower lip of the cup. The proctiger likewise is quite large and as in other pentatomids covers the aedeagus when the males are not participating in the copulatory act.

The pair of stink glands, as in other pentatomid adults, open on the metasternum just posterior to the cephalic edges of that segment and about midway between the metacoxae and the lateral margins of the plates. In one subdivision of the genus the orifice of the gland is not provided with a laterally extending auricle or canal but opens directly on the surface of the metasternum; in this case there is no evaporating area around it. In the other subdivision the orifice is slightly raised on a prominent crateriform base to which is appended a tongue-shaped laterally extending auricle acting as a distributing canal; this frequently has a partial spiral twist to it. Ordinarily the crateriform base and auricle are raised from the surface of the metasternum and contrastingly colored against a paler rugose or pebbled subtriangular evaporating area; the latter almost completely surrounds the orifice, base, and auricle.

Relationships Between Species

To arrange the species of this genus in a phylogenetic order would be more or less a hazardous undertaking at this time. Considerably more knowledge relative to the geographic distribution, habits, food plants, life cycles, rate of mutations, extent of interspecific hybridization, etc., is needed before a definite evolutionary

history can be properly established. Basing a phylogeny solely upon differences and similarities of a morphological nature would be inconclusive. However, structural evidence shows that certain natural relationships do occur and that these relationships are constant.

Within this genus no student will question the fact that large natural divisions can be established on the basis of the structure of the humeri, claspers, and metasternal orifices. The author has therefore broken the genus down into three GROUPS, or complexes. The first of these is the weakest subdivision since it consists of only one species of which the known individuals are all females. This is called the *cuspidata* GROUP, typified by *B. cuspidata* Dist. In this species the humeri are very distinctive and unlike those of any other species of *Brochymena* known, in that they are subconical and prolonged into a cuspidate process (Fig. 8). The other two GROUPS of species are strikingly in contrast with one another and the preceding and form two natural subdivisions. The *arborea* GROUP typified by *B. arborea* (Say) and including the following species: *arborea, haedula, aculeata, apiculata, poeyi, barberi* (and var. *diluta*) and *florida,* is characterized by the presence of quadrilateral humeri with strong teeth (Fig. 9), a metasternal orifice opening directly on the plate, without a crateriform base or auricle or pebbled evaporating area, and claspers, the heads of which are mattock-shaped (Figs. 2, 15, 18, 20), with the lower arm or ramus projecting over the lower lip of the genital cup. The *quadripustulata* GROUP, typified by *B. quadripustulata* (Fabr.) and including the following species: *cariosa, lineata, parva, quadripustulata, pilatei, sulcata, dilata, punctata,* (and var. *pallida*), *tenebrosa, humeralis, carolinensis, marginella, myops, affinis,* and *hoppingi,* is characterized by the presence of triangular humeri (Fig. 10) usually with small retrorse teeth, a metasternal orifice on a crateriform base, with an auricle and surrounded by a pebbled evaporating area (Fig. 24) and claspers, in which the heads are not mattock-shaped but which are provided with horizontal or up-turned hooks or laterally expanded lobes (Figs. 3–7) which never overhang the ventral lip of the genital cup.

There is apparently greater homogeneity between the species within the *arborea* GROUP than between those of the *quadripustulata* GROUP, there being less structural variation and dissimilarity between the seven species of the former.

Using the structure of the claspers alone as the basis for further analysis, we find that the *quadripustulata* GROUP can be subdivided into four lesser categories, as four distinctive types of claspers exist.

One type can be called the *cariosa* type (Fig. 4), another the *punctata* type (Fig. 5), a third the *carolinensis* type (Fig. 6) and a fourth the *affinis* type (Fig. 7).

Those species possessing claspers similar to but not identical with those of *cariosa* are *lineata, parva, quadripustulata, pilatei,* and *sulcata* (Fig. 3). These species are arranged in their ascending order of specialization of clasper patterns, *cariosa* being the simplest without any excrescences, *sulcata* bearing a prominent flaring lobe and dorsal hook on each clasper.

The species with the *punctata* type are *dilata* and *punctata* in which the head of the clasper terminates in a large block-shaped lobe (Fig. 5) which is somewhat semicircular in *dilata,* distinctly squarish in *punctata,* and provided with a pair of blunt crenulations on the upper edge of both between which a weak saddle appears. This head is set at almost right angles to the long axis of the stout basal arm of the clasper. These two forms may have been derived from the *cariosa* type; if so, then *dilata* is the closer relative to that type.

The *carolinensis* form of clasper is found in *tenebrosa, carolinensis, marginella,* and *myops.* In this type (Fig. 6) the terminal part of the clasper is bent at an obtuse angle to the axis of the basal arm but lies laterally rather than vertically in relation to that axis in contrast with either of the two preceding types. The species *B. humeralis* is unfortunately known only from the female types, but other structural characters consistent with the facies of the above mentioned species suggest that that is a natural relative of these and hence is included with them in this category.

The species *affinis* and *hoppingi* have claspers that may have been derived from the *carolinensis* type but the differences are sufficiently great to set them off in a distinct category. These claspers resemble diminutive and abortive horns or antlers of the prong-horned antelope with the long axis of the horizontal arm gradually curved upward and outward and terminating in two short blunt prongs (Fig. 7).

All in all there probably is a definite phylogenetic relationship between all these species, but nothing more definite than the above summary can be established at the present time, nor can clearer and more exact lines of descent be indicated. Clasper patterns are, by themselves, criteria of too minor value upon which to found far-reaching conclusions.

Food and Habits

The species of *Brochymena* are primarily herbivorous, although a number of instances of their using animal food have been men-

tioned by competent observers. Lugger (1900) reports that the late Prof. Uhler observed that *B. quadripustulata* is a great enemy of caterpillars and other insects; Hart (1919) says that *B. arborea* has been pictured feeding on Colorado potato beetle grubs, and Sanderson reports *B. quadripustulata* attacking tussock and brown-tail moth larvae. I have seen a nymph of *B. quadripustulata* impale a small lepidopterous larva on its beak. This, however, is not a commonly observed act. The beak is long and slender, adapted for piercing plant tissue and not the strong, stout type characteristic of truly predatory forms of pentatomids; it is apparently unsuited for consistent attack on small, albeit soft-bodied larvae.

In a note (1941) on the feeding habits of *B. carolinensis,* I have described how the beak is partly folded in a zig-zag manner when being inserted into the bark of a tree. It appears that the beak never penetrates very deeply beneath the surface of the object upon which the insect is feeding; even when piercing such soft, fleshy objects as apples or other fruits only a small part of the terminal segment passes through the skin of the food. The stylets penetrate a great deal deeper than the sheath of the beak to reach the available food supply.

For the most part the adults may be found during the summer months on a great variety of shrubs and trees, usually running up and down the trunks and smaller branches. They are by no means restricted to conifers as many older students of the genus and other observers were led to believe. During winter months the rough conifer bark furnishes excellent refuge for the hibernating adults but these insects do not necessarily feed on such plants. In New Mexico I have observed *B. sulcata* Van D., in abundance, feeding on trunks of mulberry (*Morus rubra* Linn.) and honey locust (*Gleditsia triacanthos* Linn.) ; I have likewise taken them from apple and found them abundant in fields, though not feeding there. In the Great Smoky Mountains of Tennessee, *B. quadripustulata* (Fabr.) was taken in quantity while feeding from the stems of stag-horn sumac (*Rhus typhina* Linn.). In this case the bugs tend to congregate in the crotches of the stems and feed from the axils of the compound leaves. This species is also recorded as living on elm, grape, cherry, apple and mountain ash (*Sorbus americana* Marsh.). In the Jemez Mountains of New Mexico, *B. hoppingi* Van D. was commonly found on the trunks of yellow pine (*Pinus ponderosa* Englm.) and in Arizona the late Dr. E. D. Ball said he found *B. lineata* Ruck. feeding on the white-leaf oak (*Quercus hypoleuca* Englm.). On the open mesas of the southwest, where mesquite (*Prosopis glandulosa* Torr.)

abounds, *B. parva* Ruck. is commonly found crawling and feeding on the branches. Provancher states that his *B. 4-notata* (*B. myops* Stål) was taken from sweet gum (*Liquidambar styraciflua* Linn.). In the pine barrens of New Jersey, *B. carolinensis* (West.) is known to feed on pine. In Florida this species occurs in large numbers on the trunks of long-leaf and slash pines (*P. palustris* Mill. and *P. caribea* Morelet) where it may be found actively feeding through the thinner bark. Hart reports that *B. arborea* (Say) has been found on willow, apple, peach, pear; this species also feeds on black-jack oak (*Quercus marylandica* Muench.) from which specimens collected in Virginia were taken.

Breeding and Other Habits

During the winter months the adults hibernate and many may readily be taken from under the bark of standing tree stumps and among the debris in copses. For the most part there is apparently only one generation a year, at least in the northern states. The adults mate and lay their eggs sometime after their recovery from hibernation; the nymphs take a goodly part of the summer months to complete their cycle. In more southern regions, *B. sulcata* Van D. in New Mexico and *B. carolinensis* (West.) in Florida, may have two generations; at least that is surmised from the recorded dates of the matings of the first generation adults; this takes place between the end of July and the middle of August. How soon the eggs are laid after copulation is not known, but it seems unreasonable to assume that these inseminated females, in such warm climates, would then hibernate and retain their eggs until the following year; in all probability oviposition occurs soon after completion of mating. The new generation thus reaches maturity about the end of September or mid-October and proceeds to winter over in the adult stage. Dr. J. R. Eyer of Las Cruces, New Mexico, tells me that he has taken such dormant adult specimens of *B. sulcata* Van D. from under field breeding cages, clapboards of hen houses and dilapidated dwellings, where the bugs sometimes appear in sufficient abundance to become nuisances.

Copulation, certainly in some species, occurs during the day time. The activities during mating in *B. sulcata* Van D. have been described in a short note some years ago (Ruckes, 1938). Whether or not all species follow the same sequence of steps in their respective acts is not known, but all species apparently conform to the general hemipteran pattern in respect to the position assumed during the mating process. That is that, after the male has mounted

on the back of the female and succeeded in inserting his genital organs into the receiving valves, he dismounts and remaining in copula, faces in the opposite direction to that assumed by the female so that the two individuals are in line with their posterior ends in union.

In general the species of this genus are active only during the daytime while they feed or sun themselves. I have found but few records of their capture during the night and analysis of "catches" from trap-lights fails to show that they are attracted in any abundance by lamps. Even in regions where individuals are abundant, as in Kansas, southern New Mexico and central Florida, I have consistently been unsuccessful in finding them attracted to neon lights which are veritable gold mines for collecting other kinds of pentatomids. During some summer seasons past I have had the opportunity of analyzing the trap-light "catches" that have been recorded from many points in Kansas and Nebraska, a project established by the Kansas State College at Manhattan, Kansas. Of all the thousands of insects caught in this manner I have never procured one specimen of any species of *Brochymena,* but other pentatomids have occurred in abundance. Mr. Bueno tells me that a common species (*B. parva* Ruck.) in the vicinity of Tucson, Arizona, has been taken in some numbers at lights in that city.

Distribution

As has been stated in the opening paragraph the genus *Brochymena* is a New World one extending from the nearctic region southward into Central America. As yet it has not been recorded from South America, but is known to reach into southern Costa Rica. Unfortunately there is a paucity of material collected from Mexico and Central America. Furthermore, many of the specimens in collections, even those used as types for species, merely bear a label inscribed "Mexico," "Guatemala," without stating at what collecting station the specimens were captured. We must realize that the area occupied by Mexico and Central America is truly enormous; the greatest distance from the United States border along the Pacific coast to the Canal Zone is about 3500 miles, while that on the Gulf side is well over 1500 miles. There is reason to believe that a genus like *Brochymena* would do in the tropics what other pentatomid genera do there, and that is proliferate in the number of species; yet relatively few are recorded from this entire territory. The author feels rather certain that as more intensive collecting is done in this zone many new species in this genus will be discovered.

The majority of species recorded come from the United States, Canada, and northern Mexico. *B. cuspidata* is known only from Costa Rica; *B. aculeata, B. haedula, B. humeralis,* and *B. tenebrosa* are recorded from southern Mexico, while *B. poeyi* comes from the West Indies, particularly Cuba.

Of the known species some have a wide distribution while others are very limited. Aside from the lack of knowledge due to faulty collecting, the limitations are probably prescribed by the relative abundance of food plants, although this is not the only factor involved. Climatic conditions which determine the length of breeding seasons is certainly one that cannot be overlooked. Parasites and predators apparently play a minor role in limiting the spread of species.

B. quadripustulata appears in most States of this country, is frequently taken in Canada and is recorded from northern Mexico. Its wide distribution may be accounted for by the fact that as a species it has the greatest variety and widest distribution of its food plants. In contrast *B. punctata* appears to be limited to Virginia, the Carolinas, Georgia, and Florida, although Blatchley claims to have taken it in Crawford County, Indiana. *B. carolinensis* is not known definitely from territory west of the Allegheny Mountains in the North but extends westward to eastern Texas through the Gulf States in the South. *B. affinis* seems to prefer the northwestern portion of this country inhabiting Washington, Oregon, Idaho, etc.; *B. parva* prefers the country of the chaparral, *i.e.* the mesas of Texas, New Mexico, Arizona, Colorado, Utah, Nevada, and southern California. The Mississippi Valley and the Plains belt from Nebraska and Illinois southward to the Gulf States, thence easterly to Florida is the range inhabited by *B. cariosa.*

Some species overlap one another in their distribution while the geographic limits of others are very clear cut. By numerical abundance one can easily recognize that in two adjacent areas a western species replaces a more eastern one of close relationship; thus *B. sulcata* throughout the southwest (New Mexico, Arizona, California, Colorado) takes the place of the abundant *B. quadripustulata,* a very close relative, in the eastern States. Similarly *B. hoppingi* is a southern replacement of the more northern *B. affinis,* likewise a very close relative.

Van Duzee in his Catalogue (1917) has already given an extensive list of places from which each of the then known species had been recorded as of that date. In the present paper new localities are listed as they have now become known.

Descriptions

In making up notes and descriptions of the various species a definite order has been followed; characteristics of the various parts are given in the following sequence: the general shape and appearance (facies), the head, the pronotum, the scutellum, the elytra, the connexivum, the ventral aspect of the head, the antennae, the thoracic sterna and pleura, the abdominal venter and the genitalia of both the male and female where possible.

In many of these descriptions the repeated mention of certain characteristics may suggest redundancy and by some thought to be unnecessary. However, I have only too often found that the omission of a statement concerning the nature, the presence or absence, of a certain characteristic to be a weak point in descriptions, and often results in uncertainty of species determination. The fact that the same characteristic appears in more than one species is no reason for omitting the mention of that fact from descriptive statements. I am sure, from experience, that a student may be puzzled as to whether or not the identical character appears in several different species. If that fact is not mentioned in the descriptions he is frequently at a loss to proceed with his identification.

Since the phenomenon of variation is so invariable, different individuals of a species are bound not to conform in all respects to any single character. It becomes necessary therefore, for the student of any species, genus or larger taxonomic category to become familiar with the range of structural and physiological variation within his special group. Only by dint of comparison of a goodly number of specimens of any species can the worker be certain of his identifications.

Altogether several thousand specimens of this genus have been examined during the past few years. The following keys, while artificial in some respects, have been constructed with a view of showing some possible genetic relationship between species. With the aid of Fig. 1 the salient characters used in identification are illustrated. For the most part color, as a characteristic, has been minimized (except in the case of *B. pilatei* where it is relatively constant), because of its variability and because specimens frequently tend to change their color during preservation and sometimes become concolorous after long periods of time. Relative lengths of antennal segments is a character not as dependable as could be desired. Every so often an individual will not conform to specifications as is well illustrated in examples of *B. carolinensis* sent to the British Museum for comparison with Westwood's types.

Mr. W. E. China states "while all other characteristics indicate the examples to be this species there is a distinct discrepancy in the linear ratios of antennal segments." The same is true of one or two specimens I have seen of *B. cariosa* and have compared with the Stål types; in this instance segments two and three are subequal instead of segment two being the longer.

The genus is a rather difficult one to analyze and systematize; since it becomes necessary to understand the principle of species variation and species limitations, the keys have been constructed by using combinations of characters, so that if the first mentioned does not fit exactly one or two of the others will. Some species are more stable and clear cut than others. Chromosomal numbers have not been used as they have in certain other genera, such as *Thyanta*, *Euschistus*, and *Edessa*, to demark species lines. In the future if this be done with *Brochymena*, some of the present species may be subdivided while others may be placed in synonomy and consolidated.

In the following taxonomic portion of this treatise all of the original descriptions of the various species have been brought together and included directly after the library references relative to each species.[1] Where the original description has been in some language other than English, a translation, constructed as accurately as possible to convey the intent of the original author, is given. Hereafter then, a student of this group need not be handicapped by the lack of library facilities to procure information pertinent to the original descriptions. Considerable time and energy can thus be saved.

Every attempt has been made to include as many pertinent data as possible concerning the nature of the type specimens, paratypes, type localities, place where the type is or had been deposited, the food plants, and the general distribution of each species. It is the hope of the author that such treatment may consolidate our knowledge of this genus and that other genera may, in the future, be worked over in a similar manner and all facts concerning them be made available.

Acknowledgements

At this time I wish to state that I am greatly indebted to the authorities of the Riksmuseet, Stockholm, Sweden, especially to M.

[1] In the following pages species names prefixed with † are cases of wrong identification. Homonyms are prefixed by ||. Synonyms are not prefixed by any sign.

Rene Malaise, for the loan of the Stål types which were so willingly sent me from their collections. To Mr. W. E. China of the British Museum, London, I owe the notes and drawings of the types in that institution. I wish also to thank Mr. J. R. de la Torre-Bueno and Mr. H. G. Barber for their assistance. To the late Mr. E. P. Van Duzee I owe the initial encouragement and incentive to study this difficult genus. Appreciation is also expressed to Dr. R. L. Usinger for material collected by him in Mexico. Collections of a goodly number of State Colleges and Experiment Stations were freely and ungrudgingly loaned for examination as were private collections made by numerous professional entomologists. I hereby acknowledge my indebtedness to those of the respective staffs who so willingly cooperated and to all my friends and acquaintances who loaned material for examination.

Drawings

All drawings of legs, humeri (except Fig. 8), pronotal margins, abdominal margins, and heads (except Fig. 17) were made by means of a camera lucida attached to a binocular microscope. The magnifications have thus been kept the same. The claspers (except Fig. 18) were drawn through the camera lucida and a compound microscope. Figs. 15 and 20 are about twice the enlargement of Figs. 2–7. Fig. 1 is a tracing from a projected photograph of the type specimen of *B. lineata* Ruck.

Figs. 8, 17, and 18 are from original sketches made by Mr. W. E. China of the British Museum.

Genus *BROCHYMENA* Amyot and Serville 1843

Haplotype: †**serrata** Am. and Serv. = *quadripustulata* (Fabr.)

Amyot and Serville, Histoire Naturelle des Insèctes: Hémiptères, p. 106, 1843.
Spinola, Tavola Sinottica, p. 31, 1850.
Dallas, List of Hemiptera in British Museum, pt. 1, p. 188, 1851.
Stål, Öf. Vet. Akad. Forh., v. 24, p. 525, 1867.
Stål, Enumeratio Hemipterorum, pt. 2, p. 16, 1872.
Distant, Biol. Centr. Amer., Hemip.-Heter., v. 1, p. 51, 1880.
Provancher, Pet. Faune Ent. Canada, v. 3, Hémiptères, p. 34, 1885.
Van Duzee, Trans. Amer. Ent. Soc., v. 30, p. 26, 1904 (Key).
Van Duzee, Cat. Hemip. N. A.; Univ. Calif. Pub., v. 2, p. 29, 1917.
Hart, Pentatomoidea of Illinois, p. 172, 1919 (Key).
Stoner, Scutelleroidea of Iowa; Univ. Iowa Studies; v. 8, No. 4, p. 55, 1920 (Key).

Blatchley, Heteroptera Eastern N. A., p. 95, 1926 (Key).
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 201, 1939 (Key).

Tête ayant le bord antérieur plus ou moins finement échancré à la jonction des lobes latéraux, qui dépassent le lobe median. *Bec* dépassant plus ou moins le métasternum. *Prothorax* à bords latéraux fortement crenélés, ses angles postérieurs assez fortement saillants. *Élytres* (membrane des) à nervures fourchues, formant des cellules ou figures irrégulières. Tous les autres charactères sont ceux de *Halys*.

Translation

The apex of the head more or less minutely notched at the union of the lateral lobes, which exceed the median lobe. Beak more or less passing the metasternum. Lateral borders of the thorax strongly crenulated (toothed), the posterior pronotal angles strongly produced. The membrane of the elytra with branching (arborescent) nervules (markings) forming small cellular patterns or irregular figures. All other characters are those of *Halys*.

Comments

The details of the above characters have already been given in the introductory pages under the heading of The Genus.

Species of Brochymena

The genus can be divided into three Groups of species as follows:

1) Humeral projections of pronotum acutely produced into a prominent acuminate process; basal third of scutellum gibbous with two distinct lateral elevations with a weak saddle between them; basal valves of female genital plates tumid with their posterior faces declivent and slightly excavated; distal third of fore tibiae strongly dilated.
Male specimens unknown.
cuspidata GROUP (p. 157)

This Group as yet is monospecific, represented only by *B. cuspidata* Dist.

2) Humeral projections of the pronotum subquadrate, prominently toothed; basal third or fourth of scutellum distinctly elevated, almost gibbous with or without a weak

saddle; male genital cup without the ventral lip appreciably upturned, the contents visible from posterior aspect and claspers totally evident; claspers always with a ventrally projecting hook or ramus which overhangs the ventral lip of the cup; basal valves of female genitalia appear as more or less tumid plates with declivent posterior faces usually broadly bordered with a band of fuscous; metasternal orifice merely an inconspicuous pit without an auricle or canal of any kind, or the auricle exceedingly diminutive, almost invisible and no pebbled or rugose evaporating area present; the marginal fuscous band of the elytral membrane either obsolescent, incomplete, or wanting.

arborea GROUP (p. 157)

This GROUP includes the following known species: *arborea, florida, haedula, poeyi, apiculata, aculeata, barberi* (and *barberi* var. *diluta*).

3) Humeral projections subtriangular with small teeth, rounded or otherwise but never subquadrate with prominent teeth or subconical with cuspidate process; basal third or fourth of scutellum hardly elevated; ventral lip of male genital cup somewhat produced and weakly upturned so that claspers are obscured in part and only their distal ends are visible from the posterior; each clasper with only a dorsal or laterally projecting hook or lobe which, if exceeding the margin of the cup, overreaches the dorsal and never the ventral lip; basal valves of the female genitalia never strongly convex or tumid, usually flattened and not declivent behind, and not broadly bordered with fuscous; metasternal orifice raised on a crateriform base to which is appended a distinct laterally extending auricle, this sometimes with a spiral twist to it; a dull subtriangular pebbled evaporating area surrounding the orifice, base and canal; the marginal band of the elytral membrane usually very distinct and complete in various shades of fuscous.

quadripustulata GROUP (p. 177)

This GROUP includes the following known species: *quadripustulata, pilatei, sulcata, cariosa, lineata, parva, punctata* (and var. *pallida*), *dilata, tenebrosa, carolinensis, marginella, myops, humeralis, affinis,* and *hoppingi.*

THE *CUSPIDATA* GROUP

This subdivision of the genus, represented by only the one species, *B. cuspidata* Dist., appears to be unique in so much as it shows close relationship to some species of the *arborea* Group by having the basal third of the scutellum raised, the female genital plates tumid and the distal portion of the fore tibiae dilated. It differs from that Group however by possession of the subconical humeri with a cuspidate process and, in size, being larger than the average specimens of the *arborea* Group.

B. cuspidata Distant (Fig. 8)

Distant, Trans. Ent. Soc. Lond., p. 689, 1900.

Brownish-ochraceous, head, pronotum and base of scutellum darkest; apical two-thirds of scutellum pale ochraceous, sparingly coarsely and darkly punctate, with an obscure small dark spot on each lateral margin about one-third from the apex which is marked with an elongate spot; corium ochraceous much marked and mottled with brownish and with small discal ochraceous spot; membrane grayish spotted and mottled with brownish; body beneath and legs ochraceous; head beneath, sternal margin, punctures and irregular lateral spots to abdomen, femora, excluding bases and spot near apex, tibiae with three annulations above and two beneath, piceous.

Head with the lateral lobes very slightly longer than central; pronotum with lateral margins armed with some very stout spines, the lateral angles acutely produced; base of the scutellum gibbous and with a central carinate elevation; margins of the abdomen strongly produced, the connexivum spotted and punctured with piceous; membrane extending considerably beyond apex of abdomen.

Long. 16 mm.; exp. pronot. ang. 8 mm.; max. abd. lat. 10 mm.

Holotype: Female.
Allotype: No males known.
Paratypes: Not specified.
Type locality: San José, Costa Rica, Alt. 1161 meters.
Type deposited: British Museum, London.
Food plants: Unknown.
Distribution: Costa Rica. Known only from the type.

THE *ARBOREA* GROUP

The species in this complex form a unified and very natural grouping. The salient characteristics that distinguish them from

others in the genus have already been given in the GROUP key. With the exception of the species *B. arborea* (Say) all species appear to be tropical or subtropical or at least southern in their geographical distribution. Whether this complex represents a more primitive or more specialized group than the next one (the *quadripustulata* GROUP) has not been established. On the basis of variations in clasper pattern there is less divergence between species here than in the series to follow. However the individual species are fairly well demarked and apparently show a limited degree of variation between individuals, except in size.

KEY TO SPECIES

1) Distal half to third of fore tibiae dilated, sometimes only weakly so (Fig. 11) 2
   Distal portion of fore tibiae not dilated, sometimes with a slight thickening at the extreme tip (Figs. 12, 13) 6
2) Distal portion of fore tibiae strongly dilated, almost clavate; dilated laterally as well as anterio-posteriorly (Fig. 11) 3
   Distal portion of fore tibiae only weakly dilated, gradually thickened, not clavate; dilated only laterally 4
3) Anteocular spine or sharp denticle present; apex of head subtruncate; length, 12–14 mm., width, 8–8.5 mm. (Fig. 14).
   apiculata
   Van Duzee 1923 (p. 159)
   Anteocular spine or denticle absent; apex of head distinctly arcuate; length, 12–15 mm., width, 8–10 mm. (Fig. 16).
   haedula
   Stål 1862 (p. 161)
4) Buccular tooth obtuse or rounded; tooth of antenniferous tubercle blunt, small; ventral hook of clasper without a triangular lobe; valvular plates of female weakly impressed on posterior faces; length, 13 mm., width, 8 mm. (Figs. 17, 18).
   aculeata
   Distant 1889 (p. 164)
   Buccular tooth acute, almost acuminate; tooth of antenniferous tubercle prominent and acute; ventral hook of clasper provided with a prominent triangular flange (Fig. 20); basal valvular plates of female strongly impressed on posterior faces 5
5) Juga longer than tylus, their tip flaring laterally (Fig. 19);

angles of at least the first two visible abdominal segments acute and produced; length, 13.5–14 mm., width, 8 mm.
barberi
Ruckes 1939 (p. 165)

Juga and tylus subequal, not flaring; angles of abdominal segments rectangular, only moderately produced; length, 13.5–14 mm., width, 8 mm. ..... *barberi*, var. *diluta*
Ruckes 1939 (p. 167)

6) Basal half of each antennal segment pale; head long and narrow (Fig. 21); juga distinctly longer than tylus; claspers lying divergent, close to lateral corners of genital cup and with a vermiform process on the tip of the ventral hook; basal valves of female plates convex, but not tumid, only slightly raised above the level of the abdominal disc; extreme tip of fore tibiae slightly swollen (Fig. 13); length, 12–17 mm., width, 7.5–9 mm. ..... *poeyi*
Guérin 1857 (p. 168)

Only antennal incisures pale; juga and tylus usually subequal, if longer only slightly so; claspers not appressed to lateral corners of genital cup; only weakly divergent and without a vermiform process on tip of ventral hook; basal valves of female plates strongly tumid, with declivent posterior faces which bear strong impressions; tip of fore tibiae not swollen (Fig. 12) 7

7) Head in front of subapical teeth triangular and tip subtruncate; lateral edges of juga essentially straight; lateral margins of head not or very feebly convergent anteriorly (Fig. 22); each humerus with a shallow sulcus between its teeth and dorsal crest; length, 10–18 mm., width, 6–10.5 mm.
arborea
(Say) 1825 (p. 172)

Head in front of subapical teeth arcuate; lateral edges of juga curved; lateral margins of head convergent anteriorly (Fig. 23); dorsal crest of humerus absent or obsolescent, hence a horizontal sulcus above the humeral teeth is wanting; length, 14–18 mm., width, 8.5–10 mm. ..... *florida*
Ruckes 1939 (p. 175)

Brochymena apiculata Van Duzee, 1923 (Figs. 14, 15)
Van Duzee, Proc. Cal. Acad. Sci., v. 12, p. 126, 1923.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 202, 1939.

Male: head slightly broader at base of anteocular spine than long before the eyes, sides nearly parallel, armed before the eyes with a sharp spine as long as the apical width of the tylus; subapical tooth as prominent as in *haedula* but placed farther forward; lateral lobes scarcely passing the tylus; pronotum more even than in *haedula* or *aculeata*, latero-anterior margins armed with about five long acute teeth about as in *aculeata*, the humeral angles narrower with shorter teeth than in that species; anterior lobe with distinct smooth median line the posterior coarsely nigro-punctate but not rugose. Scutellum scarcely longer than its basal width, sides very feebly excavated, apex rounded; the base convex but not tumid; continued as a feeble median carina to apical fourth. Surface nearly smooth, nigro-punctate, the basal punctures arranged in about three vittae either side of the middle. Elytral surface even, nigro-punctate, the punctures forming an obscure transverse vitta near the middle and another near the apex each indicated on the scutellar margin. Membrane and connexivum as in *haedula*. Anterior tibiae but slightly expanded about as in *aculeata*. Antennae more slender than in either allied species, black with narrow pale base to each segment; seg. 2 a sixth shorter than seg. 3. Venter pale testaceous, impunctate, wanting black lateral vittae found in allied species. Rostrum attaining middle of third segment of venter. Genital segment similar to that of *haedula* but the protruding claspers narrower and more acute (Fig. 15).

Holotype: Male #985 Mus. Calif. Acad. Sci. No Allotype.

Paratypes: None.

Type locality: San Pedro Bay, Sonora, Mexico, July 7th, 1921.

Type deposited: Museum, Calif. Acad. Sciences, San Francisco, Calif.

Food plants: Unknown.

Distribution: Southwestern States; Northern Mexico.

Comments

Several specimens in the author's collection show variation in the nature of the anteocular spine, which is of prime specific value here. This spine ranges in size from a short conical tubercle to a rather long acuminate process. In two specimens it is definitely shorter than Van Duzee states in his description while in a third it is much longer. There is also a discrepancy in the degree of dilation of the fore tibiae in my specimens. They are almost as clavate as the ones

in *haedula* and much more swollen than the ones in *aculeata*. There is no doubt that all specimens are *apiculata* for they conform in other respects to the type.

Brochymena haedula Stål (Figs. 11, 16)

Stål, Stett. Ent. Zeit., v. xxiii, p. 99, 1862.
Stål, Enum. Hemip., pt. 2, p. 17, 1872.
Distant, Biol. Cent. Amer., Hemip.-Heter., pt. 1, p. 52; pl. 5, fig. 7, 1880.
Van Duzee, Trans. Amer. Ent. Soc., v. 30, p. 28, 1904.
Barber, Jour. N. Y. Ent. Soc., v. 18, p. 28, 1910.
Van Duzee, Cat. Hemip. N. A., Univ. Calif. Studies, v. 2, p. 30, 1917.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 203, 1939.

Griseo-albida, hic illic infuscata, supra fusco-ferrugineo-punctata; callis parvis duobus discoidalibus thoracis et uno utrimque in angulis basalibus scutelli laevibus; membrana albida, fusca-varia; autennis nigris articulis basi albidus; thorace angulis lateralibus, in processum obtusum dentatum productis, marginibus lateralibus anticis parce dentatis; limbo abdominis supero saltem, nigricante, in medio margine segmenti singuli macula dilute ferruginea ornato; pedibus nigro pallidoque variegatis.

Long. 15, lat. 7 millim. (Mus. Holm. et Coll. Sign.).

Latera pectoris interdum nigricantia.

Caput lobis subaequilongis, medio interdum apice leviter deflexo, lateralibus prope apice extus dente antrorsum prominente armatis. Antennae articulo secundo tertio fere quarta parte breviore. Thorax marginibus lateralibus anticis sinuatis, dentibus nonnulis majusculis armatis, angulis lateralibus in processum truncatum, apice dentibus tribus vel quattuor armatum, productis, linea media percurrente subtili laevigata. Scutellum basi convexum, elevatum. Hemelytra corio basin versus parcius punctato. Abdomen sat ampliatum, segmentorum angulis posticus prominentibus rectis. Meso et metasternum nigra. Venter in exemplis obscurioribus parce fusco-conspersus.

Translation

Greyish-white, here and there infuscate, above fusco-ferruginous punctate; the two small calli of the thorax and one at

each basal angle of the scutellum smooth; membrane white, fusco-variegate; antennae black, base of segments white; lateral angles of the thorax produced into an obtuse dentate process, anterior lateral margins moderately dentate; abdominal margins above at least, blackish, at the middle of the margin of each segment with a dilute ferruginous spot; feet black and pale variegated.

Length 15 mm., width 7 mm. (Mus. Holm. et Coll. Sign.)

Thoracic pleura black.

Lobes of head subequal in length, sometimes middle of apex slightly deflexed, sides not far from apex armed outwardly with an anteriorly prominent tooth. Second joint of the antennae nearly one-quarter shorter than third. Lateral margins of the thorax anteriorly sinuate, armed with some large teeth, lateral angles produced into a truncate process, apex armed with 3 or 4 teeth, median percurrent line subtly laevigate. Base of scutellum convex, raised. Hemelytra sparsely punctured toward base of corium. Abdomen quite ampliate, posterior angles of segments prominent, straight. Meso- and metasternum black. Venter in darker examples sparsely fusco-consperse.

Redescription from the type specimens

Form oval; head slightly tapering from just in front of eyes; terminal half of tylus almost impunctate, paler than other markings on head; juga equal in length to tylus and rounded at tips giving an arcuate apex to head; calli tumid, deep fuscous with several irregular paler smooth spots; pronotal punctures gradually increasing in size posteriorly; posterior half of pronotal disc with a considerable number of pale smooth markings; truncated humeri upturned with three prominent and two inconspicuous bluntish teeth, these slightly retrorse; marginal teeth, before the sinus (four in male, three in female) prominent, coarse, triangular and with smaller denticles interpolated; antehumeral sinus deep and adjacent area impressed into disc; pronotum traversed by a median longitudinal narrow impunctate stripe; elevated basal third of scutellum provided with a small median saddle each side of which are a pair of dark areas with deep coalesced pits; basal elevation continued as a weak carina through apical third of scutellum; basal third of elytra with a pale smooth area, another pale smooth area near discal point; membrane distinctly milky with bright yellow-brown

markings; antennal segments three to five subequal, each slightly longer than segment two; a narrow pale annulus at the incisures of each joint in female and only on basal two joints in male; connexivum brightly alternated black and red with the lateral end of the red band becoming stramineous at the margin; the black bands unite at their inner ends to form a somewhat rectangular horse-shoe-shaped figure; under side of head rather uniformly dark fuscous; buccular edge weakly sinuate and ending in an acute tooth; the frontal edge of the jugum is broadly rounded ventrally and meets the buccular tooth at an acute angle; thoracic sternum marked longitudinally by three subequal broad bands, a median almost impunctate fuscous one, followed by a dull yellow one, laterad of which there is another dark fuscous one finely punctate; submarginal area of propleuron not conspicuously smooth; legs strikingly mottled and annulated, especially the tibiae; femora pale at basal half, dark fuscous at distal half; basal portion weakly flecked with fuscous; fore tibiae strongly dilated both laterally and dorso-ventrally producing an almost clavate appearance to the terminal third of segment; all the dilated portion dark fuscous to piceous; other tibiae not dilated but distal third and geniculum dark fuscous; abdomen dull yellow with scattered ferrugineous punctures, these congesting laterally to form well defined dark lunes on each segment; basal valves of female genital plates not strongly gibbous, rather somewhat tumid with flat tops; posterior surfaces declivent with an obscure impressed area in each plate; apical half of each plate bordered by deep fuscous; apical valves of female genitalia deep fuscous bordered internally by a narrow yellow band; median valve yellow; in the male the claspers end in an acutely rounded but not pointed tip; proctiger deep fuscous to piceous, its sides not conspicuously concave, its median keel obsolescent.

From the Sallé Collection.

Holotype: Male; 13 mm. long, 8.5 mm. wide.

Allotype: Female; 14 mm. long, 9 mm. wide.

Paratypes: None specified.

Type locality: Mexico. No definite station specified.

Types deposited: Riksmuseet, Stockholm, Sweden.

Distribution: Mexico; Guatemala. Also said to occur in the southwestern portion of the United States, but I have not seen an authentic specimen from that region.

Brochymena aculeata Distant, 1880 (Figs. 17, 18)

Distant, Biol. Cent. Amer.; Hemip.-Heter., Pt. 2, p. 327, Pl. 31, Fig. 6, 1880.

Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiv, No. 2, p. 111 (fig.), 1939.

Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 202, 1939.

Closely allied to *B. haedula* Stål but differing by having the lateral lobes of the head distinctly longer than the central lobe; the spine above the antenniferous tubercles distinctly longer and more acute;[2] the spines on the lateral margins of the pronotum much longer and more prominent; in having the third joint of the antennae much longer than the second joint. The antennae are also uniformily dark and not annulated with ochraceous as in *B. haedula*.

Length: 13–14 mm.

Type: Male.

Paratypes: Not specified.

Type locality: Chilpancingo and Amula in the State of Guerrero, Mexico.

Type deposited: British Museum, London.

Food plants: Unknown.

Distribution: Mexico. (Also said to extend into the United States along the southwestern border, but I have not seen an authentic specimen from this country.)

Comments

The State of Guerrero is in the extreme southwestern part of Mexico and it is questionable whether individuals of this species reach as far north as the United States. Most specimens in American collections (California Academy of Sciences excepted) that are identified as *B. aculeata* are in all probability *B. barberi*, or *B. barberi* var. *diluta* (q.v.). The *aculeata* type specimen (male) has

[2] The "spine above the antenniferous tubercles" referred to by Distant in this original description probably means the subapical tooth, as there is no spine above the antenniferous tubercles in any species of this genus, unless we wish to stretch the point and call the anteocular spine of *B. apiculata* Van D. such. In *aculeata* there is a blunt crenulation on the lateral edge of the antenniferous tubercle but on no place above it; in *barberi* this crenulation or denticle is acute.

claspers of the *haedula* form (Fig. 18), whereas *barberi* and *b.* var. *diluta* possess claspers that are distinctive (Fig. 20) in having the ventral hooks developed into triangular lobes. Furthermore there are distinct differences in the forms of the heads of the two species, *barberi* possessing juga that flare outward and upward rather than pointing forward as in the typical *aculeata;* Mr. China first called attention to this point and it is to him I am indebted for the sketches from which the figures of *aculeata* were made (Figs. 17, 18). Another difference between the two species lies in the nature of the buccular tooth, in *barberi* it being acute, almost acuminate, while in *aculeata* it is bluntly rounded.

Brochymena barberi Ruckes, 1939 (Figs. 19, 20)

Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiv, No. 2, p. 111, fig. 1, 1939.

Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 202, 1939.

Closely allied to *B. aculeata* Dist. but differs in several very important characters. Form broadly oval, subdepressed; connexivum distinctly explanate; color dull yellowish gray to brown gray; head widest just in front of eyes then gently converging as far as the acute, large sub-apical teeth; lobes of the juga extend beyond the tylus by about a distance equal to their width there; lobes are rounded acute and tend to flare outward, not truncated and straight as in *B. aculeata;* disc quite densely nigro-punctate, the punctures tend to be elliptical rather than circular; a small tubercle, sometimes acute, just in front of each eye; surface of pronotum moderately undulant with the smooth areas about the calli rather small, long and thin, not rounded and embossed; punctures crowded, a pair of smooth, pale vermiculate markings at inner back corner of calli; antehumeral sinus quite prominent and disc there impressed; humeri quite rectangular and protrude prominently, their dorsal surfaces somewhat transversely rugose; each humerus terminates in a pair of prominent divergent teeth between which are two or three smaller teeth; a third large tooth occurs at the anterior basal border of the humerus; pronotal marginal teeth are four to five in number, are very long, narrow and very sharp; the basal third of the scutellum gibbose, its highest point well above the disc of the pronotum; a weak saddle between the lateral portions of this raised area, this bordered with a pair of smooth, crescentic yellowish bars; four obscure fuscous bands

of larger pits longitudinally across the gibbose area; median scutellar carina broad and not very high, the disc laterally of it somewhat depressed into a pair of shallow furrows; scutellar apex narrowly rounded, paler with fewer fuscous punctures in apical third; tip slightly upturned; elytra with punctures gradually congesting apically; basal fourth with evident smooth calloused pale areas; discal spot calloused and prominent; membrane hyaline with markings dark fuscous, the vermiculate ones between the veins quite large; connexivum alternated with the pale bands, triangular in outline, the apex pointing inward; posterior angles of, at least the first three visible abdominal segments, prominent and acute, projecting strongly from the edge; in *B. aculeata* these angles are not prominent, do not project and are rectangular (notes from W. E. China); edge of buccula feebly sinuate, ending in a sharp tooth; the frontal edge of the jugum is strongly sinuate; in *B. aculeata* the buccular tooth is blunt and the frontal edge of the jugum is arcuate; the middle portion of the ventral thorax is dull yellow with some scattered reddish fuscous punctures; the lateral half of the ventral thorax is darker; the intercoxal darker blotches are continuous across the segment; coxae, trochanters and basal third of femora dull yellow; distal two thirds of femora heavily spotted with deep fuscous, this forming a broad band apically, here interrupted with an incomplete annulus of pale; fore tibiae dilated apically, almost to the extent found in *B. haedula* and much greater than found in *B. aculeata;* ventral abdominal segments rather flattish, dull orange to yellow brown with scattered fuscous punctures which become deep fuscous laterally and there form some horse-shoe like markings; rostral furrow shallow; beak long, reaching at least the front edge of the third visible segment; basal valves of female genital plates very convex; the posterior face of each sharply declivent and deeply impressed; a fuscous or reddish fuscous border reaches about half way up the declivent face; intervalvular sinus deep and broad; male cup broadly oval in outline with the claspers very distinctive, the visible lobe triangular in outline, the apex pointing downward and the face slightly concave; the claspers of *B. aculeata* are not triangular in outline but narrowly elongate somewhat like those of *B. haedula;* the proctiger is orange brown its sides distinctly concave and a broad carinate ridge evident; this has an obtuse bend in it dorsally.

Size: Female: 14 mm. long; 8 mm. across humeri; 8.5 mm. across abdomen. Male: 13.5 mm. long; 8 mm. across humeri; 8.5 mm. across abdomen.

There is close relationship to *B. aculeata* shown in the size of the pronotal and humeral teeth, the long juga, the general color and the outline of the male genital cup; the main differences are the sharp buccular tooth in *B. barberi*, the obliquely flaring juga, the sharp angulation of the abdominal segments, the dilated fore tibiae, the distinctly triangular outline to the posterior face of the male paramere.

Described from eight specimens, three males and five females.

Holotype: Female: Sonoita, Santa Rita Mts., Arizona. Collected by H. Ruckes, July 21, 1937, and deposited in the American Museum of Natural History.

Allotype: Male: Sonoita, Santa Rita Mts., Arizona. Collected by H. Ruckes, July 21, 1937. Author's collection.

Paratypes: Four females and one male in the collection of the United States National Museum, all from the Huachuca Mountains in Arizona and bearing no date labels. One male specimen in the H. G. Barber collection, this dated July 28, 1905, and located in the Huachuca Mts., Arizona.

I take pleasure in naming this species after Mr. H. G. Barber, my friend and one of the leading American Hemipterists of our time.

Type deposited: American Museum of Natural History, New York.

Food plants: Unknown.

Distribution: Along the border States, southwestern U. S., also possibly in Lower California.

Comments

See remarks under *B. aculeata.*

Brochymena barberi, var. *diluta* Ruckes

Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiv, No. 2, p. 113, 1939.

Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 203, 1939.

Very similar to *B. barberi* but with sufficient difference in important character to warrant being separated into a varietal category.

In var. *diluta* the principal characters defined for the species *barberi* are all present in a reduced form, *i.e.*, the color is lighter, the teeth shorter, the angulation of various parts more obtuse, etc.; hence the application of the term *diluta*. In var. *diluta* the lobes

of the juga do not extend beyond the end of the tylus or if so by only a very small distance; the apex of the head before the teeth is less acutely triangular; the humeral teeth are not as long as in *B. barberi* and are more blunt; the posterior angles of the abdominal segments are distinctly not acute, tending to be more rectangular and even obtusely rounded; the basal area of the scutellum is raised but not gibbose, there is still a weak saddle between the halves; the frontal edge (side view) of each jugum is less sinuate and more nearly arcuate than in *barberi;* the ventral abdominal surface is more yellowish and the punctures are lighter; there is much more pale on the lateral portion of each abdominal segment and the characteristic horse-shoe-shaped marks on each segment are less distinct and may even be obsolete.

The male and female genitalia are identical with those of the typical *barberi;* since no other relatives in the genus, as now known, have these distinctive characters there is no question of relationship between this variety and the typical species. Since all the specimens, in the collection I have examined, are from Texas, this variety may be an eastern representative of the species.

Described from six specimens from western Texas.

Holotype: Female: Size 13.5 mm. × 8.5 mm.; Brownsville, Texas; June, 1901. Collection of Mr. H. G. Barber, Washington, D. C.

Allotype: Male: Size 12.5 mm. × 7.5 mm.; Brownsville, Texas; May, 1903. Collection of United States National Museum.

Paratypes: Brownsville, Texas, May, 1903; Brownsville, Texas, no date (both in the H. G. Barber Coll.) Esperanza Ranch, Brownsville, Texas, July 30, 1931; Kerrville, Texas, June 19, 1908 (both in the U. S. N. M. Coll.).

I wish to add four more paratypes to this series, found in the University of Kansas collection. Two females, Hidalgo Co., Texas, August 14, 1928 (Beamer); one female, Brownsville, Texas, June (Snow); one male, Cameron Co., Texas, August 3, 1928 (Shaw).

Type deposited: H. G. Barber Collection, Roselle, New Jersey.

Food plants: Unknown.

Distribution: A more easterly replacement for the typical species *barberi.* Southern and central Texas.

Brochymena poeyi (Guérin) 1857 (Figs. 13, 21)

Guérin-Ménéville, M. F. E., *in* La Sagra, Hist. de Cuba; Ins., p. 365, pl. 13, Fig. 1, 1857 (*Pentatoma*).

Stål, Berl. Ent. Zeit., v. x, p. 156, 1860.

Stål, Enum. Hemip., pt. 2, p. 17, 1872.

Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 28, 1904.
Van Duzee, Cat. Hemip. N. A., Univ. Calif. Publ. v. 2, p. 30, 1917.
Blatchley, Heteroptera of Eastern N. A., p. 97, 1926.
Ruckes, Bull. Bklyn. Ent. Soc., v. 34, p. 236, 1939.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 202, 1939.

Thorace lateribus grosse spinoso, humeris productis. Flava, fusco-punctata, capite nigro-lineato; thorace antice fulvo-tuberculato; antennis pedibusque nigro-annulatis.

Longueur—14 millim.

Translation

Lateral edge of thorax strongly spined, humeri produced. Yellowish, fusco-punctate, head lineated with black; front of thorax (pronotum) with brownish-yellow tuberculations; antennae as well as legs annulated with black. Length, 14 mm.

Guérin adds the following description in French.

Entièrement d'un jaune d'ocre ponctué de noirâtre. Tête assez allongée, longitudinalement rayée de noir; côtés du prothorax fortement épineux, échancrés au milieu avec les angles huméraux saillants, tronqués et tridentés au bout. Il est jaune et couvert de points enfoncés noir au fond, et il offre en avant et de chaque côté, deux taches noires, dans lesquelles on remarque trois ou quatre gros tubercules lisses et peut saillants, d' une couleur presque fauve. Écusson et élytres irrégulièrement ponctués de noirâtre; la membrane des élytres blanchâtre, finement tachetée de brun. Côtés de l'abdomen ayant deux petites bandes noires transversales à chaque segment; dessous plus pâle, faiblement piqueté de brun. Antennes et pattes annelées de noir.

Translation

Entirely ochre yellow punctured with black. Head well elongated and longitudinally rayed (lineated) with black; sides of thorax strongly spined, indented at the middle with the humeral angles produced, truncated and tridented at their ends. Prothorax yellow and covered with deep black pits, and in front and at each side are two black spots in which one can see three or four smooth and slightly raised tubercles, almost tawny in color. Scutellum and elytra irregularly punctured

with black; the membrane of the elytra whitish and delicately spotted with brown. Sides of the abdomen with two narrow transverse black bands across each segment; below paler, weakly punctured with brown. Antennae as well as legs (feet) annulated with black.

Redescribed

Form oval with connexivum distinctly explanate; color dull ochre brown, being a mixture of dull yellow ground and numerous uniform fuscous punctures, each with a whitish bloom; head proportionately longer and narrower than any other species in this group, widest just before the eyes and converging slightly toward apex; subapical teeth prominent, smaller than in *arborea* but still meeting the juga in a deep sinus; juga long and extending well beyond tylus leaving a distinct rectilinear sinus there; inner edges of juga parallel; several irregular, elongated smooth yellowish bars on top of head; calli fuscous and slightly raised with four to six raised smooth yellow blotches; posterior half of pronotal disc with punctures of uniform size, these sparsest in the middle quarter; humeral teeth strong and bordered with fuscous; several smaller teeth between large humeral teeth; marginal teeth pale yellow, long, acute, flat-triangular and distinctly paler than their reddish bases; anterior third of scutellum raised but not tumid, rather smoothly convex; two pairs of obscure fuscous bands each side of the middle of this raised area; median carina obsolescent; apical portion truncated at tip and with a weak median notch there; elytra with punctures congesting and coalescing apically, smooth areas most evident at the base; membrane clear to slightly milky with rich brown markings; connexivum strikingly alternated with each pale band at least as wide and usually half again as wide as the black bands across each incisure; mid-point of each incisure raised in a pale point; under surface of head irregularly streaked with pale and fuscous; edge of buccula distinctly sinuate and ending in a prominent acute tooth; frontal edge of jugum vaguely sinuate and meeting the buccular tooth at an obtuse angle; antennae very distinct for this genus, basal segment reddish fuscous, remaining ones annulated with broad pale bands at the base (these at least a third the length of each segment) and black at the apex; segments two and three subequal but each shorter than four and five; thoracic venter and pleura mostly pale yellowish, some obscure fuscous markings laterally, these

most evident on the propleuron beneath the marginal teeth and below the humerus; coxae and basal half of femora pale yellow, distal half of femora with a pair of broad fuscous annuli between which is a pale ring; tips of femora pale; tibiae strikingly annulated yellow and dark fuscous, each middle small dark blotch only on front face and distinctly rectilinear; tarsi pale yellow with distal half of last segment fuscous; abdomen dull yellow with scattered rufous punctures; each segment with an obscure darker lune near each lateral margin; abdomen fairly convex so that rostral furrow is proportionately deeper than in allied species; posterior angles of abdominal segments protruding and rectilinear; basal valves of female genital plates not tumid as in allied species of this GROUP but rather convex without declivent and impressed posterior faces; these plates bordered narrowly with fuscous; male genital segment with lateral tips protruding and forming a lobe on each side, along the inner surface of which lie the divergent heads of the claspers; the lower hook of each clasper terminates in a vermiform process.

Redescribed from specimens in the United States National Museum from Mangrove Cay, Andros Island, Cabo Blanco, Cuba.

From specimens in the Cuban Museum, Santiago, Cuba.

From specimens in the author's collection.

Type: Sex not stated.

Paratypes: Not specified.

Type locality: Cuba.

Type deposited: W. Horn (1935) in his work "Ueber Entomologische Sammlungen" states that the Guérin-Méneville hemipteran types were deposited in the Zoological University Museum in Naples. Assumedly the *B. poeyi* type is there, but I have no confirmation of that fact.

Food plants: Unknown.

Distribution: Cuba, possibly also other West Indian Islands. It is said that this species extends to the southern tip of Florida, but it is suspected that all such specimens identified as *B. poeyi* are in reality a form of *B. arborea.*

Comments

A very easily recognized species of the *arborea* GROUP by virtue of its contrasting markings, its annulated antennae and the structure of the female and male genitalia. A study of its distribution

throughout the West Indies should result in some very interesting knowledge concerning insular variations as applied to Pentatomidae.

Brochymena arborea (Say) 1825 (Figs. 2, 22)

Say, Jour. Nat. Sci., Phila., v. iv, p. 311, 1825; Compl. Writ., v. ii, p. 239. (*Pentatoma.*)
Dallas, List of Hemip., v. i, p. 188, 1851.
Herrich-Schaeffer, Wanz. Ins., Verz., p. 26, 1853.
Stål, Enum. Hemip., v. ii, p. 17, 1872.
Uhler, Hayden's Sur. Terr., Rept. for 1871, p. 394, 1872.
Uhler, Bul. U. S. Geol. Geog. Surv., v. i, p. 283, 1876.
Uhler, Proc. Bost. Soc. Nat. Hist., v. xix, p. 372, 1878.
Distant, Biol. Cent. Amer. Hemip.-Heter., v. 1, p. 59, 1880.
Van Duzee, Bull. Buf. Soc. Nat. Sci., v. v, p. 170, 1894.
Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 27, 1904.
Barber, Bklyn. Inst. Sci. Bul., v. i, p. 257, 1906.
Smith, Cat. Ins. N. J., Edn. 3, p. 134, 1910.
Zimmer, Pentatomidae of Nebraska, p. 4, 1911.
Olsen, Jour. N. Y. Ent. Soc., v. xx, p. 50, 1912.
Van Duzee, Cat. Hemip. N. A., Univ. Calif. Pub., v. 2, p. 30, 1917.
Hart, Bull. Nat. Hist. Surv. Ill., v. xiii, No. vii, p. 173, 1919.
Stoner, Scutelleroidea Iowa, Univ. Iowa Studies, v. viii, No. 4, p. 55, pl. vi, fig. 1, 1920.
Parshley, *in* Conn. Geol. and Nat. Hist. Surv., Bull. 34, p. 757, 1923.
Blatchley, Heteroptera East. N. A., p. 97, 1926.
Leonard, A List of the Insects of New York, p. 78, 1926.
Brimley, The Insects of North Carolina, p. 61, 1938.
Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiv, p. 236 (Figs.), 1939.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 202, 1939.
Froeschner, Amer. Midland Nat., v. xxvi, pt. i, p. 135, pl. 2, fig. 22, 1941.
†*erosa* (Herrich-Schaeffer), Wanz. Ins., v. v, p. 70, fig. 515, 1839; v. vii, p. 56, 1844. (*Halys.*)
†*annulata* Walker, Cat. Heter., v. i, p. 230, 1867.

Brownish-cinereous, punctured; clypeus emarginate and bidentate; thorax dentate and with a prominent truncated spine behind each side; feet annulate.

Inhabits Missouri.

Body brownish-cinereous with numerous black punctures; head with a longitudinal obsolete elevated line and an abbreviated one each side its middle; clypeus emarginate at tip; lateral edge terminating in an angle near tip; antennae, base of second joint pale; thorax unequal before, dentated each side; teeth irregular unequal, acute; posterior angles extended into a prominent dilated slightly reflected, truncated projection which has two or three small teeth; hemelytra with central nervure conspicuous; nervures of the membranaceous tip black and with black arborescent lines in the interstitial spaces. Wings dusky iridescent, nervures black; feet black; thighs pale at base and annulated with pale near tips; tibiae annulated with pale; tarsi second joint pale; tergum deep purple, black impunctured; margin brownish cinereous, punctured, varied with transverse abbreviated black lines placed triangularly, and pale; venter pale, pruinous, with dusky points; stigmata each composed of three distinct black points placed obliquely; pectus and postpectus pale, dusky each side.

Length: Less than 3/5 inch.

Redescribed

Form broadly oval with connexivum explanate and slightly declivent laterally; ground color dull yellow, brownish, or reddish yellow with fuscous to piceous punctures the majority of which are uniform in size and even in distribution; surface of the head somewhat undulant with the lobes of the juga and front half of the tylus sometimes declivent; a small sharp tubercle sometimes on margin in front of each eye; subapical teeth large, pointing outward and upward so that subapical sinus is deep and acute; juga tend to reach beyond the tip of the tylus, but are not contiguous there, leaving a preapical sinus; their tips are blunt and the tip of the head in front of the subapical teeth is sub-truncate; pronotum with antehumeral sinus deep as is an adjacent impressed area; calli swollen, almost tumid, dark with numerous pale, irregular smooth blotches; a distinct squarish median impressed area in pronotal disc between calli; pronotal margins with three to six large, flattish, acute, triangular teeth with some smaller ones interpolated; humerus with a prominent raised crest obliquely across its apex subtended by a well formed parallel sulcus; humeral teeth three to four in number, blunt and retrorse; the raised basal third of scutellum continued as a median broad

ridge posteriorly to apical third; the tip of the scutellum broadly rounded its preapical area usually somewhat impressed; puncturation of scutellum rather even though some punctures tend to congregate on the raised portions; elytra with punctures becoming congested apically, a fine reticulum of smooth yellow lines is present; a larger smooth area near the base of each elytron; membrane clear hyaline with rich brown and fuscous markings; connexivum strikingly alternated with black bands extending to edge of each segment; underside of the head fuscous with some indistinct longitudinal paler vittae; buccular edge distinctly sinuate and ending in acute tooth; anterior (frontal) edge of each jugum truncated; antennal segments dark fuscous only the incisures between segment with a pale ring; segment two somewhat shorter than segment three; the basal segment usually not extending beyond the tip of the subapical tooth; fuscous punctures tend to congregate and congest on pro-, meso-, and metapleura; sternum pale with a pair of large dark spots on the mesosternum, between the pro- and mesocoxae; a distinct fuscous crescentic smooth area just below the pronotal marginal teeth; bases of coxae, trochanters, and femora pale; femora with a few basal fuscous spots which tend to aggregate distally into dark blotches; tibiae clearly annulated with a small square spot filling the space between the sulcate edges in the middle of each annulus; tarsi fuscous with the middle segment paler; abdomen dull yellow or light brown with scattered small punctures; obsolescent dark lunate markings at lateral extremities of each segment; basal valves of female genital plates distinctly tumid with the highest point in the middle of each plate; posterior face of each plate declivent but not appreciably impressed or concave; only the median apical corners of basal plates fuscous; ventral hook of clasper narrow and terminating acutely but not in an acuminate tip.

Type: Sex not stated.

Paratypes: Not mentioned.

Type locality: Missouri (?).

Type deposited: Probably in the Academy of Natural Sciences, Philadelphia. Now unknown and probably lost.

Food plants: Oak, beech, willow, apple, peach, pear, grape, pine. Also said to be predatory on soft-bodied larvae.

Distribution: Widespread over the eastern states to Canada, southward to Florida, westward to Texas, New Mexico, and Mexico.

Reaches the Plains States to eastern Kansas. No new localities to be added to the Van Duzee list.

Comment

In the eastern states this is one of the two common species, the other being *B. quadripustulata* (q.v.). It apparently is very variable and may be the ancestral form from which several other closely related species in the GROUP arose. It probably has geographic races, though these have, as yet, not been studied and defined. Specimens from the southwest differ greatly at times from those of the northeast, the teeth being more acute and proportionately a bit larger; those of the Gulf States are more brightly colored and usually of a lighter hue. In size the individuals of this species also vary greatly; some measure no more than 9 mm. long while others are at least half again that size.

The individuals are never abundant enough in any one locality to be called common, yet they appear throughout the summer months with consistent regularity.

Brochymena florida Ruckes 1939 (Fig. 23)

Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiv, No. 5, p. 236, 2 figs., 1939.

Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 203, 1939.

Form oval, subdepressed, roughish, faceted; color yellowish or reddish brown rather than grayish brown as in *arborea;* distance across head just in front of eyes one third greater than transverse distance between subapical teeth, so that sides of head tend to converge anteriorly (in *arborea* this distance averages only about one sixth greater and the sides of the head are more nearly parallel) juga subequal to tylus, very seldom longer and then by only a very small fraction of their width at their tips; the outline of the head in front of subapical teeth arcuate or nearly so, the edges of the juga being slightly curved (in *arborea* the juga are usually distinctly longer than tylus and an appreciable rectilinear sinus between their tips is usually evident, the edges of the juga are more nearly straight and the outline of the head in front of the subapical teeth is more nearly truncate); dorsal surface of the head less undulant than in *arborea;* first antennal segment reaches well beyond the tip of the subapical tooth and frequently as far forward as the tip of head (in *arborea* this segment is shorter, only occasionally

does it reach more than midway beyond the tooth); pronotal surface not as strongly undulant as in *arborea* with the anterior median rectilinear depressed area more shallow than in that species; humeri, as in allied forms, quadrangular, with a prominent tooth at the front and hind corner and at least one smaller one between; *the dorsal lateral edge of the humerus is not raised in an oblique smooth bar or obtuse ledge as in arborea and there is no horizontal sulcus between the humeral teeth and its dorsal surface* (this sulcus is usually very pronounced in *arborea*), *the dorsal humeral surface is gradually continuous to the lateral edge and the whole humerus is not block-shaped and thickish as in arborea;* basal third of scutellum while swollen is certainly not tumid and its highest point is not much raised above the disc of the pronotum (in *arborea* usually this portion of the scutellum is quite high and its surface very undulant); femora with fuscous markings usually restricted to the distal half of the shaft (in *arborea* they extend onto the proximal half and in many instances as far proximad as the trochanter; tibiae distinctly sulcate with the edges raised and quite evident (in *arborea* the edges are usually indistinct and the sulcus shallow); the annulations on the tibiae are distinctive in that there are usually only two broad black annuli, one toward each end of the shaft, and a much smaller central one, indistinct and frequently represented by only a few darkish flecks (in *arborea* the annuli, three in number are more nearly subequal in size, especially on the fore tibiae, and the middle annulus is rectilinear and conspicuous); the first tarsal joint has the major portion of its dorsal surface pale and frequently the second joint is pale also; exposed portion of the connexivum alternated as in *arborea* but the dark bars do not reach the very edge of the segments, or if they do they are weak there and inconspicuous; the ventral stigmata in oblique lines, mentioned by Say for *arborea* are much less conspicuous than in that species, the colors being paler and the dark ring around each spiracle much narrower; anterior and posterior angles of ventral abdominal segments either lack the black triangular spot, so characteristic for *arborea* or the marks are very obsolescent, the females have a greater tendency to retain these spots than the males, in which case then the dark bands on the connexivum reach the edge of the segments; the horseshoe-shaped fuscous or black vittae on the lateral ends of each ventral segment, also so characteristic of *arborea,* are lacking or very indistinct; genitalia, both male

and female somewhat heavier than in *arborea;* the exposed posterior surface of the hook of the male paramere is flattish and in some specimens shallowly sulcate, the lateral surface of the paramere appears dark fuscous and the medial surface much paler, tawny or light fuscous (in *arborea* the hook of the paramere has its surface slightly convex and the surfaces are more nearly concolorous); female with a small triangular sinus between the proximal median corners of the basal valves and the midpoint of the posterior edge of the previous segment.

Holotype: Female, 18 mm. long, 10 mm. across humeri, Tampa, Fla., A. M. N. H. Acc. No. 26226; Coll. Mrs. A. T. Slosson. Deposited in the American Museum of Natural History.

Allotype: Male 14 mm. long, 8.5 mm. across humeri. Same data as holotype. Deposited in the author's collection.

Paratypes: Purdue University Collection: Males: Dunedin, Fla., 1/13/30, 11/13/11, 2/29/13; Mooseft, Fla., 3/2/18; Royal Palm Pk., Fla., 12/12/24; Cape Sable, Fla., 2/23/19. Females: Dunedin, Fla., 1/20/18, 4/13/25; Little River, Fla., 8/1/31 (J. C. Bradley); Royal Palm Pk., Fla., 12/12/34, a second specimen, no date, Coll. P. M. Jones; Cape Sable, Fla., 2/23/19 (2 specimens). American Museum Collection, in addition to the types; Males: Biscayne Bay, Fla., 8/20/35 (2 specimens); another specimen from the A. T. Slosson Collection, no date; A. M. N. H. Acc. No. 26226. Female: La Belle, Fla., 4/27/12.

Habitat: Definitely known from Florida, may be expected to occur in southern Georgia and Alabama westward to Texas. It appears to be a southern replacement for *B. arborea* (Say).

Type deposited: American Museum of Natural History, New York.

Food plants: Not definitely known but probably may be found on the same as for *arborea.*

Comments

A relatively recently described species which undoubtedly is the one most closely related to *B. arborea.* At first it was thought to be merely a minor variety of *arborea*, but a close study of its salient characters led to its creation as a distinct species.

THE *QUADRIPUSTULATA* GROUP

Into this category I have placed certain combinations of associated species all of which differ from those preceding by, at least,

the characters designated in the keys (p. 156). Within this GROUP the species may be further subdivided into lesser complexes if one wishes to use genitalic characters for such differentiation. Whereas the characteristics found in the female genital plates, while not obscure, are somewhat subtle, those of the male cup and claspers are rather outstanding and distinctive. The four types of claspers found among these species have previously been mentioned (p. 147). To these should now be added the four types of genital cup associated with each type of clasper.

In the *cariosa* grouping (p. 147) the cup is small and shallow, its ventral wall variously reflexed or upturned apically, obscuring the contents in part; the lateral tips are either bluntly or acutely rounded but do not project beyond the apical corners of the seventh abdominal segment and the cup is deeply retractable; the cavity of the cup is somewhat limited in its capacity and the contents appear as if crowded by virtue of the fact that the entire periphery of the cup is inflexed; the dorsal border is continuous, except for an inconspicuous median area (where a narrow, depressed superior ridge occurs) and no sharp prominent teeth project posteriorly from it.

In the *punctata* grouping the open face of the cup is rhomboidal in *punctata* and broadly oval to almost orbicular in *dilata*. The claspers and proctiger are very large in both species and occupy most of the available space. The dorsal border is provided with a narrow over-hanging flange and the superior ridge is narrow laterally but bluntly tongue-shaped longitudinally. The inner faces of the genital cup are strongly hirsute. The ventral border is only weakly upturned and not inflexed. The proctiger is subrectangular in outline, without a keel, in fact its face is distinctly impressed below the dorsal bend. The entire cup is small and retractible so that the apical corners of the seventh segment protrude well beyond it. No teeth project posteriorly from the dorsal border across the open face of the cup.

In the *carolinensis* grouping (p. 147) the cup is robust and deep, its ventral wall gradually but very broadly upturned apically leaving the cup somewhat flat-faced across its exposed ventral surface or somewhat impressed there; the lateral tips are acutely rounded and, even when the cup is totally retracted, reach at least to the apical corners of the seventh segment, and usually protrude beyond; the cavity of the cup is capacious and its contents not crowded, indeed there appears to be more space than structural contents; the dorsal border is broken medianly by a prominent, broad or narrow depressed superior ridge that extends as a shelf

underneath the lateral portions of the border above it; from the dorsal border on each side, about midway between the median point and the lateral tip, a prominent stout tooth projects posteriorly above the widely open cup.

In the *affinis* grouping the cup is robust and nearly as deep as that found in the preceding, with the ventral wall similarly broadly upturned, but its apical edge is provided with a rather deep transverse sulcus each side of the middle; the most striking feature of the cup in this grouping lies in the great extension of the lateral tips, which project very far beyond the apical corners of the seventh segment, so much so that the cup cannot be retracted as in most other species; the entire periphery of the cup is somewhat roundly inflexed, so that the spaciousness of the cup is reduced, otherwise the cavity is deep and the contents not crowded; as in the *carolinensis* grouping the dorsal border is broken and is provided with similar stout teeth.

In constructing the following keys an attempt has been made to keep closely allied species in opposable couplets and the couplets in progressive succession leading from assumedly the more primitive species to the more specialized ones. Thus the keys become less artificial, but at the same time more difficult to compose and use. I am told that some of the characteristics employed are somewhat subtle and evasive; this is probably due to the fact that the one using the keys is not too familiar with the array of species in this genus. With a goodly number of the species before him, a student should not have too much difficulty with his identifications. Even such astute students of the Hemiptera as Van Duzee, Blatchley, Hart, etc., admitted repeatedly that they ran into trouble attempting to construct keys of a natural as contrasted with an artificial type. There is no question but that the genus *Brochymena* is one of the most difficult ones among the Pentatomidae to analyze.

Key to the quadripustulata Group

1) Apical lobes of juga considerably longer than tylus, subfoliate, (a) overlapping, leaving no preapical sinus there (Fig. 25), or (b) with their inner margins parallel or connivent, leaving an elongated preapical sinus between them (Fig. 27); antennal segment two never longer than segment three; species narrowly oval or elliptical in outline only. 2

Apical lobes of juga subequal to tylus or if longer, not subfoliate, overlapping or connivent but stubby and not longer than tylus than by a part of their width at the apex (Fig.

30, 38); their inner margins usually parallel leaving a short and broad preapical sinus between them; antennal segment two either longer or shorter than or equal to segment three; species may be any form in outline 4

2) Color dull yellow to pale orange; membrane usually milky with arborescent and vermiculate markings pale, weak and obsolescent; venter dull yellow sparsely punctate; laterally with obsolescent lunate markings on each segment; base of second, third and fourth antennal segments with a pale annulus. Length 12–14 mm.; width 5.5–6.5 mm. ..... *pilatei* Van Duzee 1934

Color not as above; darker; grayish brown to fuscous; membrane either vitreous or milky but with arborescent and vermiculate markings strong and conspicuous; venter not dull yellow; punctured finely laterally and with dark, whole or broken lunate marks near lateral edges of each abdominal segment; antennal segments not annulated at the bases or only base of segment three so; only segmental incisures pale. 3

3) Inner edges of juga connivent to overlapping; humeral angle rectilinear to obtuse, hardly produced into an acute tooth; membrane vitreous with dusky suffusion; median spot in pale annulus of fore tibia rectilinear, prominent and occupying about half the length of the pale annulus; osteolar auricle blunt-lanceolate (Fig. 24–B), not much longer than diameter of its orifice; male genital segment without a transverse sulcus across its apical edge. Length 10–18 mm.; width 6–9.5 mm. ..... *quadripustulata* (Fabricius) 1775

Inner edges of juga usually parallel so that lobes do not converge or overlap but leave an elongated preapical sinus between them; humeral angle acute and somewhat produced into a tooth (Fig. 28); membrane milky hyaline with but little if any dusky suffusion; median spot in pale annulus of fore tibia small to obsolescent, leaving most of the pale annulus unfilled; sometimes this dark spot is lacking; osteolar auricle distinctly longer than its adjacent orifice and usually acute-spatulate in outline (Fig. 24–C); male genital segment with a distinct transverse sulcus across its apical edge; general color of species grayish rather than fuscous. Length 12.5–15 mm.; width 6–8 mm. ..... *sulcata* Van Duzee 1918

4) Antennal segment two longer than segment three; second rostral joint reaching the mesocoxal cavities or nearly so; third rostral joint reaching the metacoxal cavities; tip of beak extending beyond the border of the fourth (third visible) abdominal segment. 5

Antennal segment two shorter than or subequal to segment three; second rostral joint reaching no farther than about midway between the pro- and mesocoxal cavities; third rostral joint not attaining the metacoxal cavities and the tip of the beak not extending beyond the fore border of the fourth (third visible) abdominal segment 6

5) Form broadly oval, dorsum convex; design mottled, no prominent pale raised calloused lines extending longitudinally across the pronotum onto base of scutellum; dark alternations of connexivum reaching the margins of the respective segments. Length 17–19 mm.; width 8.5–10 mm.

cariosa
Stål 1872

Form narrowly oval to elliptical (Fig. 1); subdepressed; design lineated, a pair of prominent pale, raised, calloused lines extending across posterior edge of pronotum onto base of scutellum; dark alternations of connexivum hardly reaching the margins of the respective segments, leaving the abdomen bordered by a narrow impunctate pale line; length 16.5–17 mm.; width 8 mm. ..... *lineata*
Ruckes 1938

6) Propleuron and pronotal surface directly above it swollen so that lateral half of prothorax appears subglobular and the lateral margin becomes inconspicuous; marginal teeth few (usually three), small, sharp, and wide-spaced (Fig. 32); species rather small, usually less than 14 mm. in length; upper and lower margins of male genital cup flexed. Length 10–14 mm.; width 5–7.5 mm. ..... *parva*
Ruckes 1946
(*obscura* (H.-S.) 1839)

Propleuron and pronotal surface not swollen as above; pronotal margin thick, usually prominent and frequently acute; marginal teeth more than three in number and close together, sometimes blunt; species medium to large in size (12–22 mm. in length), not strongly convex, in some cases decidedly depressed. 7

7) Apex of head in front of subapical teeth roundly truncate or broadly arcuate; subapical sinus obsolescent; head wider through the eyes than long from base to apex (Fig. 29); elytra with numerous small pale points; exposed surface of the claspers distinctly squarish (Fig. 5); apical edges of basal valves of female genital plates deeply sinute 8

Apex of head in front of subapical teeth narrowly arcuate, triangular or otherwise but not roundly truncate; subapical sinus evident, acute or obtuse but not obsolescent; elytra with various markings but when pale points are present they are few and scattered; head narrower through the eyes than long from base to apex; exposed surface of clasper any shape but never squarish; apical edges of basal valves of female genital plates not sinuate or only vaguely so. 9

8) Forms brown or reddish, legs particularly so; length 15–17 mm.; width 8–9 mm. ..... *punctata* Van Duzee 1909

Forms gray or ashy pale; length 14–16 mm.; width 7.5–8.5 mm. ..... *punctata* var. *pallida* Blatchley 1926

9) Antehumeral sinus obsolescent and adjacent impression inconspicuous (Fig. 33), shallow, when evident circular in outline; tibiae without annulations or with very vague ones; punctures of body fine and numerous but forming no particular design; very few small pale points evident; form broadly oval, abdomen almost orbicular, its greatest diameter wider than distance across humeri; ventral surface of male genital cup with a pair of prominent protruding auricular lobes; exposed inner face of claspers semi-circular in outline. Length 17–18.5 mm.; width 9–9.5 mm. *dilata* Ruckes 1938

Antehumeral sinus evident and adjacent depressed area clearly marked (Figs. 34–36); tibiae distinctly annulated; body punctures forming some sort of design and smooth pale points numerous (except in *carolinensis*); form less broadly oval, diameter of abdomen equal to or less than distance across humeri; male genital cup varied in form but not with a pair of protruding ventral auricular lobes; exposed inner face of clasper any form but not semi-circular. 10

10) Lateral pronotal margins bright yellow, thickish, calloused, with but very few punctures if any; teeth concolorous with adjacent margin; humeri edentate; four conspicuous yellowish calloused spots present, two on disc of pronotum and one at each basal angle of scutellum; tibia conspicuously annulated, the pale annulus without a trace of a dark spot; length 18–22 mm.; width 9.5–12 mm. ..... *myops* Stål 1872

Characters other than above 11

11) Exposed portion of connexivum raised above the disc of the abdomen so that elytra appear to be impressed or sunken into dorsum (Fig. 37). 12

Exposed portion of connexivum not raised above the disc of abdomen, sometimes weakly declivent, and the elytra do not appear to be sunken below the exposed edge of the abdomen. 13

12) Apex of head in front of subapical teeth subtriangular (Fig. 30); narrow edge of connexivum alternated across the marginal sulcus; discal point on elytra pale and evident; humeri well raised above the surrounding pronotum; a strong oblique crest across each humerus; antehumeral sinus well defined; length 11–18 mm.; width 8–11 mm. *carolinensis* (Westwood) 1837

Apex of head in front of subapical teeth subtruncate (Fig. 31); subapical teeth blunt, but their sinuses still evident; alternations of the connexivum stop at the marginal sulcus leaving the entire abdominal edge bordered by a narrow, continuous pale line; discal point of elytra inconspicuous to obsolete; humeri not much raised above the surrounding pronotum, oblique crest across each humerus weak, not evident; length 18.5–20 mm.; width 10–11 mm. ..... *marginella* Stål 1872

13) Species distinctly convex, larger (usually more than 16 mm.); lateral margins of pronotum weakly arcuate before the antehumeral sinus; lateral borders of only the first two ventral segments transversely rugose or not rugose at all 14

Species distinctly subdepressed, smaller (usually not over 16 mm.); lateral margins of pronotum strongly arcuate before the antehumeral sinus (Fig. 36); lateral borders of all ventral segments transversely rugose 15

14) Ventral edges of first two abdominal segments weakly, but distinctly, transversely rugulose, appearing as if milled; juga

longer than tylus; head broadly triangular in front of subapical teeth, and broadly truncate at apex (Fig. 38); length 16.75–17.5 mm.; width 8.5–9.5 mm. ..... *tenebrosa* Walker 1867

Ventral edges of abdominal segments smooth or slightly roughened but not transversely rugulose or milled; juga and tylus subequal; apex of head in front of subapical teeth long, triangular and narrowly truncate at apex (Fig. 39). *humeralis* Ruckes 1939

15) Subapical teeth acute, their sinuses evident and usually rectilinear to acute (Fig. 40); tips of subapical teeth pale in contrast with disc of head; antennal segment three about equal to segment two, segments one and two rufous; pronotal marginal teeth tending to be yellow or ivory; length 12–16 mm.; width 7–8 mm. ..... *affinis* Van Duzee 1904

Subapical teeth obtuse, almost appearing as crenulate lobes, their sinuses obtuse and inconspicuous (Fig. 41), sometimes obsolescent; tips of juga and tylus concolorous with disc of head; antennal segment three almost half again as long as segment two; basal segment dark fuscous, segments two to five piceous; pronotal marginal teeth tend to be reddish; length 10–14 mm.; width 6–7.5 mm. ..... *hoppingi* Van Duzee 1921

Brochymena pilatei Van Duzee, 1934

Van Duzee, Pan Pacific Entomologist, v. x, p. 22, 1934.

Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 204, 1939.

Head distinctly arcuate before the eyes, about rectilinear in *sulcata;* cheeks exceeding the tylus, sometimes somewhat connivent but rarely touching before the apex. Pronotum as about in *sulcata,* sides sinuate, dentate for their whole length, the teeth being smaller on the humeral lobe. Scutellum less elevated and narrower behind the frenum; membrane reticulate with fulvous brown instead of black, these reticulations nearly obsolete at times; antennae and feet as in *sulcata;* puncturation of upper surface irregularly distributed but more uniform in size than in *sulcata,* a few about the base of the scutellum being larger and black, the scattering large punctures found on the pronotum of *sulcata* being wanting in *pilatei.* Last ventral seg-

ment of male sulcate as in *sulcata,* the fringe of long hairs heavier and nearly meeting over the smooth depressed area; claspers somewhat shoe-shaped, broader and more triangular than in *sulcata* with a distinct heel, narrower with rounded angle in *sulcata.*

Color paler, with fulvous brown effect, produced by the castaneous puncture on a yellow background, with a few pale calloused spots, especially on the elytra; antennae black with pale incisures; beneath yellowish ferruginous, the pectoral pieces with groups of black punctures laterally; sides of cheeks below, a broken annulus on apex of femora and apical annulus, and about three spots on the tibiae and the apex of the tarsi black; vestiture beneath pale of short hairs on venter but mixed with long ones on the legs.

Holotype: Male #3839, deposited in Mus. Calif. Acad. Sci.
Allotype: Female #3840, deposited in Mus. Calif. Acad. Sci.
Type locality: El Centro, Imperial Co., Calif.; Jan. 26, 1910.
Paratypes: A long series with the same data.
Food plants: Unknown.
Distribution: Lower California, northwestern Mexico, southern California, western Arizona, Utah.

Comments

Due to the striking yellowish color, *pilatei* is one of the most readily identified species in the genus. The elytral membrane tends to be milky rather than hyaline. The sulcus across the apical border of the male genital cup is not as deep and wide as in *sulcata* but the vestiture is about the same or perhaps a bit heavier. From both the description and the facies of individuals it is very obvious that this species is most closely related to *sulcata.* While the ranges of the two overlap somewhat, *pilatei* has a tendency to be more abundant in the southern and western areas.

Brochymena quadripustulata (Fabr.), 1775 (Figs. 1–B, 10, 24–B, 25, 26)

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Amyot and Serville, Hémip., p. 107, 1843. (*Brochymena.*)
Uhler, Hayden's Surv. Terr., Rept. for 1871, p. 394, 1872.

pupillata (Herrich-Schaeffer), Wanz. Ins., v. iv, p. 104, fig. 453, 1839. (*Halys.*)
(Herrich-Schaeffer), Wanz. Ins., v. vii, p. 58, 1844. (*Halys.*)

†*annulata* Uhler, Bull. U. S. Geol. Geog. Surv., v. i, p. 283, 1876.
Uhler, Proc. Bost. Soc. Nat. Hist., v. xix, p. 373, 1878.
Provancher, Pet. Faune Ent. Can., v. iii, p. 35, 1885.

Thorace crenato, obtuse spinose scutelloque punctis duobis rufis. Habitat: America. (Drury.)

Praecedente (*C. annulata*) paulo minor. Clypeus fissis. Thorax lateribus crenatis, postice obtuse spinosis, scaber, fuscus, punctis duobus parvis ferrugineis, dosalibus. Scutellum concolor, punctis

duobus paulo majoribus ferrugineis ad basin. Elytra et alae fusca. Subtus cinereus.

Translation

Thorax crenate, obtuse spinose, scutellum as well as thorax with a pair of reddish points.

Habitat: America (Drury Collection).

Slightly smaller than the preceding (*C. annulata*). Apex of head cleft. Thorax laterally crenate, posteriorly obtusely spinose, rough, with a pair of small ferrugineous points on the dorsal surface. Scutellum concolorous with a pair of larger ferrugineous points at the base. Elytra and wings fuscous. Below ashy.

Redescription

Form narrowly oval to elliptical, dark brown to fuscous, subdepressed. Head before the eyes not much wider than across the tips of the subapical teeth, sides concave; subapical teeth rectilinear and strong and their sinuses rounded obtuse; juga subfoliate and much longer than tylus, connivent or overlapping; if connivent, the preapical sinus is deep and narrow and its sides are not parallel; disc of head undulant and irregularly wrinkled; surface of pronotum undulant with areas about calli well raised and a vague rectangular portion between them impressed; area in front of humeri, adjacent to antehumeral sinus likewise impressed; a smooth ferrugineous point at the inner corner of each callus; margins of the pronotum before the humeri weakly arcuate and provided with from 5–10 moderately strong triangular teeth between which are numerous denticles; humeri terminating obtusely with retrorse serrations on frontal edge and a weak crest obliquely across the top; the area of the pronotum just behind each humerus and above the base of the elytra is distinctly tumid, more so than in allied species; scutellum with base slightly raised, tending to be flat-topped; punctures largest on basal third, forming vague divergent bands there; basal angle of scutellum smooth and raised, usually ferrugineous and pitted with a cluster of deep piceous punctures, another elongated cluster just behind the angle along the edge; scutellum is not carinate, but there is a weak, convex median ridge which is evanescent toward the apical third of the disc; elytra with rather uniform punctures which are densest toward the apical end and scattered toward the costal base; discal point weak and inconspicuous; membrane

hyaline with strong, rich brown markings, mostly concolorous, a few nearer the apex being darker; submarginal band moderately wide, wider than its distance from the edge of the membrane; under side of head rather evenly punctured without distinct lineations; darkest beneath the juga and subapical teeth; buccular edge sinuate for its entire length terminating in an acutely rounded but not pointed tooth; frontal edge of jugum oblique, straight or very weakly convex, meeting buccular tooth at about a right angle; antennae piceous, segment one sometimes with a reddish tinge; segment three about half again as long as segment two; sternal area with the usual dark rounded patches between the pro- and mesocoxae, remainder testaceous becoming darker laterally so that pleural area is fuscous; a strong piceous arcuate sulcus on propleuron below the marginal teeth; metasternal orifice oblique, its auricle black, sub-lanceolate and about as long as the crateriform base with only a vague partial spiral twist to it; pebbled evaporating area contrastingly pale; femora dull brown or yellow, sparingly speckled with black proximally, spots congesting distally to form solid patches; a subapical pale incomplete annulus present; tibiae with their pale annulations narrower than adjacent black ones; fore tibia with a median square spot reaching across frontal width of segment; tarsi piceous; ventral abdominal furrow obsolescent, most distinct on the first and second visible segment just behind the metacoxae; beak not reaching the hind border of the second visible segment; venter dull yellow or light brown, rather evenly punctured; dark lunes laterally on each segment; basal valves of female genital plates weakly convex, hardly raised and not declivent behind; a subtriangular fuscous patch between them; male genital cup narrow, its ventral surface up-turned or deflexed, moderately impressed medianly and its apical edge forming a very broad and shallow "V"; the ventral edge is involuted so that the heads of the claspers are almost totally invisible from behind; no prominent sulcus present across the apical end of the cup; the vestiture is dense but very short. Average size, 14 mm. long; 9 mm. across abdomen.

Type: Sex not stated.

Type locality: "America."

Type deposited: Now lost.

Food plants: Pines (various species), sumac (*Rhus typhina* Linn.), mountain ash (*Sorbus americana* Marsh), elm, grape, cherry,

apple, pear; also being recorded as occasionally being predatory on soft-bodied larvae.

Distribution: Across southern Canada and United States from the Atlantic to Pacific coasts; most abundant north of 40° latitude; reaches south into northern Mexico. Recorded from almost every state in the Union.

Comments

This is the most common of all species in the genus. Its abundance and wide distribution suggest that it might be an ancestral stock from which several other species evolved. Its great variety of food plants indicates great adaptability which is usually a trait indicating primitiveness or generalization.

Individuals vary somewhat in both size and color; large examples sometimes measuring as much as 18 mm. long, small ones no more than 10 mm.; some are dark fuscous, almost black, while others can be a rusty pale brown.

As in all other species of the genus the adults hibernate under bark or in rubbish; they can withstand extreme cold temperatures, but appear to become very lively when warmed by the rays of the spring sunlight.

Brochymena sulcata Van Duzee, 1918 (Figs. 3, 27, 28)

Van Duzee, Proc. Cal. Acad. Sci., v. 8, p. 277, 1918.
Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiii, No. 1, p. 1, 1938.
Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiii, No. 2, p. 89, 1938.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 204, 1939.

Head as long as the pronotum on the median line; cheeks surpassing the tylus by their own width at that point, their inner margins at the sinus parallel or diverging, not approaching or overlapping as in *4-pustulata*, their lateral tooth, rectangular. Segments 2–5 of the antennae subequal in length, the third sometimes a little longer, normally so in *4-pustulata*. Rostrum attaining the middle of the second ventral. Pronotum across the humeri a little more than twice broader than its median length; lateral margins before the sinus with four to six triangular flattish teeth that merge into the adjoining surface, the humeri with six to eight serrations or small teeth; in *4-pustulata* these teeth are more terete and calloused and sometimes curved backwards. Exserted osteolar canal tongue-shaped, narrowed at the base rather longer than the external

diameter of the tube; in *4-pustulata* lanceolate, broadest at the base and distinctly shorter; male genital segment almost attaining the outer angle of the sixth ventral segment, its apical margin transversely sulcate omitting the median smoothly rounded excavation; either side of the sulcus clothed with long pale hairs; claspers elliptical ventrally; in *4-pustulata* broad-rounded. Other characters substantially the same as in *4-pustulata.*

Color above as in allied species; beneath pale with the marginal alternation, slender edge of the segments, stigmata, a line behind them and the spot on the middle of the sixth ventral segment blackish. Femora fuscous with their bases pale, an apical and subapical spot pale, the latter often produced basally as a vitta. Tibiae with a broad median pale annulus carrying a fuscous spot on the exterior surface, the posterior rarely marked with a pale basal spot exteriorly; antennae black with the incisures slenderly pale; rostrum pale with its median line and apex black.

Holotype: Male #391, deposited Mus. Calif. Acad. Sci.

Allotype: Female; deposited in Van Duzee collection.

Paratypes: Five males and eleven females from California and Arizona.

Type locality: San Diego, Calif. (both types).

Type deposited: Mus. Calif. Acad. Sci.

Food plants: Honey locust, mulberry, apple, probably many others and possibly occurs in chaparral.

Distribution: Calif., Utah, Arizona, New Mexico, Colo., Nevada, Western Texas, probably northern Mexico and Lower California.

Comments

A very common species of the south west and western States, where by its abundance it takes the place of the more eastern *quadripustulata.* It is easily distinguished from the latter by its more ashen color, its sharper humeral angles, the more evident preapical sinus and, of course, in the male by the presence of the prominent sulcus across the apical edge of the genital cup. Newly matured females are easily distinguished from those of *quadripustulata;* but older ones in which the whitish bloom has been rubbed off tend to become brownish and the student may have trouble differentiating the individuals of the two species. One must then rely upon such structural characteristics as shape (*sulcata* being slightly more

narrowly oval than its relative), the sharper humeral angle, and the more open preapical sinus. For additional comments see the remarks concerning *B. pilatei.*

Brochymena cariosa Stål, 1872 (Figs. 4, 24–A)

Stål, Enum. Hemip., pt. ii, p. 17, 1872.
Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 30, 1904.
Van Duzee, Cat. Hemip. N. A., Univ. Calif. Pub., v. 2, p. 31, 1917.
Hart, Pentatomoidea of Illinois; Bull. Nat. Hist. Surv. Ill., v. xiii, art. vii, p. 173, 1919.
Blatchley, Heteroptera Eastern N. A., p. 100, 1926.
Brimley, The Insects of North Carolina, p. 61, 1938.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 206, 1939.
Froeschner, Amer. Midland Nat., v. xxvi, p. 135, 1941.

Jugis tyloque aeque longis; articulus secundo et tertio antennarum aeque longis vel illo hoc paullo longiore.

Nigricans, supra grisea, inequaliter distinctissime nigro-punctate, punctis fortioribus in thorace scutelloque intermixtis; articulis tribus basalibus rostri, trochanteribus, basi annuloque maculari subapicali femorum nec non annulo lato tibiarum sordide flavo-albidis, hoc annulo superne nigro-maculato. ♀, long. 17 mm., lat. 8.5 mm.

Patria: Texas (Mus. Holm.)

Praecedentibus tribus statura, punctura picturaque maxime affinis, differt forma capitas, quae eadem est ac in *B. obscura,* jugis tyloque tamen aeque longis, longitudine articulorum secundi et tertii antennarum hemelytrisque hic illic minus dense punctatis et igitur, uti videtur, pallido-mamoratis. Fasciae segmentorum connexivi et maculae marginales ventris griseo-flavescentes. Rostrum apicem segmenti tertii ventris attigens vel subsuperans. Discus ventris vix pallescens. Segmentum anale maris apice late sinuatum, postice in medio levissime et quam in speciebus praecedentibus multo minus late subretusum.

Translation

Juga and tylus equal in length; second and third segments of antennae about the same length or the former slightly longer.

Blackish, gray above, very distinctly unequally nigro-punctate, larger punctures intermixed on thorax and scutellum;

basal three segments of rostrum, trochanter, the base and the subapical annulus of the femur as well as a wide band on the tibia dull yellow, the latter bearing a black patch on its upper surface. ♀, 17 mm. long, 8.5 mm. wide.

Locality: Texas (Mus. Holm.)

Closely related to the three preceding species in its puncture pattern, differs in the form of the head which is the same as in *B. obscura,* nevertheless the tylus and juga are subequal, and in respect to the relative lengths of the second and third antennal segments as well as the hemelytra which are less densely punctate and therefore appear to be palely mottled or marbled. Bands on the connexival segments and the ventral marginal spots grayish-yellow. Rostrum reaching apex of the third ventral segment or barely passing it. Disc of venter hardly pale. Apical margin of terminal male segment broadly sinuate and the median posterior area very weakly and much less broadly notched than in the preceding species.

Redescription from the type specimen

Form broadly oval, the dorsal surface quite convex, more so than in allied species; general appearance ashy gray and strikingly but irregularly mottled with dark; head elongated and slightly convergent apically; ground color of head somewhat yellowish; three obscurely defined yellow longitudinal lines on head, one on the tylus and one on each inner edge of the juga; head sculpturing irregular, dark fuscous pits of various sizes; subapical tooth small meeting the margin of the jugum obtusely; width across the subapical teeth twice the length of distance from that line to apex of tylus; juga narrow converging apically but hardly reaching beyond the tip of the tylus; apex of head distinctly triangular; pronotum with calli raised but not tumid; sculpturing on disc made of fuscous to piceous shallow and deep punctures and pits of various sizes between which is a reticulum of smooth dull yellow lines; a fair indication of a smooth median yellow line on front half of pronotum; humeri acutely angled with four or five retrorse small piceous teeth; antehumeral sinus shallow and inconspicuous; marginal teeth pale, four to six in number, small and conical with interpolated smaller sharp piceous denticles; base of scutellum not appreciably raised; punctures largest, deepest and darkest near the base; apex with some large paler yellowish

areas; a broad, posteriorly dilating band of deep, piceous pits extends across each basal corner; apex rounded and bordered with deep fuscous; elytra with two transverse broad obscure bands of deep fuscous congested punctures, one about a quarter distance from base and the other about same distance from apex; basal quarter of elytra with some very evident smooth pale yellowish areas; scattered pale yellow points over remaining portion of elytra; membrane but slightly milky, almost clear hyaline; markings rich, pale, reddish fuscous; connexivum narrowly exposed; distinctly alternated fuscous and pale; the pale band with a few reddish brown punctures; under surface of head dark fuscous, almost piceous; buccula tending to be deeply sinuate apically and ending in a sharp, though short, forward projecting tooth; its frontal edge slightly concave; antennal segments almost piceous, only their incisures pale; segment two slightly longer than segment three; second joint of rostrum remarkably compressed so that there is a sharp median edge present; this segment is long, usually reaching beyond the mesocoxal cavities; thoracic sternum dull yellow, thoracic pleura gradually becoming darker to fuscous laterally; posterior edge of metapleuron yellowish; osteolar canal long, narrow at the base and spatulate apically; evaporating area pale on its inner half, dark on its lateral half; mid-portion of abdomen dull reddish, lateral portion becoming darker; each segment with a striking yellow rectangular mark on the lateral edge between the arms of dark lunes; femora reddish fuscous, a narrow basal band and a subapical annulus dull yellow; tibiae annulated, a brownish spot on front surface of each pale annulus; tarsi fuscous, second joint paler; ventral tarsal pubescence golden; male genital cup smallish for the genus, lateral lobes with a small expansion mesally and ventrally, pubescence very heavy on inner faces of cup; visible posterior ends of the claspers stubby and tapering dorsally to a small hook (Fig. 4); inner faces of clasper head semilunar in outline; inner edges of basal valves of female genital plates narrowly reflexed so that when closed the combined plates produce a compound diminutive carina between them; the reflexed edges diverge apically leaving a wedge-shaped hiatus or space in front of median valvular plate.

Holotype: Female; long. 17 mm.; max. lat. 8.5 mm.
Paratypes not specified.
Type locality: Texas (Belfrage Collection).

Type deposited: Riksmuseet, Stockholm, Sweden.

Food plants: Slash pine in southern States; probably oak and other species of pines in northern habitats.

Distribution: Florida, Alabama, Mississippi, Louisiana, eastern Texas, Arkansas, Kansas, Missouri, Nebraska, Illinois, Indiana, Tennessee.

Comments

The general color pattern of *cariosa* suggests a mottled or marbled design, somewhat like that which is occasionally seen in *affinis*, to which however *cariosa* has no close relationship. The resemblance is purely superficial; *affinis* is an oval, sub-depressed form while *cariosa* is an elliptical very convex species. The head of *cariosa* is rather long and narrow for a species in which the juga and tylus are subequal; the apex of the head in front of the subapical sinuses is strikingly triangular in outline, similar to that found in *lineata* and *humeralis*. The scutellum is somewhat constricted at the point where the frenum ends so that the apical third is distinctly set off from the rest of the disc, a feature that is further accentuated by the presence of a pair of clusters of piceous pits at the region of the constriction. The elytral membrane is hyaline rather than milky and the vermiculate markings are very fine and numerous, more so than in many other species. The genital cup is proportionately small for the size of the individual; it is subglobose and when fully retracted leaves a rather wide space between the tips of the seventh segment.

The species *cariosa* by its abundance throughout its range in the plains States appears to take the place of the commoner and more easterly *carolinensis* which in the northern latitudes does not extend westward beyond the Appalachian Mountains.

Brochymena lineata Ruckes, 1938 (Figs. 1–A, 24–F)

Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiii, No. 5, p. 236, 1938.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 205.

Form elliptical; neither conspicuously depressed nor convex dorsally or ventrally; color in general aspect pale, being a mixture of ivory, testaceous, fuscous and black; punctures varying from minute ferruginous pin-point dots to deep, corroded black pits, the latter disposed in broad bands on the pronotum and scutellum. Head testaceous; disc between the eyes somewhat convex, in front of the eyes gradually undulating and flattened; diameter behind the eyes just about equal to that in front of

them so that eyes appear to protrude; sides of head from eyes to subapical teeth feebly converging, very nearly parallel, their edges weakly concave; subapical teeth in female small and rectangular to obtuse, in male more obtuse and less conspicuous; gena converge to an acute apex; diameter across subapical teeth about three times as long as distance between that line and apex of head; punctures mostly ferruginous, some nigro-fuscous ones found at base of tylus and surrounding area. Edge of bucculae strongly sinuate and ending anteriorly in a very prominent, latero-divergent, acute tooth; the edges of the bucculae and margins of the gena, at least in the females, ivory and smooth, in the males testaceous. First and second antennal segments reddish-fuscous, others deeper fuscous to piceous; *the basal fifth of segment four distinctly flattened or compressed and more smooth than the remaining portion of the segment;* segments two to five subequal in length, with segment five shortest; in one male specimen segment two is distinctly longer than the others. Median length of the pronotum equal to that of head; diameter across humeri about one-sixth greater than median length; disc irregularly undulating with a median, weak ivory or pale carina on front half; the carina becomes obsolete on hind half; *two prominent smooth ivory colored irregular longitudinal bars on posterior half,* each one about midway between the midline and the respective humerus; between the carina and each of these ivory bands appears a *broadish subrectangular area of large deep, corroded pits, nigro-fuscous to piceous,* some of these having smooth ivory or pale borders; several shallowly depressed or excavated areas on disc; calli somewhat raised and irregularly smooth; edges of pronotum weakly convex arcuate bearing six to eight ivory, conical teeth which blend with the dull yellow edge of the disc; humeri subtriangular, slightly tumid, the edges with four or five retrorse serrations. Propleuron with an arcuate sulcus just underneath the margin of pronotum; this sulcus subtended by a punctured area at least no appreciable amount of smooth showing; the punctures more or less evenly distributed and of medium size; propleuron becoming darker laterally toward sulcus and paler toward prosternal region; the sulcus appears as a dark fuscous groove. Scutellum long and narrow for this genus; basal third somewhat tumid with a broadish median carina continued to apical third; basal angles in the form of deep, corroded, nigro-fuscous pits; *median to these a short ivory or pale*

bar, impunctate and continuous with a similar one on the pronotum; this pale bar followed medially by a broad, rugose band of nigro-fuscous pits which extend posterior to the claval edge of scutellum; this area in turn followed medially by a very irregular longitudinal stripe that becomes punctured with ferruginous and fuscous pits toward the inner edge; apical third of scutellum paler, with smooth areas becoming larger; the scutellar carina with an irregular row of large fuscous punctures. Elytra pale to testaceous with *very uniform fuscous punctures evenly distributed* and tending to coalesce toward the apical end; the highest point on the elytra usually impunctate and pale. Membrane clear with rich ferruginous vermiculate and arborescent markings. Edges of the abdomen not excessively explanate, rather less so than is common for this genus, the outline being elliptical and abdomen somewhat tapering posteriorly; greatest width of the entire body across humeri; *greatest width of abdomen distinctly less than that* across humeri, abdomen alternated with testaceous and fuscous, the narrow band each side of the incisures being testaceous. The venter bright testaceous with incisures between segments distinctly dark fuscous, as are also the stigmata, a thin line behind them and a smooth spot near them; punctures on the venter are of medium size, fuscous to reddish and irregularly scattered, tending to concentrate laterally; sixth ventral of the female with five to seven fuscous blotches, one median and two or three laterally across segment; basal valves of female genital plates with an inner border of fuscous or dark. Femora dull testaceous with fuscous maculations arranged in longitudinal vittae which coalesce distally and there interrupted by a partially complete pale annulus; tibiae conspicuously annulated; the exterior surface of the pale band with a small dark blotch, smallest on the fore tibia and becoming increasingly larger on the middle and hind. Proximal two joints of the tarsi distinctly pale above, otherwise fuscous; claws and remaining joint fuscous. Beak reaching past the middle of the third ventral. Metasternal osteole and canal small though conspicuous because of contrasting color; osteolar cone and crater ivory or very pale, auricle deep fuscous almost piceous, narrowed at base and spatulate distally; evaporating area small, its lateral edge cutting obliquely across the surrounding disc, area pale, testaceous, surrounding regions darker. Male genital cup small for this genus, *rounded, without any conspicuous outgrowths of lateral expan-*

sions; the lateral corners do not reach even close to the ends of the sixth ventral segment; posterior edge across cup, excluding a shallow median excavation, provided with a very shallow, obsolescent sulcus; pubescence very short and fine, not silky; proctiger very wide and testaceous-fuscous to fuscous; claspers almost piceous and smallish.

Holotype: Female, Patagonia, Sonoita Creek, Santa Cruz Co., Arizona, 7/23/37. Deposited in the American Museum of Natural History. 16.5 mm. long; 8.5 mm. across humeri.

Allotype: Male, Patagonia, Sonoita Creek, Santa Cruz Co., Arizona, 7/23/37. Long. 16 mm.; width across humeri 8 mm. Author's Collection.

Paratypes: One female, Williamson Valley (E. D. Ball), 6/22/35; one female, Fort Wingate, N. M., 3/15/08; these specimens in the collection of the Academy of Natural Sciences, Philadelphia.

Type deposited: American Museum of Natural History, N. Y. C.

Food plants: White-leaf oak (*Quercus hypoleuca* Englm.); possibly also pines found within its range.

Distribution: Known only from the type records, *i.e.*, Arizona and New Mexico.

Comments

While the records show that this species occurs in both New Mexico and Arizona, in the latter state it appears to be very local. All the specimens collected by the author were taken from white-leaf oak in the Sonoita Creek Valley. The late Dr. E. D. Ball told me that he found it feeding on that tree. The species is easily identified as it can be readily distinguished by the pair of ivory calloused bars across the pronotum and scutellar base. It seems to show closest affinity to *cariosa* in so much as the male genital cup and claspers are similar and in having the second antennal segment ordinarily longer than the third. The elytral membrane, however, is not as clear as in that species and the vermiculate markings are much coarser and paler. Whereas the venter in *cariosa* tends to be dark, almost nigro-fuscous in some cases, with a conspicuous pale blotch at the lateral margin of each abdominal segment, the venter of *lineata* is lighter fuscous and the pale blotches are ill-defined. The very narrow whitish border on the edge of the abdomen is also a distinguishing characteristic.

Brochymena parva Ruckes, 1946 (Fig. 32) = obscura (H.-S.) 1839
Ruckes, Bull. Bklyn. Ent. Soc., v. xli, No. 2, p. 41, 1946.

‖*obscura* Herrich-Schaeffer, Wanz. Ins., pt. v, p. 68, fig. 513, 1839; pt. vii, p. 59, 1844. (*Halys.*)
Stål, Enum. Hemip., pt. 2, p. 16, 1872.
Uhler, Bull. U. S. Geol. Geog. Surv., v. i, p. 283, 1876.
Distant, Biol. Centr. Amer., Heter., v. i, p. 52, 1880.
Uhler, Proc. Ent. Soc. Wash., v. ii, p. 368, 1893.
Uhler, Proc. Cal. Acad. Sci., Ser. 2, lv, p. 228, 1894.
Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 29, 1904.
Barber, Bklyn. Inst. Bull., v. l, p. 257, 1906.

†*tenebrosa* Distant, Biol. Centr. Amer., Hemip.-Heter., v. i, p. 52, 1880.
Kirkaldy, Cat. Hemip., v. i, p. 192, 1909.
Van Duzee, Cat. Hemip. N. A., Univ. Cal. Publ., v. 2, p. 31, 1917.
Van Duzee, Proc. Calif. Acad. Sci., v. xii, pt. i, p. 126, 1923.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 204, 1939.
Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiii, p. 10, 1938.

Form oval, small, with head form similar to *B. cariosa* Stål; body quite convex apparently more so than in *cariosa* due to smaller size; ground color dark testaceous with pits, punctures, calli, and markings on legs deep fuscous or piceous giving a dark brown appearance to the individual; edges of head in front of eyes concave, frequently sinuate with narrowest diameter about midway between eyes and subapical teeth; edges of juga straight or very weakly arcuate, converging to form a narrowly truncated apex to head; apex of each jugum acute; juga hardly longer than the tylus, if so then a very small rectangular sinus there; subapical teeth forming acute angles with juga, their tips upturned somewhat; disc of head between the eyes more convex than rest of head.

Pronotal area about the calli distinctly swollen, tumid, almost gibbose; propleuron, mesad to margin, likewise swollen so that prothorax is very thick through the calli ventrally, almost globose; pronotal collar distinctly set off from adjacent swollen areas; marginal teeth very small, almost needle-like, sharp and very few in number, not more than four, usually two or three, wide-spaced, sometimes with minute denticles between them. [The character of the marginal teeth was for a long time used to identify *Brochymena obscura* (H.-S.).] Humeri convexly

thickish, terminating laterally in an acute small tooth, this frequently directed backwards; front edge of humerus with three of four very small retrorse serrations, these sometimes obsolescent; antehumeral sinus evident with adjacent impression prominent; coarse pits of pronotum irregularly placed and no design evident; scutellum with punctures coarse and irregular in contrast with finer and very evenly crowded ones of elytra; the usually vague median impunctate line from tip of head to apex of scutellum present; base of scutellum distinctly raised, more so than in allied species but not as much as in species of the *arborea* group; sometimes base of scutellum is higher than adjacent area of pronotum and the transverse sulcus between these two is very marked; wing membrane somewhat milky arborescent and vermiculate markings strong.

Antennae thin and weak for this genus; segment two only about one-twelfth as thick as long (in *quadripustulata* this ratio is about one-sixth to one-eighth); other segments in proportion; segment one with a reddish tinge, others almost piceous with only the incisure of proximal two or three segments pale; segment three longer than segment two, and five shorter than four, sometimes the latter ratio very marked. Fore tibiae stubby, about one-sixth as wide as long (in *quadripustulata* this ratio is about one-eighth or one-ninth); tibiae annulated as in related species, the dark spot in the pale annulus just about filling the width of the annulus but usually not coloring the carinate edge of the tibia; metasternal evaporating area entirely dark, only the crateriform base and orifice pale; auricle piceous, in length about twice the diameter of the orifice, thin and spatulate in outline with a partial twist to it. Median third of abdominal venter pale, testaceous, almost impunctate; laterally on each segment punctures become reddish to dark fuscous and form dark, sometimes almost piceous, lunes, similar to allied species; each lune enclosing an almost semi-circular pale, nearly impunctate blotch.

Male genital cup much like that in *quadripustulata* but its color and contents paler; posterior border as seen ventrally, broadly U-shaped, somewhat broader than in *quadripustulata* and the surface just below the middle of the U a little more impressed or concave. Apical edge of terminal female segment, as seen from above, straight to weakly sinuate, color of disc piceous except for two lateral subtriangular patches and marginal edge which are pale. This plate has some fine scattered punctures on it.

Described from twenty-five specimens as follows:

Lectotypes: Male: 13 mm. long; 6.5 mm. across humeri; Globe, Arizona, 7/20/37. Deposited in the American Museum of Natural History. Female: 14 mm. long; 7 mm. across humeri; Globe, Arizona, 7/20/37. Deposited in author's collection.

Paratypes: Author's collection: Males: Santa Rita Mts., Ariz., 6/15/36; Tucson, Ariz., 8/15/05, 5/10/30, 6/25/35, 8/15/37; Wilcox, Ariz., May, 1937; Huachuca Mts., Ariz., 8/23/05. Females: White Mts., Ariz., 7/12/36; Wilcox, Ariz., Sept., 1936; Tucson, Ariz., 8/15/37 and one labeled Arizona 1923. American Museum Collection: Males: Concepcion Bay, Cal., 4/6–10/11; Sierrita, Ariz., 7/29/16; Van Horn, Texas, 5/22/32; Port Ballandra, Carmen Isl., Gulf of California, 5/22/21. Females: Tucson, Ariz., 10/2–25/16 (four specimens); Sonora, Mexico, 9/13/20; Tucson, Ariz., no date; (Slosson Collection) Ac. No. 26226; Van Horn, Texas, 5/22/32; Port Ballandra, Carmen Isl., Gulf of California, 5/22/21.

Type locality: Globe, Arizona.

Type deposited: American Museum of Natural History, New York. (Also see above.)

Food plants: Mesquite (*Prosopis glandulosa* Torr.); probably on desert oak [*Quercus arizonica* Sarg. (?)] and other chaparral vegetation.

Distribution: Southwestern Texas, New Mexico, Arizona, Mexico, Utah, California, and Lower California. Possibly also in Nevada; probably not in southern Mexico.

Comments

B. parva is the name given to the species originally described by Herrich-Schaeffer as *Halys obscura* which became quite badly confused in identification with *B. tenebrosa* (Walk.). As explained in the author's reference above (1946) it appears that Distant erred in synonymizing these.

The species averages small for the genus, individuals sometimes being no more than ten millimeters long. Although specimens of other species sometimes are diminutives and approximate this size they are never consistently dwarf.

The convexity of the propleuron and pronotal area above it makes the entire lateral thoracic portion of the insect appear swollen, so much so that the pronotal margin is almost eliminated and the few small teeth seem to emanate directly from the wall of the segment. When one is familiar with the general characteristics of the other species in the genus, the thinness of the antennae and the

stubbiness of the tibiae in *parva* stand out distinctly as valid differentiating features, as do also the narrowly arcuate tip of the head and the acuteness of the juga.

Most specimens in American collections that have been previously identified as *B. obscura* (H.-S.) or *B. tenebrosa* (Walk.) and which come from the geographic areas specified above are undoubtedly individuals that should be called *B. parva*. *B. tenebrosa* (q.v.) is an entirely different species, much larger in size and of more southern (Mexico) distribution.

Brochymena punctata Van Duzee, 1909 (Figs. 5, 29)

Van Duzee, Canadian Ent., v. xli, p. 369, 1909.
Banks, Cat. Nearc. Hemip., p. 92, 1910.
Van Duzee, Cat. Hemip. N. A., Univ. Calif. Pub., v. 2, p. 32, 1917.
Blatchley, Heter. Eastern N. A., p. 102, 1926.
Brimley, The Insects of North Carolina, p. 61, 1938.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 205, 1939.

Smaller than *annulata* with the head more truncated at the apex; pronotum, scutellum and elytra distinctly dotted with smooth white points. Length 14–15 mm.

Apex of head very obtusely angled, almost truncated, inner angle of cheeks scarcely meeting over apex of tylus. First antennal joint almost attaining the tip of the head, second and third respectively longer, the fourth equal to the third. Pronotum hardly as wide as in *annulata;* humeri less produced, and the anterior lobe with coarser and more irregular denticulations; the posterior lobe quite distinctly denticulate on the latero-anterior margins; the surface closely and quite regularly punctured with fuscous on a whitish ground; anteriorly with dark punctures segregated along the submargins and in two oval patches at the inner angles of the callosities; median line carinate and smooth anteriorly. Scutellum shorter and more rounded at apex than in *annulata,* punctured with blackish on a pale ground, and marked with a few scattering larger black pits and a cluster of the same at each basal angle, intercepted by an oblique pale callus. Elytra pale, with distinct dusky punctures, which become finer and confluent in areas posteriorly on the disc; the surface sprinkled with conspicuous white calloused points which are found more indefinitely on the scutellum and pronotum. Membrane more irregularly and

obscurely veined than in allied species. Connexivum conspicuously alternated. Legs, base of antennae and the rostrum ferruginous or obscure brown; the black apex of the latter attaining the base of the third ventral segment. Genital segment of the male short, of almost equal length across its whole width, the broad apical sinus subangular.

Cotypes: One male and two females.

Type locality: Georgia; no station mentioned.

Type deposited: Van Duzee Collection, University of California Museum.

Food plants: Oak (*Quercus* spp.).

Distribution: Virginia, Georgia, Florida, Indiana (?).

Comments

Little need be added to the excellent description that Van Duzee has given above. Blatchley, in his *Heteroptera of Eastern North America* adds a character that appears to be a good one, that of the median plate of the female genital valves being longer than the lateral lobes. In the male, this species is the only one in the genus, with its variety *pallida* (q.v.), that possesses claspers, the heads of which are squarish block-shaped structures, and which nearly fill the cavity of the genital cup.

It is a most distinctive species with its rusty color and stellate points, its short, broad head with an obtuse apex, and its broadly oval form.

Apparently this is not a common species, being absent in most collections that have been examined, and seems to be restricted to the southeastern States, although Blatchley claims to have taken it in Crawford County, Indiana. While Blatchley's authority should not be questioned, it does seem rather odd that no other record exists that places this species beyond the range of Virginia, Georgia, and Florida. Such a specimen could possibly have been accidentally introduced and escaped as an adventitious individual.

Brochymena punctata var. *pallida* Blatchley, 1926

Blatchley, Heteroptera of East. N. A., p. 101, 1926.

Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 205, 1939.

Oval, subdepressed, small for the genus. Grayish-white with numerous small fuscous punctures; pronotum and scutellum with a number of widely scattered coarse, deep black punctures, these aggregated to form an oval spot at each basal angle

of scutellum; also with numerous elevated smooth white spots, the most conspicuous of these being near middle of front lobe of pronotum and each side of scutellum; antennae dark reddish-brown; connexivum with alternate bars of fuscous and pale gray; under surface dull grayish white with scattered very small fuscous punctures and thickly clothed with white hair-like bloom; legs dull yellow mottled with purplish dots. Head relatively short, its apex obtusely angled or subtruncate, cheeks reaching tip of tylus; subapical sinus and tooth scarcely evident. Beak reaching base of second ventral. Bucculae with a preapical tooth. First antennal reaching the sinus of cheeks, second one-fourth longer than third. Side margins of pronotum armed both before and behind the sinus with short, regular subacute teeth. Scutellum shorter and more rounded than in *carolinensis*. Osteole with tube shorter, its auricle smaller than in the two preceding species (*cariosa* and *myops*). Genital segment of male short, shallowly emarginate behind, the notch with a short median lobe. Lateral lobes of the female genital plate distinctly surpassing the oblong median lobe. Length 13–15 mm.; width 7–9 mm.

Cotypes: One male and one female.
Type locality: Sanford, Florida (March 25th).
Type deposited: Purdue University Museum, Indiana.
Food plants: Unknown, but likely to be on oaks and pines.
Distribution: Known only from Florida type locality.

Comments

Blatchley says that this species is closely related to *B. punctata* Van D. I have had the opportunity of examining the type specimens which were kindly loaned me from the Purdue University Museum's collection and after careful study have found that the structural differences, other than color, between *pallida* and *punctata* are so slight that there is no very good reason to keep *pallida* as a valid species. The male genitalia are identical, and although there is a minor difference in the female genital plates of the two, the variation is within the limits that one can expect and within those shown by other species in this genus. In general the facies are quite similar, Blatchley's *pallida* being of course the paler form. I do not believe that the slight differences apparent in the shape of the apical portion of the head or the relative lengths of the antennal segments are characters of sufficiently great value to differentiate

these two forms into two distinct species. Therefore, *pallida* is being relegated to the status of a variety of the typical species *punctata*. It is probably a southern variation of the Georgia type.

Brochymena dilata Ruckes, 1938 (Figs. 24–D, 33)

Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiii, p. 239, photo., 1938.

Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 205, 1939.

Torre-Bueno, Bull. Bklyn. Ent. Soc., v. xxxv, p. 63, 1940.

Form broadly oval, somewhat depressed on top and slightly convex beneath; dorsal surface at least not as convex as in allied species; color in general aspect somewhat cinereous, being a mixture of a dull testaceous background mixed with fuscous and blackish punctures, of various sizes, each of the smaller ones provided with a whitish bloom. Head more reddish than testaceous; diameter behind the eyes much less than just in front of them, disc widest just in front of eyes and then sides slightly converging to an evenly obtuse, arcuate apex in the female and a slightly more truncated one in the male; diameter across subapical teeth about four times the distance between that line and apex of head; juga as long as tylus with their tips not touching; edges in front of eyes somewhat sinu-concave, these edges and those of the juga finely and irregularly creno-serrulate, at least not smooth; apical tooth not conspicuous and tending to be blunt, not acutely angled. Edge of the bucculae deeply sinuate and ending anteriorly in an acute prominent tooth that meets the blunt, rounded ventral extension of the gena in an inconspicuous angle. *Basal three segments of antennae reddish, distal two much darker; almost piceous;* segments two to five subequal, at least none conspicuously longer or shorter than another. Median length of pronotum as long as that of head; diameter across humeri about one-seventh greater than the median length; disc around the calli somewhat tumid in two raised areas leaving a shallow median restilinear portion excavated; two lateral obscurely circular areas also excavated, these about equidistant from front and hind margins of pronotum but closer to lateral edge than median line; some scattered large piceous pits on pronotal disc, these forming, however, *no definite pattern; small punctures numerous and very evenly distributed* reaching the very bases of the marginal teeth. Marginal teeth seven to nine in number, *bluntly rounded, uniform in size, perceptibly flattened, never conical or terete,*

sometimes with denticules at their bases; teeth either concolorous with disc of pronotum or paler, never darker; *teeth tend to point backwards;* humeri subtriangular with irregular small serrations becoming obsolete posteriorly. Propleuron with an arcuate sulcus just below the pronotal margin; *area around appreciably smooth and concolorous with remaining disc;* rest of propleuron and prosternum with scattered coarse fuscous or reddish-fuscous punctures. *Elytra with numerous substellate points and blotches,* these impunctate and pale and evenly distributed over elytra. Scutellum with a *few widely scattered large punctures,* these concentrated at the basal angles to form two small corroded areas. Edges of the abdomen *explanate and extend well beyond the costal margin* of the elytra and in the female at least form an almost *orbicular outline* to the body; *lateral diameter across widest part of abdomen at least one-sixth greater than width across humeri;* exposed edge of abdomen *not* brightly colored and *inconspicuously* alternated. Venter testaceous to reddish-fuscous with many punctures of various sizes scattered irregularly; sparsely clothed with an inconspicuous tomentum. Femora with maculations arranged in incomplete longitudinal vittae which terminate in a distal irregular piceous area which is broken medially by a rectilinear pale blotch; *tibiae distinctly reddish to reddish-fuscous and without annuli or maculations of any kind;* tibiae more slender and more uniform in diameter than in related species; the sulcate face slightly darker than posterior surface; tarsi and claws fuscous. *Male genital cup with lateral wings conspicuously protruding ventrally and medially,* not laterally, into a pair of thickish, darker, rounded lobes, the dorsal surface of which is clothed with short soft hairs; exposed face (medial aspect) of dorsal ramus of claspers semicircular in outline and piceous in color, shining; proctiger broad and deep fuscous with a paler reddish median stripe. Membrane with veins strikingly fuscous on an obscurely milky-hyaline background. Basal valves of female plates somewhat convex, at least more so than in allied species; the distal valves not reaching the edge of the eighth tergites; median plate of valves broadly triangular with a concave posterior edge. Auricle of the metasternal canal elongated, tongue-shaped, narrowed at the base and several times as long as the external diameter of the orifice; the auricle has a partial spiral twist to it; the evaporating area and the crateriform of the base of the orifice are not conspicuously different in color from the surrounding area.

Holotype: Female, White House Canyon, Santa Rita Mts., Santa Cruz Co., Ariz., 7/21/37. Coll. H. Ruckes, deposited in American Museum of Natural History. 18.25 mm. long; 9.5 mm. across humeri; 11.5 mm. across abdomen.

Allotype: Male, same data, deposited in author's collection. 17.5 mm. long; 9 mm. across humeri; 10.75 mm. across abdomen.

Paratypes: One female in author's collection.

Type locality: Santa Rita Mts., Santa Cruz Co., Arizona.

Type deposited: American Museum, N. Y. C.

Food plants: Unknown.

Distribution: Arizona; Hot Springs, New Mexico; Salt Lake City, Utah; possibly northern Mexico. In the collection of the late William T. Davis there was a specimen of this species which was labeled "Chisos Mts," presumably from Texas. It was wrongly identified as *B. quadripustulata;* apparently the example was lost or given away without a record of its disposal.

Comments

This species, while apparently uncommon and somewhat spotty in its distribution, is easily recognized by its almost orbicular abdomen, the inconspicuous antehumeral sinus, the fineness of its many punctures, its dark color and concolorous tibiae and, in the male, by the presence of large lobes developed ventrally and medially of the lateral corners of the genital cup. The heads of the claspers indicate relationship to *punctata* in that they are large block-shaped hooks on the crest of which is a pair of blunt crenulations with a weak saddle between them; in *dilata* the meso-posteroir face of each clasper head is semicircular while in *punctata* it is distinctly squarish.

One specimen in the collection of the National Museum, Washington, D. C., has the fore tibiae not immaculate, as stated in the description, but provided with a vague, inconspicuous annulus near the knee.

Brochymena myops Stål, 1872

Stål, Enum. Hemip., pt. 2, p. 16, 1872.
Uhler, Bull. U. S. Geol. Geog. Sur., v. 1, p. 283, 1876.
Uhler, Proc. Bost. Soc. Nat. Hist., v. xix, p. 373, 1878.
Distant, Biol. Cent. Amer., Hemip.-Heter., v. i, p. 51, 1880.
Bueno and Brimley, Ent. News, v. xviii, p. 441, 1907.
Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 29, 1904.
Van Duzee, Canad. Ent., v. xliv, p. 318, 1912.

Van Duzee, Cat. Hemip. N. A., Univ. Calif. Pub. v. 2, p. 30, 1917.
Blatchley, Heterop. Eastern N. A., p. 100, 1926.
Brimley, The Insects of North Carolina, p. 61, 1938.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 203, 1939.

†*quadripustulata* Herrich-Schaeffer, Wanz. Ins., v. vii, p. 57, fig. 729, 1884.

4-notata Provancher, Nat. Can., v. iv, p. 74, 1872.
Uhler, Check List, p. 8, 1886.

Thorace marginibus lateralibus anticis pone sinum integris vel inermibus, ante sinum rotundatis, callosis, laeviusculus et obtuse dentatis; scutello ad angulos basales laeviusculo, hac parte laevi intus serie subobliqua punctorum acervatorum, extus impressione marginali longitudinali continua fortiter nigro-punctata terminata; margine costali basin versus laevigato.

Translation

Lateral anterior thoracic margin entire and unarmed, in front of the sinus (humeral) rounded, calloused, somewhat smooth and obtusely dentate; scutellum at basal angles somewhat smooth which smooth part is traversed by a series of suboblique rough punctures or pits which become more strongly nigro-punctate towards the longitudinally impressed margin; base of costal margin levigate.

Redescription of the Type

Large species, form very broadly oval, robust; general color dull brownish yellow with varying sizes of dark fuscous punctures and pits; head with a continuous longitudinal smooth stripe (apparently variable) continuous with a median one on the front half of the pronotal disc; subapical teeth of juga broad and blunt, apex of head short and triangular, juga converging slightly over the tip of the tylus, but not contiguous with each other; pronotum strikingly marked with an elliptical smooth pale area at the posterior inner angle of each callus; calli mediumly raised and irregularly punctate; humeri thick, obtusely angled and edentate; sinus not very deep and margin in front of it thick, smooth, light yellow with four to six blunt, stubby, pale yellow teeth; punctures of pronotal disc variable, pit-like ones just posterior to the two large smooth areas; basal

third of scutellum not much raised and continued as a very broad flattish ridge to the distal third; a broad band of black, transversely elliptical pits cutting obliquely across the basal corners of scutellum, each lateral third of scutellar base smooth and dull yellow with scattered deep fuscous punctures of various sizes; edge of the posterior third of scutellum deep fuscous; an irregular band of congested shallow punctures appears each side of the median raised line; punctures of elytra of rather uniform size and even distribution; punctures slightly more dense in vicinity of high discal point; membrane clear hyaline, suffused with dusky; arborescent markings dark brown; edge of connexivum dull yellow, remaining portion not conspicuously alternated; under surface of the head and juga pale; antennal segments two and three rufous (in type but not necessarily so in other examples), segments one, four, and five deep fuscous; segment two subequal to segment three or but slightly shorter; edge of buccula hardly sinuate, ending in a blunt, rounded, pale tooth; pro-, meso-, and metasterna evenly colored and more or less evenly punctured; a darker smooth blotch between the pro- and mesocoxae; propleuron with a prominent smooth, dark fuscous crescentic area just below the margin of the pronotum; metasternal evaporating area slightly impressed in the surrounding disc, dull brownish orange in color; auricle slightly darker than evaporating area, short and blunt; femora distinctly red immaculate except for dark, almost black incomplete annulus at apices; tibiae strikingly annulated with fuscous and pale yellow, the pale annulus with a dark patch on its anterior face; tarsi uniformly deep fuscous; abdomen essentially impunctate and graduating from pale rufous medially to dark fuscous laterally; male genital cup like that in *carolinensis* but with more prominent auricular edges on the parameres; proctiger without a median keel, uniformly dark.

Type: Male; 19 mm. long; 11.5 mm. wide.

Paratypes: Not stated.

Type locality: Stål described the species as coming from New Orleans, La., the type specimen however bears a label reading "Mexico."

Type deposited: Riksmuseet, Stockholm, Sweden.

Food plants: Never definitely stated; probably various species of pines in its habitat. Provancher collected his *B. 4-notata* from sweet gum (*Liquidambar styraciflua* Linn.).

Comments

This is the largest and most colorful species of them all. In fresh specimens the bright yellow (almost orange) coloring stands out in sharp contrast with the drab brown-gray background. It is, needless to say, the species most easily identified.

The relationship to *carolinensis* is evident due to the similarity of the structure of the claspers and male genital cup.

Individuals appear to occur common locally, being taken in considerable numbers when and where it appears. However its distribution is rather spotty. Numerous records are listed from various stations in North Carolina, but in Texas, Louisiana, Georgia, Alabama, and South Carolina individuals have been taken at only isolated places. The record from New Mexico is questionable; the record was established years ago by Uhler when species of the genus were not too well known and could easily have been misidentified at that time. The record is accepted with reservations, the author being of the conviction that the New Mexican specimen could have been, in reality, an over-sized example of *B. hoppingi* Van D., in fact such an erroneous identification was made by him in 1937.

Brochymena carolinensis (Westwood), 1837 (Figs. 6, 30, 34, 37)

Westwood, Hope Cat., v. i, p. 22, 1837. (*Halys.*)
Dallas, List of Hemip., v. 1, p. 189, 1851.
Stål, Enum. Hemip., pt. 2, p. 17, 1872.
Distant, Proc. Zool. Soc. Lond., p. 823, 1900.
Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 29, 1904.
Kirkaldy, Cat. Hemip., v. i, p. 191, 1909.
Van Duzee, Cat. Hemip. N. A., Univ. Calif. Pub., v. 2, p. 31, 1917.
Blatchley, Hemip. Eastern N. A., p. 102, 1926.
Leonard, A List of the Insects of New York, p. 78, 1926.
Brimley, The Insects of North Carolina, p. 61, 1938.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 203, 1939.
Ruckes, Bull. Bklyn. Ent. Soc., v. xxxvi, p. 27, 1941.

‖*annulatus* Fabricius, Syst. Ent., p. 704, 1775. (*Cimex*).
Goeze, Ent. Beytr., v. ii, p. 238, 1778. (*Cimex.*)
Fabricius, Spec. Ins., v. ii, p. 347, 1781. (*Cimex*).
Fabricius, Mantissa Ins., v. ii, p. 285, 1787. (*Cimex*).
Gmelin, *in* Linnaeus, Syst. Nat. Edn. 13, v. i, pt. 4, p. 2139, 1788. (*Cimex.*)
Fabricius, Ent. Syst., v. iv, p. 100, 1794. (*Cimex.*)

Fabricius, Syst. Rhyng., p. 182, 1803. (*Halys.*)
Herrich-Schaeffer, Wanz. Ins., v. vii, p. 57, fig. 728, 1844. (*Halys.*)
Stål, Enum. Hemip., v. ii, p. 16, 1872.
Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 30, 1904.
Bueno and Brimley, Ent. News, v. xviii, p. 442, 1907.
Van Duzee, Can. Ent., v. xli, p. 369, 1909.
†*serrata* Wolff, Icon. Cimic., v. v, p. 184, fig. 178, 1811. (*Halys.*)
harrisii Uhler, Proc. Bost. Soc. Nat. Hist., v. xiv, p. 95, 1871; v. xix, p. 373, 1878.

Fusca, nigro-punctatissima, capite antice, integro, thoracis lateribus spinuloso-serratis angulis posticis parum prominulis; hemelytris punctis duobus nigricantibus, membrana apicali albida nervis 4 longitudinalibus, pulcherrime ramulosis, plaga interna nigricanti, femoribus fascia ante apicem tibiisque fascia media pallida. Long. corp. lin. 8.

Translation

Fuscous, very finely punctate, apex of head entire, lateral margin of thorax sharply-serrate, posterior angle weakly produced; hemelytra punctured with two blackish points, apical membrane white with four longitudinal nerves, beautifully ramifying, and an inner spot darker, a subapical band on the femora and a median band on the tibiae pale. Length of body, 8 lines.

Redescription of Specimen Compared with Type

Form broadly oval; cinereous-brown, in fresh specimens provided with a whitish bloom causing individuals to appear beautifully mottled; worn specimens become almost concolorous fuscous. Head widest before the eyes, its sides weakly concave and converging anteriorly; subapical teeth prominent and their sinuses rectangular, their tips rectangular to acute; head in front of subapical teeth triangular; juga somewhat longer than the slightly deflexed tylus leaving a preapical sinus about as deep as the width of the tip of one jugum; disc of head not very undulant and with dark punctures more or less parallel between thin, sinuate, laevigate longitudinal paler stripes; eyes prominent; disc of pronotum somewhat undulant with a very deeply impressed area adjacent to each antehumeral sinus; area of the

calli raised and irregularly pitted between smooth patches; median quarter of disc more finely punctate than rest; dentate margins distinctly convexly arcuate and provided with numerous strong peg-like teeth, between which are minute denticles; humeri strong and ending in an acute tip somewhat produced; frontal edge of each humerus with retrorse serrations above which is a prominent thick crest; narrow posterior border of pronotum and a similar border across base of scutellum, declivent, producing a shallow but easily recognized sulcus transversely between the two; surface of scutellum irregular, somewhat convexly faceted; an elongate cluster of large, deep piceous pits at and behind the basal angles; a few large scattered punctures irregularly distributed between finer ones of disc; no median carina present but the center of the scutellum is convexly, but weakly raised; apical edge bordered with a darker crescent; elytra with uniform and evenly distributed small punctures, only the basal area of the costal margin smooth; discal point pale and prominent; elytral membrane slightly milky to hyaline with beautiful, rich arborescent and vermiculate markings, the basal two-thirds of which are rufous to ferrugineous while the distal ones are deep fuscous; the submarginal brown border is very narrow and close to the edge of the membrane; lateral two-thirds of the connexivum raised above the level of the abdominal disc, producing the effect of the elytra being impressed into the dorsum (Fig. 37); connexivum not as strikingly alternated as in many other species; each segment with three color bands, two dark fuscous ones between which is a lighter one, each subequal in width; apical edge of terminal female segment very weakly sinuate transversely; under side of head longitudinally lineated dark fuscous and light fuscous; buccular edge sinuate towards its acute apical tooth, which has a concave frontal edge; frontal edge of jugum truncated and meeting the base of the apical tooth at a right angle; antennal segments one, two, and basal two-thirds of three, dull reddish brown, apical third of segment three and segments four and five almost piceous, except for a narrow annulus at the base of segment four, which is yellowish; this annulus is present in the type specimen, in the specimen compared with the type and several others in my collection; it appears to be a very variable character and can be discounted; segment three at least half again as long as segment two; median half of pro-, meso- and metasterna pale, except for a

darker patch between the pro- and mesocoxae; propleuron somewhat swollen with a deep crescentic sulcus parallel to the underside of the pronotal margin just below the marginal teeth; lateral half of each pleural segment becoming gradually darker, the metapleuron being the darkest; metasternal evaporating area paler and slightly impressed in its plate, orifice oblique, auricle darker, spatulate and without a spiral twist; abdominal venter dull reddish or yellowish brown medianly, darker laterally; punctures extremely fine and provided with short sericeous vestiture; while the lateral piceous lines are not as distinct as in many allied species, there is a central pale marginal blotch about half the width of the edge of each segment; female genital plates essentially concolorous, basal valve only convex, not tumid.

In the male the genital cup is transversely elliptical with the opening, as seen from the posterior, somewhat lunate in outline; the lower lip is somewhat up-turned or deflexed with a weak impression medianly and its edge is centrally excavated to form a pronounced U-shaped cut; the dorsal border is complexly sinuate with a pair of strong triangular teeth towards the lateral tips, each such tooth overlying the head of a clasper; clasper heads slipper-shaped, lying transversely across the cup, dark fuscous to almost piceous in color; proctiger likewise dark with weakly concave sides and a moderate carina present, the highest point of which is pale yellow; genital cup deep with plenty of space left between its contents and walls.

Type: Female; 18 mm. long; 10 mm. wide.

Allotype: Not specified.

Paratypes: Not specified.

Type locality: "North Carolina."

Food plants: Slash pine (*Pinus caribea* Morelet), long-leaf pine (*Pinus palustris* Mill.), various oaks (*Quercus* spp.), and probably others.

Distribution: Eastern seaboard from New England to Florida, westward across Gulf States to Texas; northerly not west of the Appalachian Mountains.

Comments

The only species, together with *marginella*, that the writer knows in which the elytra appear to be impressed in the dorsal wall between the up-raised borders (connexivum) of the abdomen.

Of very common occurrence but interestingly restricted to the eastern states in its northern range. In freshly matured specimens the numerous piceous punctures are filled with a whitish bloom, giving an ashy color to the bug; this bloom rubs off quite easily so that in older or frequently handled examples the individuals tend to become concolorous and somewhat glabrous. The mottled appearance of new adults causes them to be rather inconspicuous against the rough grayish bark of pines.

The feeding activities of this species have been described by the present author in 1941 (q.v.). The food plants are predominately pine, but specimens have been taken from several other sources, particularly oak.

The individuals of *carolinensis* apparently do not vary as much in size as do many other species, such as *arborea, quadripustulata, sulcata,* and *affinis,* nor is there as extreme a variation in color as sometimes appears in forms like *cariosa.*

Brochymena marginella Stål, 1872 (Fig. 31)

Stål, Enum. Hemip., v. ii, p. 16, 1872 (as a variety of *B. annulata* (Fabr.) = *B. carolinensis* (West.)).

Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 31, 1904.

Van Duzee, Cat. Hemip. N. A., Univ. Calif. Pub., v. ii, p. 32, 1917.

Blatchley, Heter. Eastern N. A., p. 103, 1926.

Torre-Bueno, Entomologica Americana, v. xix, p. 204, 1939.

Specimina plura e Texas divergunt ab exemplis Carolinis magnitudine saepius majore, rostro paullo breviore, medium segmenti ventralis tertii tantum attingente, ruga scutelli distinctiore, margine abdominis toto anguste pallido, nec tantum in medio segmentorum macula angusta pallida notato, marginesque costali basin versus minus dense punctato, laeviusculo; an species distincta? *B. marginella* Stål.

Translation

Several specimens from Texas differ from the Carolina examples in size, being often larger, in having the rostrum somewhat shorter, just about reaching the middle of the third ventrial segment, the ruga of the scutellum more distinct, the abdominal margin totally but narrowly pale, and the pale spot on each segment less raised and less evident and the costal margin somewhat smooth and less densely punctate towards the base; a distinct species? *B. marginella* Stål.

Redescription from the Type Specimens

Form very large (almost as big as *B. myops*), broadly oval, dorsal surface somewhat depressed and faceted as in *B. carolinensis;* general appearance concolorous dull orange brown; head widest just in front of eyes but hardly tapering or converging anteriorly; subapical teeth blunt, smaller than in *carolinensis* and their sinuses much more obtuse; head in front of subapical teeth rather short and truncated across the apex; juga and tylus subequal, the juga raised slightly above the tylus and surrounding disc; punctures of head rather uniform in size and irregularly arranged so that there appears to be a fine smooth reticulum of dull orange brown running over the head between the punctures; surface of pronotum not distinctly undulant; calli somewhat raised but not tumid by any means; punctures more or less uniform except for a band of deeper ones just behind each callus; antehumeral sinus almost obsolete, certainly not as deep as in *carolinensis,* much more like the condition in *dilata;* anterior margin of humerus with four or five retrorse indistinct serrations; crest over top of humerus wanting; marginal teeth flattish, paler than pronotal margin, blunt and tending to be retrorse; basal third of scutellum not appreciably raised, somewhat flat-topped and continued posteriorly as an obsolescent broad ridge; a cluster of large piceous coalesced pits impressed at the basal angles and the declivent lateral faces of the raised portion; otherwise the punctures are evenly distributed; apex narrowly rounded; elytra evenly covered with light fuscous punctures that become somewhat indistinct apically; membrane clear hyaline, the basal arborescent markings rich orange brown, the distal vermiculate ones darker fuscous; marginal band narrow and close to edge of membrane; exposed portion of connexivum raised above the disc of the abdomen, as in *carolinensis,* so that it is higher than the costal margin of the elytra which then appear to be impressed into the dorsum; inconspicuously alternated; the entire edge of each segment and the incisures between them a pale dull yellow almost ivory; under surface of the head orange brown to light fuscous; buccular edges weakly sinuate, ending in a strong rectilinear tooth, this with its frontal edge vertical and straight; frontal edge of jugum like that in *carolinensis;* second rostral segment relatively short, barely reaching the middle of the mesosternum; antennal segments distinctly reddish, segment

three about half again as long as segment two; the usual dark patch between the pro- and mesocoxae present; thoracic sterna and pleura concolorous orange brown, slightly darker laterally; a fuscous crescent and distinct groove beneath marginal teeth of propleuron; metasternal evaporating area pale and impressed in its surrounding plate; osteolar canal narrowly spatulate; femora reddish brown and indistinctly mottled with dark; subapical paler annulus indistinct; tibiae with pale annuli vague and black patches on their frontal surfaces obsolescent; basal segment of tarsi reddish; others deep fuscous; ventral abdominal segments punctured more densely laterally than medianly; ground color of venter dull orange brown; genitalia in both sexes similar to those in *carolinensis*, but proportionately larger; proctiger in male with a more distinct keel and sides slightly more concave; high point of keel pale yellow.

Holotype: Male; length 18.5 mm.; width 10 mm.
Allotype: Female; length 20 mm.; width 11 mm.
Paratypes: Not specified.
Type locality: "Texas." Harris County.
Type deposited: Riksmuseet, Stockholm, Sweden.
Distribution: Texas. Also recorded from Florida (Osborn Coll.).
Food plants: Probably the same as those used by *B. carolinensis*.

Comments

The only specimens that the writer has seen are the two types and one of doubtful status in the collection of the U. S. National Museum. A specimen of this species is said to be in the Osborn collection but this I have not seen. The locality of this example is stated as Florida, but no definite station is given.

The type specimens have proportions that resemble *myops*, being stout and big, but the structural characters are more nearly those of *carolinensis*. There is no doubt that all three of these species are closely related; the parameres alone are evidence of that fact.

Brochymena tenebrosa Walker, 1867 (Figs. 24–E, 38)

Walker, Cat. Heter., pt. i, p. 231, 1867.
Distant, Biol. Cent. Amer., Heter., v. i, p. 52, pl. 6, fig. 5, 1880.
Kirkaldy, Cat. Hemipt., v. i, p. 192, 1909.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 204, 1939.
Ruckes, Bull. Bklyn. Ent. Soc., v. xli, p. 41, 1946.

†*obscura*, Distant, Biol. Cent. Amer., Hemip.-Heter., v. i, p. 52, 1880.

usingeri, Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiv, p. 114, fig. 2, 1939.

Pallide flava, elliptica, asper punctata, nigro-conspersa; caput breviusculum lateribus anticis angulatis, lobis lateralibus lobum medium paullo superantibus; rostrum apice nigrum, coxas posticas paullo superans; antennae nigrae, corpis dimidio non longiores; thorax lateribus serratis, angulis positis obtusis; venter rufescens, sulcatus lituris lateralibus nigris; pedes nigri, robusti; femoribus testaceis nigro conspersis, tibiis testaceo fasciatis; membrana lituris ramosis fasciaque submarginali nigricantibus.

In addition to the above Latin description Walker gives the following more elaborate English version. Hence there is no need of translating the above.

Pale yellow, elliptical, roughly punctured, punctures black, here and there clustered with intervening smoother spaces. Head much shorter than the thorax with an angle on each side in front, lateral lobes extending a little beyond the middle lobe. Eyes prominent. Rostrum black towards its tip, extending a little beyond the hind coxae. Antennae black, about half the length of the body; first joint not extending to the front of head; joints two to five successively slightly increasing in length. Thorax with a very slight transverse impression; sides serrated, hind angles obtuse, not prominent. Scutellum slightly attenuated with a slight keel which is forked towards the fore border. Abdomen with black lateral spots; underside reddish, almost smooth, with black marks on each side and with a furrow which extends to the hind border of the fourth segment. Legs black, stout; femora testaceous, black speckled; tibiae with a testaceous band. Fore wings more finely punctured than the thorax; membrane cinereous with some blackish ramose marks and with an excavated submaringal band. Length of body 8 lines.

Redescribed

Form narrowly oval, somewhat depressed; venter not appreciably convex; color, median fuscous with a tinge of reddish, shiny; diameter of head in front of eyes slightly wider than

distance from that line to apex of head; sides very slightly converging; juga longer than the tylus and exceeding it by about a length equal to the width of one jugum at that point; inner margins of juga lobes parallel so that a conspicuous rectangular sinus appears between them; subapical teeth broadly triangular; distal half of tylus, apical lobes of juga and a third of the subapical teeth, impunctate and pale; punctations of the head irregular with a tendency to coalesce; pronotum with antehumeral sinus weak and inconspicuous, so that front edge of humerus and margin of pronotum are nearly a continuous line; front half of pronotal disc with irregular punctures, many coalescing into corroded areas about the calli; front half of disc provided with obliquely elongated, smooth, irregular island-like, raised, pale areas; posterior half of disc with regular and rather uniform circular nigro-fuscous punctures of medium size; crest of each humerus with a prominent oblique smooth pale band; just inside of this an oblique rugose band of broad black punctures cuts across the shoulder; marginal pronotal teeth concolorous with the pale markings of head and pronotum; teeth four to seven in number with smaller ones interpolated between them; humeri with one or two minute crenulations at the most, otherwise edentate; a striking character lies in the flat-topped nature of the raised basal portion of the scutellum, the whole surface appearing truncated as in *B. affinis*. This region is suffused with reddish; the posterior faces of this raised portion become declivent and a broad median elevation, broader than a carina, extends to the apical third of the shield; the frenum ends posterior to the middle of the scutellar edge so that the apical tongue appears to be proportionately short; punctures on the basal raised portion large, deep and irregular, tending to coalesce at the lateral thirds, there forming a broad, oblique corroded band just inside the basal corners; the basal angles furnished with one or two large, deep piceous pits; middle portion of scutellum with rather uniform nigro-fuscous shallow punctures of medium size; punctures at the apical fifth suddenly become much smaller and more condensed; elytral punctures small, shallow and regular, interspersed with numerous small irregular smooth points; membrane hyaline somewhat infused with deep orange brown, the veins and vermiculate markings darker reddish fuscous not outlined by a pale border of membrane; exposed edge of connexivum alternated with dull yellow and dark brown, punctures small and scattered; incisures

between the segments raised and pale; posterior angles of abdominal segments inconspicuous and distinctly obtuse; edge of the buccula sinuate and ending in a prominent stout acute tooth which tends to be concave on its front edge; basal antennal segment tends to be paler than remaining four which are nigrofuscous; segment two somewhat shorter than segment three; segments three, four and five subequal; fore tibiae stoutish and gradually dilating toward the apex; femora with fuscous maculations tending to coalesce into longitudinal vittae; a longitudinal pale stripe on front and back surfaces of the femora; a subapical incomplete pale annulus present, this most noticeable on the fore femora; tibiae annulated as in allied species; second joint of each tarsus pale above, other parts fuscous; metasternal evaporating area conspicuously pale with a contrasting dark auricle which tends to be acute and is well raised above the surrounding disc; ventral abdominal color dull orange brown with a few widely scattered inconspicuous punctures, these most abundant laterally where they become darker and form horseshoe-shaped designs near the edge of each segment; lateral borders of the first two or three ventral adbominal segments weakly transversely rugose or milled, the milling becoming evanescent on posterior segments; rostral groove long, broad and shallow, the beak reaching at least the middle of the second visible segment; inner apical corners of basal valves of female genital plates reddish brown, together forming a dark narrow triangle in the middle of the genitalia; narrow mesal border of each basal plate slightly impressed, certainly not raised or reflexed; male genital cup similar to that of *B. carolinensis;* the upper surface of each clasper broadly oval in outline, the under surface provided with a high carina and lateral spur. Size—Male: 16.75 mm. long; 8.5 mm. across humeri. Female: 17.5 mm. long; 9.5 mm. across humeri.

Type: Male; length 8 lines.

Allotype and paratypes: Not specified; apparently only one specimen used for description.

Type locality: Oajaca, Mexico.

Type deposited: British Museum, London.

Food plants: Unknown.

Distribution: Guerrero, Temescaltepec, Southern Mexico; many specimens in American collections identified as this species are probably *B. parva* Ruck. (q.v.).

Comments

Considerable confusion has existed as to the identity of this species. Unfortunately Distant in 1880 placed the species, known up until that time as *B. obscura* (H.-S.), in synonymy with *B. tenebrosa*. Authorities subsequently accepted Distant's decision as valid and thereafter identified specimens that conformed to the facies of *B. obscura* as *B. tenebrosa*. In a recent paper the author has pointed out the incorrectness of this synonymy on two grounds, first that *B. obscura* is an untenable name since it is a homonym and secondly that *B. obscura*, even if it were a valid name, could not be *B. tenebrosa* since the two species are not at all comparable. The name *B. parva* Ruck. (q.v.) has been assigned to that species that previously had been called *B. obscura* and *B. tenebrosa* set off as a very distinct and individual species.

Through the fine cooperation of Mr. W. E. China of the British Museum it has been possible to come to the above conclusions. Apparently Walker, in describing the real *B. tenebrosa* had before him only one male specimen about the size of *B. carolinensis* (West.). No female specimens are mentioned and there are no cotypes, paratypes or duplicate specimens in the collections of the British Museum, where Walker's type specimen is deposited. Whether or not the type specimen was even used for comparison with specimens of American species is not known at this time. Probably it never had been, otherwise Distant and other authorities would certainly never have fallen into the error of considering such very different species as *B. obscura* and *B. tenebrosa* as the same thing.

In 1938 Dr. R. L. Usinger sent me, for identification purposes, seven specimens (two males and five females) of a species of *Brochymena* collected in 1933 near Tejupilco in Temescaltepec, Southwestern Mexico. These were all one species and so distinct from any others known by me at that time that they were described (1939) as *B. usingeri*. As a result of comparison with specimens in the British Museum, my species *usingeri* turns out to be the real *tenebrosa* or at the most a minor variety of it. Mr. China states that these two differ only in the size of the flange on the lateral surface of the clasper (*tenebrosa* having the larger) and the number of excavated piceous areas at the basal angles of the scutellum, *usingeri* possessing only one large pit there while Walker's type specimen has two. I believe that these are not sufficiently critical characters to warrant the retention of two different specific names. In all other important respects, *e.g.*, the facies of the male genital cup,

the nature of the scutellum, the milling of the lateral borders of the first two ventral abdominal segments, the total size, etc., the specimens called *usingeri* coincide with Walker's type of *tenebrosa.* Therefore *usingeri* is now being placed in synonymy.

For purposes of correcting errors of identification in pentatomid collections in this country the present author suggests that specimens labeled *B. tenebrosa* Walk. be reexamined and renamed if necessary. The following critical facts should be kept in mind. The real *B. tenebrosa* apparently comes from southern and southwestern Mexico and possibly northern Central American countries; no authentic specimens have ever been collected north of Mexico City. If specimens are less than 15 mm. long they are probably not *B. tenebrosa* as this species is as big or bigger than the well known *B. carolinensis.* The pronotal marginal teeth of *B. tenebrosa* are more than three in number, and are not sharp wide-spaced needle-like denticles; the lateral pronotal and propleural areas of this species are not tumidly swollen. In *B. tenebrosa* the basal third of the scutellum is flat-topped or truncated and the tip of the head is likewise truncated across its apex, there being a distinct rectilinear preapical sinus between the juga.

For purposes of the above redescription of *B. tenebrosa,* the critical characters of its synonymous *B. usingeri* were used.

Brochymena humeralis Ruckes, 1939 (Figs. 35, 39)

Ruckes, Bull. Bklyn. Ent. Soc., v. xxxiv, p. 116, fig. 3, 1939.

Form broadly oval; color grayish yellow brown, shiny; not appreciably depressed and the dorsal surface faceted; the head as long before the eyes as wide just in front of them; sides of head converging to a subacute apex; subapical teeth not large, acute; the sinus acute; edges of the juga bend inwardly away from the margin of the head behind the subapical teeth; juga do not, or only slightly, extend beyond the tylus, their tips acute; apex of head narrowly triangular and subtruncate; the most striking character appears in the *protruding prominent humeri;* the lateral margin of the pronotum has a *well defined and deep antehumeral sinus,* the front edge of each humerus meeting the long axis of the pronotum almost at right angles; the apex of the humerus is acute and slightly produced; a short, rugose band of black pits cuts obliquely across the base of each humerus, marginal teeth of pronotum four to six in number, small and irregular with small ones interpolated; front margin of humerus with three retrorse serrations, the apex acute and

smooth; punctures of pronotum mixed in size; a pair of irregular, longitudinal, short bands of deep, large black pits extend across the highest points of the posterior half of the pronotal disc; basal portion of scutellum raised and quite convex but not tumid; punctures and pits of various sizes and mixed throughout; there is a band of deep corroded pits obliquely across each basal corner and some obsolescent dark, pitted vittae across the median third; the elevated portion continues posteriorly as a broad, short convex ridge, thicker than a carina; posterior half to two-thirds undulating; the frenum ends posterior to the middle of scutellar edge and the apical tongue is rather short; elytral punctures large and fewer basally becoming gradually finer and coalescing apically; numerous substellate white points and reticulations scattered over the surface; a discal point prominent; membrane hyaline with a fulvous tinge; veins and vermiculate markings bright reddish brown and without pale membranous borders; connexivum alternated dull yellow and brown; some fulvous punctures in the yellow band; incisures raised and pale; *posterior abdominal angles protruding and rectangular;* edge of buccula *shallowly sinuate* and ending in a stout acute tooth, tending to have a concave front edge; first and second antennal segments dull reddish brown, remaining ones darker brown becoming fuscous; segments two and three essentially subequal; segment four the longest; maculations of legs reddish brown to fulvous rather than fuscous; color design similar to allied species; fore tibiae stoutish slightly dilated apically giving a subclavate outline; metasternal evaporating area pale, orifice opens laterally; the crateriform base well elevated and auricle relatively short and dark and well raised above surrounding disc; ventral abdominal segments dull yellow with a scattering of rufous to fuscous punctures; pubescence sparse and silky pale; horse-shoe-shaped lateral designs on each abdominal segment obsolescent or inconspicuous; rostral groove long and shallow; beak reaching at least the front margin of the third visible segment; *inner narrow margins of basal valves of the female genital plates very narrowly upturned or reflexed*, so that, when valves are tightly closed, there appears to be a thin median carina between them.

Size: Female; 18 mm. long; 10 mm. across the humeri.

Described from five specimens, all female, collected by R. L. Usinger and H. E. Hinton at Bejucos and Tejupilco, Temascaltepec, Mexico, June 29th to July 5th, 1933.

Type: Female, Bejucos, Temascaltepec, Mexico, July 2nd, 1933.
Allotype: None is known.
Paratypes: Four females, Tejupilco, Temascaltepec, Mexico, June 29th and July 5th, 1933; two deposited in Museum, California Academy of Sciences, and two retained by the author.
Type locality: Bejucos, Temascaltepec, Mexico.
Type deposited: Museum, California Academy of Sciences, San Francisco, California.
Food plants: Unknown.
Distribution: Known only from the type localities.

Comments

The species is somewhat like *B. quadripustulata* with its prominent rectangular posterior abdominal angles; like *B. carolinensis* with its faceted dorsal surface and prominent humeri which in *B. humeralis* are still larger producing the effect of a pair of epaulets covering the shoulders; like *B. cariosa* with its acute juga and compound carina-like ridge between the basal valves of the female genital plates. To which one of the above species *humeralis* is most closely related is impossible to say without the existence of male examples.

Brochymena affinis Van Duzee, 1904 (Figs. 7, 36, 40)

Van Duzee, Trans. Amer. Ent. Soc., v. xxx, p. 29, 1904.
Van Duzee, Cat. Hemip. N. A., p. 31, 1917.
Parshley, University of Michigan, Occ. Papers, No. 71, p. 7, 1919.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 206, 1939.

Very closely allied to *4-pustulata* (Fabr.); differing principally from that species in having the genital segment of the male very short and broad, extending on either side beyond the sixth ventral segment and beyond the projecting apex of the membrane, and heavily fringed with long pale hairs either side of the median sinus. Two basal joints of the antennae rufous, the remaining joints black with rufous incisures, second joint nearly or quite as long as the third, fifth a little shorter than the preceding. Head about as in *4-pustulata* but with the tylus scarcely shorter than the cheeks. Sides of the pronotum distinctly rounded and strongly toothed before the sinus. Scutellum perhaps a little broader and more rounded at tip than in *4-pustulata*. Rostrum reaching to the middle of the third ven-

tral segment, pale with a black tip and median line within. Other characters substantially as in *4-pustulata*. The general color, however, seems to average somewhat lighter.

Length: 13–16 mm., width across the humeri 7–8 mm.

Redescription

Form broadly oval, subdepressed, dorsal surface faceted; color dark cinereous to dark fuscous. Head about as wide before the eyes as long from there to apex; dorsal surface somewhat undulant; margins before the eyes concave and weakly converging anteriorly; subapical teeth prominent, rectilinear to acute and their sinuses deep and rectilinear to obtuse; juga slightly longer than the tylus, narrowly overlapping the latter and leaving a small rectangular preapical sinus; apex of head narrowly arcuate; pronotum very undulant, area of the calli well raised and irregular surfaced; laterally a pale, calloused arcuate bar runs parallel to the dentate edge of the pronotum; a deep circular impressed area in the disc at the base of each humerus; a pair of corroded clusters of deep dark pits behind each callus; posterior portion of pronotal disc with smaller and more regular punctures; humeri not exceptionally produced and the humeral angle is rectilinear, frontal edge weakly serrate; dentate margin strongly arcuate and its teeth large and usually blunt, almost crenulate; basal third of scutellum raised, its sides declivitous and its dorsal surface flat or truncated, sometimes weakly concave; continued posteriorly as an obsolescent broad ridge; scutellum strongly pitted on base and at basal angles, the punctures becoming smaller and more shallow apically; elytral punctures small, uniform and evenly distributed; connexivum alternated as in allied species, with two piceous and one reddish band on each segment, the latter tending to become paler at the margin and provided with a few scattered piceous punctures; vermiculate markings of membrane slightly darker than arborescent ones; marginal fuscous border prominent; underside of head obscurely mottled with more dark than pale; buccular edge sinuate apically and ending in an acute tooth the frontal edge of which is somewhat sigmoid; basal two antennal segments rufous, other piceous; segments two and three subequal, three perhaps slightly longer; sternal and pleural area about equally punctured with fuscous, *i.e.*, no striking division of color between the two areas; a crescentic groove beneath the marginal teeth prominent, but its adjacent

nearly impunctate area usually fuscous rather than darker as in many other species; femora heavily speckled with black, the spots arranged in obscure longitudinal vittae which become congested apically; an incomplete subapical pale annulus present; pale annulus of fore tibia with only a few small black spots in its middle on the frontal surface instead of a square patch there; all tarsi concolorous piceous or nearly so; metasternal evaporating area contrastingly pale, ostiole opening laterally and its auricle long and ending acutely; venter testaceous with numerous scattered piceous punctures which coalesce laterally to form dark lunes on each segment, frequently each lune is incomplete, being broken at its middle; median furrow shallow but evident; lateral border of each abdominal segment transversely rugose so that entire ventral abdominal margin appears to be milled; basal valves of female genital plates with basolateral corners acutely produced; a darker triangular patch of color between the two basal plates apically; male genital cup with lateral tips produced into blunt finger-like processes, vestiture strong and heavy.

Cotypes: Two male and six female specimens.

Type localities: Palo Alto, California; Moscow, Idaho; Olympia, Washington.

Types deposited: Van Duzee Collection, Museum, California Academy of Sciences, San Francisco, California.

Food plants: Unknown; probably species of pines throughout the range.

Distribution: Washington, Oregon, California, Idaho, Nevada, Utah, Colorado.

Comments

This and the next species (*hoppingi*, q.v.) are very close relatives as is evident from a study of their general appearance, diagnostic characteristics and comparison of their genitalia.

Although in the original description Van Duzee compares this species with *quadripustulata* it is very apparent that there is no direct phylogenetic relationship between the two. The probable reason for Van Duzee making the comparison lies in the fact that in 1904 when he described *affinis* as new there were only eight other species in the genus recognized, of which *quadripustulata* was the best known and the one which at that time most resembled the proposed *affinis*. Further study of both *affinis* and *hoppingi* will prob-

ably show that there is closer relationship between these two and *carolinensis* than between them and any other species.

Males of both *affinis* and *hoppingi* are readily distinguishable from all others by the presence of blunt finger-like extensions of the lateral tips of the genital segments. In the females the differentiating characters are a bit more subtle and difficult to distinguish. One must rely on such distinctions as are to be found in the basal valves of the genital plates, the crenulation of the pronotal margin, and the flat-topped, almost truncated appearance of the basal third of the scutellum. In the matter of the basal valvular plates, there is an evident acute lateral angle on each plate that differentiates these species from others wherein the homologous angle is usually less acute or may appear merely as a rounded obtuse corner. Furthermore a line drawn between the two lateral angles and across the posterior marginal edges of the combined basal plates forms a pronounced arc, whereas in most other species the arc is more shallow and in some cases, like *dilata,* becomes a straight line.

The pronotal marginal dentations are more nearly crenulations than they are pointed teeth and, with the exception of *tenebrosa, affinis* and *hoppingi* are the only two species that have a pronounced flat-topped basal third on the scutellum. This portion is well raised and its sides are declivitous but the dorsal surface is all in one plane.

The transversely rugose borders of all of the ventral abdominal segments, more than any other character, distinguishes *affinis* and *hoppingi* from other species in the genus.

Brochymena hoppingi Van Duzee, 1921 (Fig. 41).

Van Duzee, Proc. Calif. Acad. Sci., v. xi, No. 10, p. 111, 1921.
Ruckes, Bull. Bklyn. Ent. Soc., v. xxxii, No. 1, p. 33, 1937.
Torre-Bueno, Entomologica Americana, v. xix, No. 3, p. 205, 1939.

†*myops,* Ruckes, Bull. Bklyn. Ent. Soc. v. xxxii, No. 1, p. 33, 1937.

Male: Head slightly longer than broad across the eyes; cheeks overlapping tylus, sometimes almost contiguous at apex; subapical angle obtuse or rounded; second antennal segment two-thirds length of third. Sides of pronotum with about five rounded teeth on anterior lobe, the humeral lobe rounded anteriorly as in *affinis* but scarcely crenulate, humeral angle less prominent; surface deeply punctured and sculptured, the callosities more prominent than in *affinis.* Scutellum a little shorter, scarcely raised at base, median line subcarinate, surface

more deeply pitted than in *affinis*. Elytra closely and quite evenly punctured with a few calloused points. Rostrum passing the middle of the third ventral segment; venter nearly smooth with small, scattering obsolete punctures, sulcus shallow, but obvious. Genital segment of male greatly extended either side as in *affinis,* their apices distinctly passing line of sixth abdominal segment, hind margin heavily bearded.

Color variable, mostly black, testaceous interspaces less conspicuous; lateral crenulations of pronotum rufous; membrane with but few vermiculate marks; femora with pale subapical mark and median annulus more or less distinct; antennal incisures very narrowly rufous; connexivum with small marginal spots and the incisures rufous, the median line of the venter narrowly rufous.

Female: Larger with pale margins a little more conspicuous, especially near the apex of the scutellum and on venter.

Size: Male; 12 mm. long. Female; 14 mm. long.

Holotype: Male #749.

Allotype: Female #750.

Paratypes: Four males and four females.

Type locality: Vallecito Co., California, April 18, 1919.

Types deposited: Museum, California Academy of Sciences, San Francisco, California. One paratype is deposited in the Canadian National Collection, Ottawa, Canada.

Food plants: Ponderosa pine (*Pinus brachyptera* Englm.) Douglas spruce (*Pseudotsuga mucronata* (Raf.)). Probably on other species as well.

Distribution: California, Arizona, Utah, Colorado, New Mexico.

Comments

In addition to the characteristics mentioned by Van Duzee in the original description, I would add the following which are features in common with the preceding species, *affinis:* form broadly oval, subdepressed; the border of the lateral portion of each ventral abdominal segment is transversely rugose causing the entire abdominal margin to appear as if it is milled; the pale annulus of the fore tibia is provided only with a few black spots rather than a distinct square patch on its frontal surface; the base of the scutellum tends to be flat-topped or indeed in *hoppingi* more frequently concave; and the basal lateral angles of the basal plates of the female genital valves are acutely produced.

To differentiate between the species *affinis* and *hoppingi* we have to rely on color differences primarily, the average smaller size of the latter, the more obtuse subapical tooth and the more concave base to the scutellum of the latter. In the male of *hoppingi* there is a slightly deeper and wider sulcus across the apical border of the genital cup above the vestiture, and the blunt finger-like lateral extensions diverge slightly more, so that the V-shaped border, as seen ventrally, is more shallow than in *affinis*.

This appears to be a rather common species in the Jemez Mountains of New Mexico.

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Plate I

Fig. 1–A. *Brochymena lineata* Ruckes. Abbreviations: PAS: preapical sinus; JUG: jugum; TYL: tylus; SAT: subapical tooth; CAL: callus; M.T.: marginal teeth; AHS: antehumeral sinus; HUM: humerus; FEM: femur; TIB: tibia; TAR: tarsus; SCUT: scutellum; ELYT: elytron or hemelytron; DIS. P.: discal point; antennal segments are numbered from 1 to 5.

Fig. 1–B. Side view of head of *B. quadripustulata* (Fabr.) Abbreviations: ANT. P.: antennal pedicel; BK.: beak or rostrum; BUC.: buccula; BUC. T.: buccular tooth; JUG.: jugum.

Fig. 2. Left clasper, ental view, *B. arborea.*

Fig. 3. Right clasper, ectal view, *B. sulcata.*

Fig. 4. Right clasper, ectal view, *B. cariosa.*

Fig. 5. Right clasper, dorsal view, *B. punctata.*

Fig. 6. Right clasper, dorsal view, *B. carolinensis.*

Fig. 7. Right clasper, ectal view, *B. affinis.*

Fig. 8. Left humerus, *B. cuspidata.*

Fig. 9. Left humerus, *B. arborea.*

Fig. 10. Left humerus, *B. quadripustulata.*

Fig. 11. Tibia, *B. haedula.*

Fig. 12. Tibia, *B. arborea.*

Fig. 13. Tibia, *B. poeyi.*

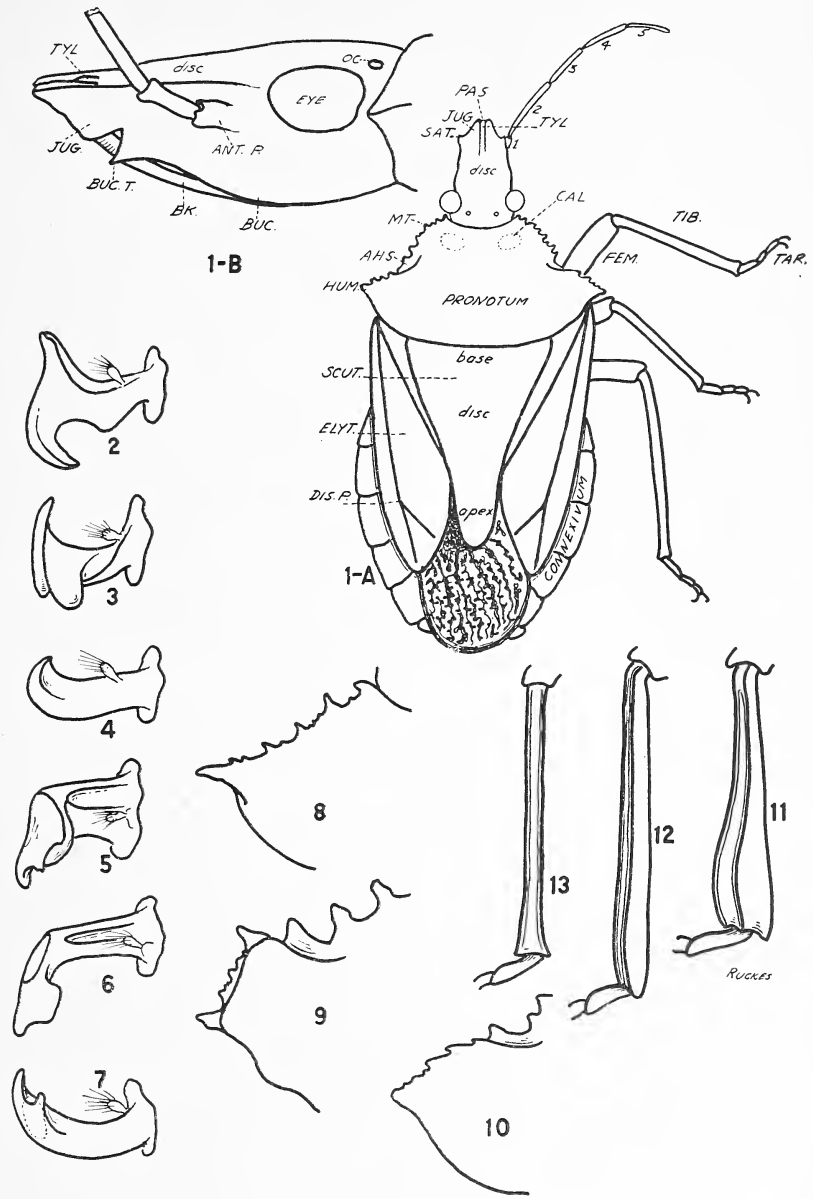

TYL
disc
OC.
EYE
JUG.
ANT. P.
BUC. T.
BK.
BUC.
1-B
PAS
JUG.
SAT.
TYL
disc
CAL
MT.
TIB.
AHS.
FEM.
TAR.
HUM.
PRONOTUM
base
SCUT.
disc
ELYT.
DIS. P.
apex
CONNEXIVUM
1-A
2
3
4
5
6
7
8
9
10
11
12
13
RUCKES

PLATE II

Figs. 14, 16, 17, 19, 21, 22, and 23. Dorsal aspects of heads.
Figs. 15, 18, 20. Left claspers, ental aspect.

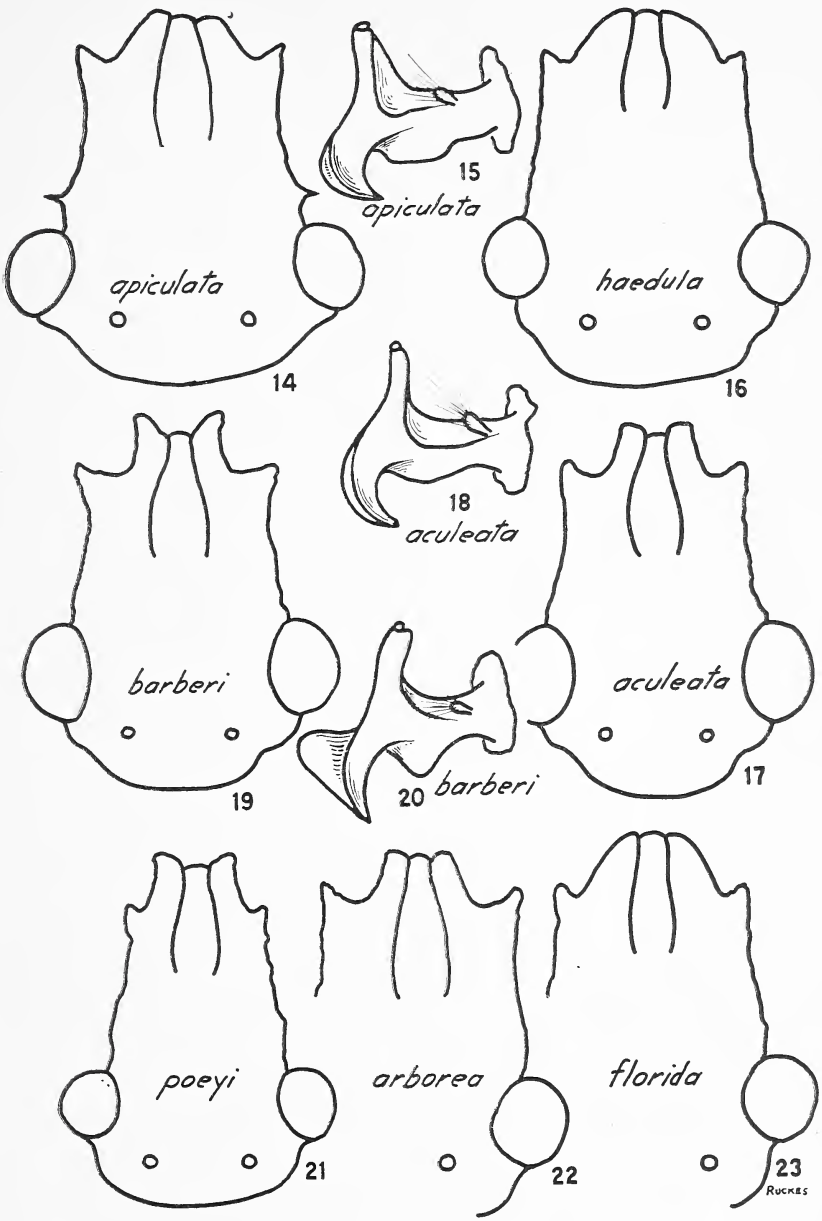

apiculata
14
15
apiculata
haedula
16
18
aculeata
barberi
19
20 barberi
aculeata
17
poeyi
21
arborea
22
florida
23
RUCKES

Plate III

Fig. 24–A. Left metasternal plate, *B. cariosa*, showing crateriform base, orifice and auricle of stink gland, surrounded by subtriangular evaporating area.

24–B. Base and auricle, *B. quadripustulata*.

24–C. Base and auricle, *B. sulcata*.

24–D. Base and auricle, *B. dilata*.

24–E. Base and auricle, *B. tenebrosa*.

24–F. Base and auricle, *B. lineata*.

Figs. 25, 27, 29, 30, 31. Dorsal aspects of heads.

Figs. 26, 28. Right humeri.

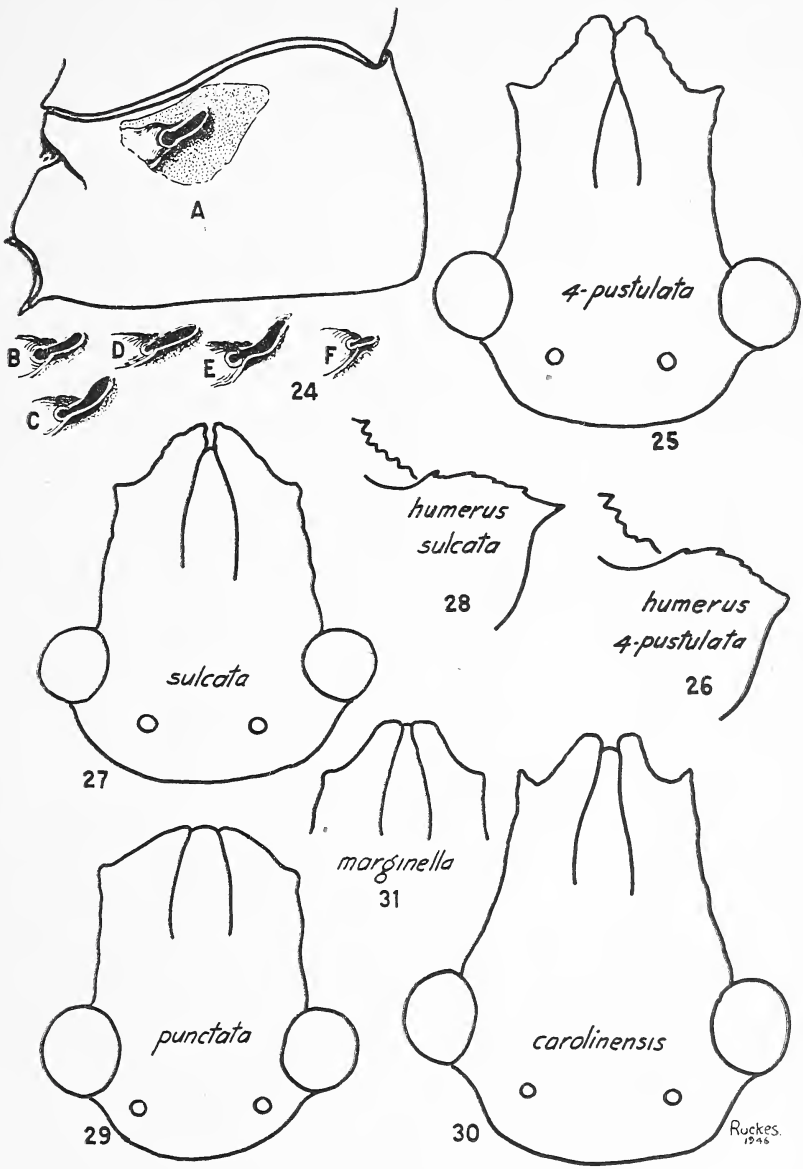
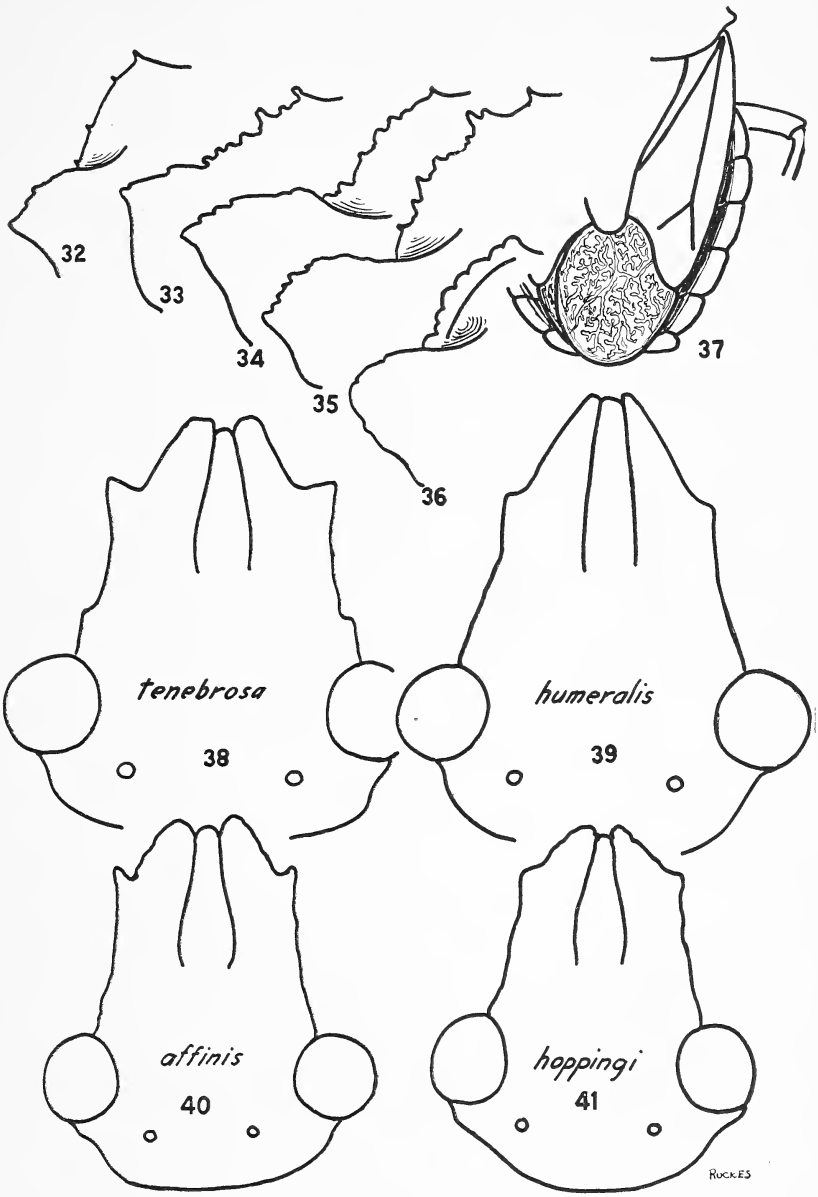

A
B
C
D
E
F
24
4-pustulata
25
humerus
sulcata
28
humerus
4-pustulata
26
sulcata
27
marginella
31
punctata
29
carolinensis
30
Ruckes
1946

PLATE IV

Fig. 32. Left humerus and pronotal margin, *B. parva* = *B. obscura.*
Fig. 33. Left humerus and pronotal margin, *B. dilata.*
Fig. 34. Left humerus and pronotal margin, *B. carolinensis.*
Fig. 35. Left humerus and pronotal margin, *B. humeralis.*
Fig. 36. Left humerus and pronotal margin, *B. affinis.*
Fig. 37. Right half of body of *B. carolinensis* showing elevated connexivum and impressed elytron.
Figs. 38–41. Dorsal aspects of heads.


32
33
34
35
36
37
tenebrosa
38
humeralis
39
affinis
40
hoppingi
41
RUCKES

A Check List of the Species

ENTOMOLOGICA AMERICANA

Index to Vol. XXVI (n.s.), 1946

New species and other forms in **bold face**; valid species in Roman; synonyms in *Italics;* * indicates plants; ø other animals.