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The Genus *Rheumatobates* and Notes on the Male Genitalia of Some Gerridæ (Hemiptera, Gerridæ).*

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INTRODUCTION.

THE genus *Rheumatobates* is perhaps the most remarkable group of insects in the order Hemiptera. It is included in that very interesting family commonly known as the water striders. As none of the species is much over three millimeters in length the amateur often mistakes them for the immature stage of some of the larger striders and seldom gives them any attention. They are therefore usually taken only by the collector particularly interested in the group. As a result there are few specimens in our museums and the known distribution is very limited.

HISTORICAL ACCOUNT.

The genus was erected by E. Bergroth in 1892. The preceding year Rev. J. L. Zabriskie, in collecting aquatic insects at Flatbush, Long Island, found among his specimens a very curious one. Soon afterward C. V. Riley published a description and illustration of it in *Insect Life* without giving it a name. Upon the strength of this description Bergroth based his *Rheumatobates rileyi*. He gave as generic characters the curiously formed antennæ and posterior legs and the presence of two ocelli. Ocelli, however, are absent in all species of the genus, and since that time two species have been added with normal hind legs. In 1894 Uhler described a species

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which he called *Hymenobates imitator*. This was the winged form of Meinert's *R. bergrothi* described in 1895. Thus Meinert's species and Uhler's genus fell into synonymy and the species became *R. imitator* (Uhler). At the same time Meinert described *R. tenuipes*, which is one of the two species with normal hind legs; the other was described in 1908 as *R. præposterus* by Bergroth from the collection of Prof. James S. Hine. Doctor Riley was already familiar with *tenuipes* Mein., but he was mistaken in regarding it as the "normal" form of the apparently "abnormal" *rileyi* Berg. He was evidently misled by the fact that they are often found associated together, and as the females are quite similar the mistake was easily made.

BIOLOGY.

Little is known regarding the biology of *Rheumatobates*. At first these insects were thought to occur only on swiftly flowing streams, but since then they have been collected from the backwaters of sluggish streams and in the West even from the standing muddy waters of ponds. They are gregarious in habit, sometimes occurring in large numbers, often in association with other members of the Gerrid family, particularly *Trepobates pictus* H. Sch. They are very active; their long intermediate legs propel them over the water with surprising speed. Grace O. Wiley writes that "The winged forms are very agile and hard to capture; they have the habit when disturbed of skimming over the surface of the water in astonishing leaps and bounds, aided no doubt by their wings even when truncated." Doctor Hungerford has made the following observations with regard to their habits: "In Kansas *R. rileyi* (var. *palosi* Blatchley) is common enough on the muddiest ponds and pools. Three summers have failed to disclose the nature of the oviposition. The ovipositor suggests that the eggs are laid in the tissue of a plant.

"They feed upon insects dropped upon the water, and if watched in a pool teeming with ostracods they can be seen to scoop them out of the water and carry them on the upturned tip of the beak."

He describes the eggs as being .728 mm. in length and .208 mm. in width. Elongate-cylindrical in shape, one end bluntly pointed and the other end rounded, bearing a short micropyle.

Various functions have been ascribed to the curiously formed antennæ; the most logical one seems to be that of clasping organs used during copulation. In all the species, except possibly those from South America, they seem to be well fitted to clamp around the antennæ of the female. As the females have normal antennæ

it seems highly probable that they serve some secondary sexual function. It has been suggested, also, that they are prehensile in function, serving to catch and hold the insects and other organisms upon which they feed. However, if this were true the females would need this type also.

Nearly all of the species are known to be dimorphic, occurring in both the winged and wingless form. More extensive collecting will probably prove all species to be dimorphic. Generally the apterous form is the more common, although the macropterous form is very numerous at times. The winged form differs from the wingless mainly in the size and shape of the pronotum, which is greatly enlarged to cover the base of the hemelytra and almost the entire mesonotum. The venation of the hemelytra is greatly reduced, the costal margin is thickened and sometimes fringed with short hairs. The membrane is separated from the corium by a whitish vein which extends entirely across the wing; there is also a whitish vein running the entire median length of the membrane. A vein follows the entire margin of the membrane, forming a loop. The clavus is quite narrow. The membranous hind wings are shorter and narrower than the hemelytra, but they have approximately the same venation. As in other Halobatinae, the winged individuals often break off their wings leaving only the corium and clavus, thus exposing the tip of the abdomen. The membrane always breaks off along the whitish vein which extends across its base.

Another curious difference between the winged and wingless forms is the presence of from five to eight long stiff hairs on the dorsal surface of the genital segment. They are arranged in a single or double transverse row, depending upon whether the hairs are few or many. They are vertical or bent slightly backward. When the wings are folded back they rest upon these hairs. Only the males have these hairs, and they never occur on the wingless forms of either the males or females.

DISTRIBUTION.

All of the species thus far described have been collected in the Western Hemisphere. Their presence in Europe seems doubtful as they have never been reported by any of the Hemipterists of that continent. It is interesting to note that for almost twenty years after the first species was described no specimens were taken far from the sea. Since that time *R. rileyi* var. *palosi* Blatchley has been found as far west as the Rocky Mountains and from Minnesota

in the North to Arkansas in the South. *R. imitator* (Uhler) and its variety *meinerti* var. new, occurs in the Lesser Antilles. *R. crassifemur* Esaki, *R. crassifemur* var. *esakii* var. new, and *R. klagei* sp. new occur in Argentina, Paraguay and Brazil, South America. *R. præposterus* Bergroth has been collected only from Guatemala of Central America. All of the other species are found in the United States. The distribution of the various species seems to be quite limited with the exception of *R. rileyi* var. *palosi* Blatchley as given above. This is probably due more to the lack of extensive collecting than to a local distribution.

STRUCTURAL CHARACTERS USED.

The structure of the antennæ, the posterior legs, and in one species the structure of the middle tibiæ, form the basis for separation of the species within the genus. In the North and Central American species the third segment of the antennæ bears a peculiar spongy pit or fossa which varies to a considerable extent in size, shape and in the degree and manner of armature. The position of the tooth on the fourth antennal segment is of some value. The hairs on the intermediate legs and the hairs and spines, and especially the manner and degree of incrassation, of the hind legs easily separate some species.

The genitalia of four species were dissected and good specific characters were found. These are, however, not essential to the separation of the species and will be described in detail under the studies of the genitalia of some male Gerrids.

THE SPECIES OF *RHEUMATOBATES* BERGROTH.

KEY TO THE MALES.

- A. Hind legs normal.
 - B. Tibiæ of middle legs strongly arched at the base, then straight to the tip. *præposterus* Bergroth.
 - BB. Tibiæ of the middle legs straight.....*tenuipes* Meinert.
- AA. Hind legs incrassated, curved or deformed.
 - B. Hind trochanter smaller than hind coxæ.
 - C. Hind femora hairless or at most with very short fine hair along the whole inner margin.
 - D. Posterior margin of middle femora with a row of long, straight hairs, base and tip bare.....*hungerfordi* Wiley.
 - DD. Middle femora hairless.....*trulliger* Bergroth.
 - CC. Hind femora with long hairs on the basal third of the posterior margin.
 - D. Spur on terminal antennal segment beyond the middle...*rileyi* Bergroth.
 - DD. Spur on terminal antennal segment before the middle. *rileyi* var. *palosi* Blatch.
- BB. Hind trochanters incrassated, longer and larger than hind coxæ.
 - C. The hind trochanter inserted beyond the base of the femur.
 - D. A dense tuft of bristles extending forward from the basal extremity of the hind femora.....*klagei* sp. new.

- DD. Basal extremity of hind femora bare.
 E. Terminal antennal segment with a row of a strong setæ on the dorsal margin near the apex.
crassifemur var. *esakii* var. new.
 EE. Terminal antennal segment relatively bare....*crassifemur* Esaki.
 CC. Distal end of trochanter joining basal end of femur.
 D. Intermediate tibiæ sinuate with long hairs at the middle.
imitator Uhler.
 DD. Intermediate tibiæ straight, no long hairs at the middle.
imitator var. *meinerti* var. n.

RHEUMATOBATES Bergroth.

Rheumatobates Bergroth. Insect Life, Wash. IV, p. 321; 1892.

Hymenobates Uhler. Proc. Zoöl. Soc. London, p. 214; 1894.

Halobatopsis Ashmead. Can. Ent. XXIX, p. 56; 1897.

Description of the genus from Blatchley's Hemiptera of Eastern United States:

"Very small oblong or oblong-oval species having the head quadrate wider across the eyes than long, its blunt tylus projecting forward between the bases of the antennæ; eyes very large, coarsely granulated; antennæ of males curiously curved and armed with several short, acute spines; pronotum much wider than long, its front and hind margins truncate; mesonotum (brachypterous form) subquadrate, three or more times as long as pronotum; elytra rarely present; front legs short, stout, the tibia less than half the length of femur; basal joint of tarsi very small, second joint with apical half flattened beneath and claws inserted near the middle; middle legs very long and slender, tibia and usually the femur of male fringed on the inner side with long hairs."

Rheumatobates rileyi Bergroth.

Rheumatobates rileyi Berg. Insect Life, Wash., IV, p. 321; 1892.

Halobatopsis beginini Ashmead. Can. Ent. XXIX, p. 56; 1894.

This is the first species described and is the one upon which the genus was erected. Blatchley's description is as follows:

"Length, 2.8-3 mm. Oblong robust, narrowed behind. Above velvety black; a transverse median spot on the pronotum, a diamond-shaped median spot on the mesonotum, a rounded one above the middle coxæ, the front femora and the reflexed connexivum yellow, antennæ, beak and middle and hind legs fuscous brown, the bases of the antennals and the femora yellow, under surface pale yellow, abdomen often with a dusky tinge. Male with first joint of antennæ gradually thickened from the base, armed beneath at apical third with one or two short spines; second joint very short-armed with a slender spine near the base; third strongly curved with a shallow spinose fossa at apical third; fourth with apical half curved acute, armed in front of the middle with a strong tooth. Middle tibia of male fringed with short hooked hairs on inner side of basal half; hind femora of male swollen, strongly curved and fringed within on basal third with a tuft of long hairs, the apex also with two tufts of hairs; hind tibia narrowed and slightly curved at the base, fringed above on inner side with short, stiff hairs and with a tuft of long hairs glued together projecting backward from inner side of basal fourth. Female with antennæ and legs unmodified, the former beset with a few long, stiff bristles."

Notes. The mesosternum is unicolorous, varying from light yellow to dark yellow. The color variation in this species is much less than in *rileyi* var. *palosi* Blatchley. Even here, however, the mesonotal spot becomes smaller and darker and almost disappears entirely in some individuals.

Distribution. The distribution seems to be very limited, having been taken only near the Atlantic coast from New York to the District of Columbia.

Rheumatobates rileyi var. *palosi* Blatchley.

Rheumatobates rileyi var. *palosi* Blatchley. Hemip. of East. U. S.; 1926.

Blatchley gives the following description for this variety:

"Differs from *rileyi* in having the body of the male more slender, yellow spot on the mesonotum only about half the width of that of pronotum; tooth of apical joint behind middle; hind tibiae straighter, more slender, without tubercle on apical half and with a fringe of long, black hairs along the entire inner side. Female with mesonotum wholly black."

Notes. The hairs on the head are shorter, while those on the inner margin of the hind femur are longer and more numerous than those in *R. rileyi*, Bergroth. The color characters given in the above description hold only for a very small number of individuals in the variety. Doctor Hungerford's collection contains specimens from a wide range of localities and the variation in color is remarkable. The spot on the mesonotum is not at all constant in size, shape or color. Specimens from Hodgeman county, Kansas, have the spot almost a creamy white, covering more than half the width of the mesonotum, only slightly narrower than the spot on the pronotum. Even the black band on the anterior margin of the mesosternum is broken between the anterior legs. Some of the females taken at the same place not only have a mesonotal spot, but it is even larger than that of the male; it runs the full length of mesonotum. The metanotum also has an irregular dark yellow spot. At the other extreme are specimens from Douglas Lake, Michigan, which, except for a small brown pronotal spot, are entirely black above. These specimens are also remarkable for their very large size, being by far the largest individuals in the genus. The males measure fully 3.1 mm. and the females 3.4 mm. in length, while the specimens mentioned above are only 2.7 mm. and 3 mm. in length for males and females respectively. Between the two extremes in color almost every gradation exists. Other specimens from Kansas have the pronotal and mesonotal spots brown, the latter very faint in some cases. Specimens taken in Minnesota are just as black as those from Michigan, but they are of normal size. In the past color has played a very important part in separating the species, especially the females. Where such a range of color exists it can be of little or no use in identification.

Distribution. *Rh. rileyi* var. *palosi* Blatchley seems to enjoy a wider distribution than any other member of the genus. It has been taken in at least six states. These are: New York, New Jersey, Michigan, Minnesota, Arkansas and Kansas.

Rheumatobates tenuipes Meinert.

Rh. tenuipes Meinert. Ent. Meddel. V, p. 7; 1895.

Rh. tenuipes Bergroth. Ohio Natur. VIII, p. 381; 1908.

Description according to Bergroth's key:

"Mesonotum scarcely (male) or slightly (female) broader than long, median yellow spot distinctly narrower than pronotal spot. Mesosternum yellow with the anterior margin and two posteriorly diverging bands brownish-black, dilated near the anterior margin. Second male antennal joint beneath at the base

with a small tubercle bearing a fine hair (not visible when joint is strongly deflected), the curved basal part of the third joint one-half the length of the whole joint, the spongy pit occupying the apical half with a long slender spine at its base, fourth joint scarcely shorter than third, curved near the base and at the extreme apex with the curved spine on the basal half. Middle tibiæ in the male fringed with short hooked hairs on the inner side, almost to the apex. Hind legs in both sexes simple, straight and hairless."

Notes. The general form and appearance of this species is very much like that of *R. rileyi* Bergroth, except that the hind legs are normal. The third antennal joint is a little shorter and the fossa or spongy pit occupies about one-half the segment, while in *rileyi* it covers only a little more than the apical fourth; the tooth on the fourth segment is even nearer the base than in *rileyi* variety *palosi*, Blatchley. Except for the ventral spine, the first segment is entirely free from hairs and those on the third and fourth segments are much shorter and lighter. The macropterous male has the pronotum expanded as in other winged members of the genus. It differs, however, in being distinctly longer than wide, and in having about six or eight long, stout, black hairs scattered over each side of the anterior region. There are also a number of pits on each side of the middorsal line between the two hairy regions. The entire costal margin of the corium bears a row of hairs. These are about twice as long as those on *rileyi*.

Distribution. The distribution of this species is the same as that of *rileyi* Bergroth, with which it often associates. It has also been taken in Georgia.

Types. One of Meinert's types taken by O. Heidemann at Glen Echo, Maryland, is in the Snow collection, Kansas University, Lawrence.

Rheumatobates imitator (Uhler).

Hymenobates imitator Uhler. Proc. Zool. Soc., London, p. 214; 1894.

Rheumatobates bergrothi Meinert. Ent. Meddel. V, p. 7; 1895.

Description taken from Bergroth's key.

"Mesonotum much broader than long. Second male antennal segment with a slender spine beneath near the base; third segment with a strong triangular tooth at the basal end of the not dilated spongy pit, the lower margin of the pit beset with stiff hairs; fourth segment much shorter than third, straight, unarmed. Middle coxæ in the male not thicker than the hind coxæ; trochanter many times smaller than the hind trochanter; femora fringed with long hairs on the inner margin near the base and apex; the remaining part glabrous; tibia somewhat curved in the middle where they are thickest, from the base to near the middle fringed on the inner side with short curved hairs, then along a shorter space with long hairs. Hind trochanter of the male excessively incrassated, much broader and thicker than the coxæ and femora, armed with a stout spine on the upper side, longly and thickly pilose on the inner side; femora incrassated and curved with a strong tooth on the upper side before the middle and a curved chitinous process on the inner side behind the tooth, near the apex on the same side with another linear chitinous process (apparently made up of hairs glued together); tibia rather stout, slightly curved, the inner margin with scattered hairs from the base to near the middle, behind the middle fringed with long hairs."

Notes. This species is dimorphic, occurring in both the apterous and macropterous forms. First described under *Hymenobates* by Uhler, and later as *Rh. bergrothi* by Meinert, who described the apterous form as a new species.

Rheumatobates imitator var. *meinerti* var. new.

Size. Male, length, 2.7 mm.; width, 1.3 mm.; female, length, 3.24 mm.; width, 1.3 mm.

Color. Body velvety black or blackish-brown above; head dark brown along the posterior margin; pronotum with a large median rectangular yellow spot, anterior margin of spot almost as long as the width of the head, posterior margin shorter; mesonotum with a median yellow spot varying in shape from diamond to obovate lying closer to the anterior than to the posterior margin; a yellow spot lying above the acetabula on the posterior margin of the mesopleura; abdomen with a silvery bloom, caudal two-thirds of the male connexiva yellow, outer margin of female connexiva yellow for almost the entire length; entire ventral surface yellow except the anterior margin of the mesosternum, which is brown, and the middle abdominal segments, which are light brown.

Structural characters of apterous male:

Head: Distinctly longer than broad, three or four long, stiff hairs scattered along the lateral margins.

Thorax: Pronotum, length .21 mm., a stout hair directed backward from each lateral margin; mesonotum, length .75 mm., with an indistinct median line; metanotum, length .4 mm.

Antennæ: First segment the longest, almost as long as three and four together, thickened at the middle, base and apex about equal in thickness, armed at the outer under side at the middle with a brush of stiff bristles glued together, and a group of similar hairs just behind it; also a group of eight or ten stiff hairs on the dorsal side at the middle; second segment very short, half again as long as thick, a little thinner than the apex of the basal segment; the ventral base bears a tubercle armed with a brush of hairs glued together; third segment long, strongly curved at the basal third, armed at the angle with stout setæ, thickened toward the apical third which bears a pit or fossa, armed with stout setæ on the inner margin; fourth segment about one-third as long as the third, coated at the tip, not conspicuously armed.

Anterior legs: Coxæ small, trochanters enlarged and ventrally expanded, femur thinner than first segment of antennæ, armed with a row of black setæ on the ventral surface; tibiæ about one-half as long as the femora, also armed with hairs on the ventral surface; first tarsal segment very short, the two tarsal claws prominent.

Intermediate legs: Coxæ large, almost as thick as long with a tubercle on the outer posterior margin surrounded by hairs which close over it; trochanters small, only slightly thicker than femur; femur slightly over 2 mm. long and of uniform thickness throughout its length, unarmed except for a few hairs at the apex; tibiæ 2 mm. long, only very slightly sinuate, armed with short hairs along the middle; tarsi about 1.7 mm. long, the first joint about three times as long as the second.

Posterior legs: Coxæ slightly longer than coxæ of intermediate legs, but not as thick, with a small tubercle on the dorsal posterior margin; trochanter very large and globular .4 mm. thick, armed on the inner posterior margin with a broad-edged projection, the edge lying vertically; a dense row of long

hairs, arising from the inner side, extend to the median body line; femur thickened, almost as thick as the coxæ, closely and broadly joined to the trochanter without constricting, curved at about the middle toward the median body line, armed at the angle on the dorsal surface with a curious clavate structure attached at about one-third of the distance from its anterior end by means of a short stem or pedicel; femur margined on the outer side of its point of attachment to this structure by a row of stiff hairs directed upward; a brush of long stiff bristles arises from the inner apical fourth; in the natural position of the legs these brushes cross each other; tibia joined a little before the apex of the femur on the outer side, curved outward and thickened toward the apical third, then tapering to about the same thickness as the base, about as long as the trochanter and femur taken together, armed on the inner margin of the apical third of its length with a row of hairs. Tarsi a little more than half the length of the tibiæ, first segment about twice as long as second.

Structural characters of apterous female: Head slightly broader than long with two hairs on the lateral margins and one on either side of the base of the tylus, two hairs directed forward from the posterior margin of the eyes as in other species; pronotum with a hair on the lateral margin and the mesonotum with three hairs on the lateral margins; out margins of the connexiva covered with long black hairs for their entire length; anterior legs small, trochanters not expanded as in the male, femora with a row of short black setæ on the outer side and a row of fine hairs on the ventral side, two long setæ on the ventral side of the tibiæ; intermediate coxæ with a tubercle surrounded by hairs, femur straight with a row of very short black setæ on the inner margin; posterior legs straight, femora slightly thickened toward the apex, tibiæ about one-third shorter than femora, tarsi one-half as long as the tibiæ.

Notes. The male of this variety differs from that of *R. imitator* (Uhler) mainly in the following respects: The tibiæ of the intermediate legs of *R. imitator* are markedly sinuate with a short row of long hairs at about the middle with short hairs on either side of these. In variety *meinerti* var. new the tibiæ are almost straight and only the short hairs are present. The middle femora of *R. imitator* have a row of long hairs at the base and apex, while in var. *meinerti* the femora are entirely bare. In this variety the clavate structure on the hind femur projects about one-fourth of its length beyond its supporting stem, which is not the case in *R. imitator*.

The females of *R. imitator* (Uhler) and var. *meinerti* var. new can be easily distinguished from all others in the genus by the presence of the hairs on the connexiva, which are lacking in all other species. The female of var. *meinerti* has a comparatively broad dark band on the anterior margin of the mesosternum, this band is sharply broadened opposite each anterior coxa; there is also a dark band marking off the middle acetabula.

Distribution. Taken only from Aux Cayes, Haiti.

Types. Holotype, apterous male; allotype, apterous female; paratypes, three apterous males and one female. All collected by H. Nepperschmidt.

Rheumatobates trulliger Bergroth.

R. trulliger Bergroth. Bull. Brooklyn Ent. Soc., p. 63; 1915.

R. trulliger Blatchley. Hem. of Eastern U. S.; 1926.

R. trulliger Hungerford. Biology of Aquat. Hemip. North of Mexico. Kansas University Sc. Bull.; 1919.

Size. Male, length, 2.6 mm. to 2.8 mm.; width, 1 mm. to 1.1 mm.

The original description is as follows:

"Color as in *Rh. tennipes* Meinert, the pale lozenge-shaped spot on the mesonotum being narrower than the spot on the pronotum and the mesosternum being marked with two longitudinal black bands. Mesonotum of the apterous form in both sexes somewhat broader than long.

"Male: The spongy fossa of the third antennal joint occupying somewhat less than the apical half of the joint, being distinctly longer than in *Rh. rileyi* but shorter than in *tenipes*; fourth antennal joint somewhat shorter than third, being conspicuously longer than in *R. rileyi* but a little shorter than in *R. tenuipes*, its spine placed in the basal half but nearer to the middle than to the base. Legs much as in *rileyi* but with the following differences. Middle femora perfectly straight, hairless from the base to near the apex, where there are a few hairs on the inner margin. Middle tibia fringed with long straight hairs on the inner side from the base to beyond the middle, then with short straight hairs. Curved hind femora scarcely or slightly thicker at the middle than at the base and apex, with very short and tiny hairs along the whole inner margin. Hind tibiae on outer side between middle and apex with a distinct spine and the apex filled with a very thick tuft of rather long hairs."

Notes. In addition to the characters given above this species differs from *R. rileyi* Bergroth in having remarkably thick basal antennal segments, the vertical thickness being one-third the length of the segment; also the dorsal and lateral surfaces are free from hairs. The pronotum of the apterous form and the corresponding area of the macropterous form has short black hairs scattered over the surface resembling *R. tenuipes* Meinert in this respect. The pronotum is decidedly longer and narrower than in *R. rileyi*, but not as long as in *R. hungerfordi* Wiley. The apical third of the posterior tibia is flattened to form a spoon-shaped concavity with a dense fringe of hairs covering the margins. The spine between the middle and the apex referred to above is composed of a tuft of long hairs glued together; in many individuals these hairs have either never been joined or have become separated and no longer appear as a distinct spine, but only as a tuft of hairs somewhat longer than the adjoining ones.

Specimens taken in Arkansas are black with a bluish bloom, especially on the abdomen; the mesosternum and the spots on the pro- and mesonotum are very light yellow. Specimens taken in Kansas are light brown with the same color markings given above except that the mesonotal spot is somewhat smaller and less clearly defined.

Distribution. Georgia (type locality), Kansas and Arkansas.

Rheumatobates hungerfordi Wiley.

R. hungerfordi Wiley. Can. Ent. LV; 1923.

Description after the original:

Velvety black, covered with a bluish-white bloom except on head; pronotum with a large yellow spot occupying the entire length, quadrate to twice as long as wide with sides rounded; mesonotum with a large median yellow spot

quadrate or diamond-shaped in some species. Connexivum of male yellow for at least half its apical length, in female along outer half for almost its entire length, small yellow spot above intermediate acetabula.

Apterous Male. Structural characters: Head shorter than in *R. rileyi* Bergroth and *R. tenuipes* Meinert, slightly narrower than in *R. rileyi*. Pronotum long, longer than in any other species. Nearly twice as long as that in *R. rileyi*, but much narrower, mesonotum not as broad as long. Antennæ with the basal segment very thick armed on the outer under side with a brush of hairs glued together and just beneath with a scattered bunch of coarse hairs. Second segment short, unarmed. Third segment almost as long as first, strongly curved at basal half, large fossa or pit occupying nearly entire apical half, and extending a little beyond insertion of segment four. Segment four as long as the third with a thick tooth just before the middle, bent outward at the middle, apex curved back. Intermediate legs long and slender, femur of uniform thickness throughout, armed on inner margin with a row of long straight hairs of uniform length, base and apex bare; tibia as in *R. rileyi* with long straight hairs near the base and shorter hooked hairs at the middle, apical third bare. Posterior legs, coxa and trochanter slender, linear; femur arched as in *R. rileyi*, but not thickened, and free from hair; tibia joined to femur nearly at right angles. Angulately elbowed near the base, thickened and tufted at the angle with a stiff brush of hairs.

Notes. The macropterous form is very common. This is a very slender species resembling *R. trulliger* Bergroth in this respect.

Distribution. Recorded only from Texas and Utah.

Rheumatobates præposterus Bergroth.

R. præposterus Bergroth. Ohio Natur. VIII, p. 379; 1908.

Original description:

“Male. Head, pronotum and mesonotum together longer than the rest of the body; first antennal joint as long as the head, incrassated and compressed and with a submedian spine on the upper and under side, the apical part upturned with a tuft of hairs on the inner side of the tip, the upper margin almost straight from the base to beyond the middle, the lower margin angularly dilated; second joint inserted at right angles to the fore side of the apex of the first joint; third joint shorter than the first with the short basal part narrower than the second joint, straight and linear than moderately and suddenly incrassated, but not dilated and proceeding in a gentle curve to the apex, the curved apical part occupying more than two-thirds of the joint and provided on the posterior side with a very shallowly impressed spongy surface with some stiff hairs on the lower margin and a toothlike projection at the base; fourth joint a little longer than third, inserted at right angles to the back side of the apex of the third point, unarmed, shortly pilose, rectangularly curved not far from the base; fore femora very slightly thickened toward the base; middle femora as long as hind femora, slightly incrassated and curved toward the base and with a spine on the inner side not far from the apex and a very short acute spur on the same side immediately before the apex; middle tibiæ subsemicircularly curved at the base, turning the convexity of the curve outward, with a tuft of short hairs on the inner side of the tip of the curve, from which point to the apex the tibiæ are straight with some rather short straight hairs on the outer side of the middle part; hind legs straight, simple, three-fourths longer than the body, the tip of the abdomen slightly passing the base of the hind femora when they are stretched straightly backwards.

"Female. Head, pronotum and mesonotum together shorter than the rest of the body; antennæ simple, linear, the first joint a little shorter than the head, third joint a little longer than the first with a few rather long stiff hairs in the inner side near the base and apex, fourth joint as long as the third; fore femora linear; middle legs straight, simple femora longer than hind femora, tibiæ a little shorter than femora and longer than tarsi; hind legs as long as the body, the tip of the abdomen reaching the apical fourth of the hind femora when they are stretched straightly backwards."

Notes. The outstanding characters of this species are the peculiarly joined antennæ, the long fossa of the third joint and the arched basal portion of the middle tibia.

Distribution. Guatemala, Central America.

Rheumatobates crassifemur Esaki.

R. crassifemur Esaki. Ann. Musei. Nat. Hung. XXIII, p. 148; 1926.

Original description is as follows:

"Apterous Form, Male. Body black or blackish-brown. Head blackish-brown with a bluish-gray spot on the vertex. Eyes dark gray. Antennæ black with first joint yellowish-white. Pronotum black or blackish-brown with the central portion broadly yellowish-white. Mesonotum black or blackish-brown with a large bluish-gray spot at the center. Metanotum black or blackish-brown, much suffused with bluish-gray. Underside of thorax black, anterior and intermediate acetabulæ yellowish-white beneath. Anterior legs with coxa trochanter, and femur except the apex yellowish-white. Intermediate legs black or dark brown, trochanter and the base of femur pale yellow posterior legs dark brown, coxa and basal half of trochanter yellowish-white. Abdomen above black or blackish-brown suffused with bluish-gray; genital segment, apical portion of connexiva, and posterior margin of dorsal abdominal segment yellowish-white. Abdomen beneath black, with the sixth abdominal and the genital segments yellowish-white.

"Head nearly as long as broad between the eyes. Eyes moderately prominent laterally. Antennæ; first joint nearly as long as the head, much thickened at the middle, not armed with long setæ; second joint very short; third joint a little longer than the second, but thinner than the latter; fourth joint the longest, a little constricted at about one-third from the base, and vertically dilated at the apex, with a tuft of long stout setæ on the outer side at the base. Pronotum very short, comparatively much shorter than in *rileyi* or in *tenuipes*. Anterior and posterior margins moderately sinuate. Mesonotum somewhat broader than long. Metanotum about two-thirds the length of the mesonotum. Anterior legs small, trochanter about twice as long as coxa, femur not long, not incrassated, with a fringe of long hairs inwardly, though sometimes much obscured, tibia about equal to the half of femur in length, widened towards the apex; tarsus about two-thirds the length of tibia, flattened, first joint very small. Intermediate legs strongly developed; coxa very large, nearly as long as thick, with a conspicuous tubercle on the outer side near the apex; trochanter very large, a little longer than coxa; femur very long and thick, nearly as long as body, club-shaped, much incrassated near the apex, not curved, not fringed; tibia much longer than femur, about one and a half times as long as femur, much thinner than the latter, moderately tapering towards the apex, not fringed; tarsus nearly equal to half the length of tibia joint, about twice as long as second. Posterior legs comparatively short, nearly as long as intermediate tibia; coxa nearly longer than thick; coxa almost globular at the base with a conspicuous tuft of long, stout setæ at the basal corner, which is curved inwardly near the middle, connected to the femur at a little after the base of the latter; femur one and a half times as long as trochanter, incrassated towards the base, with a fringe of five or six stout

setæ on the apical half of the superior surface; tibia long and slender, about one and a half times as long as femur, not armed; tarsus very short, shorter than half the length of the tibia, first joint a little shorter than the second. Dorsal of abdomen flat, dorsal abdominal segments very distinct, connexiva conspicuous, first dorsal genital segment somewhat tubelike, a little shorter than twice the length of the sixth dorsal abdominal segment, second dorsal genital segment much shorter and narrower than the first."

Notes. The color of the female is much like that of the male, except in specimens taken in Argentina which have very little black and are a very pronounced bluish gray. The female is flat and broad, especially across the abdomen.

This species differs from *R. esakii* sp. new in having more massive appendages. The intermediate tibiæ are somewhat longer and the brush is lacking from the anterior end of the posterior femora. It occurs in both the apterous and macropterous forms.

Distribution. *R. crassifemur* Esaki has been taken in Argentina and Paraguay, South America.

Types. One female is in the Snow collection, Kansas University, Lawrence. Others are in Hung. Nat. Mus., Budapest, and Natur. Hist Mus., Vienna.

Rheumatobates klagei sp. new.

Apterous Form, Male. Size: Length, 2.44 mm.; width, 1.2 mm.

Color: Body dark velvety brown; head dark brown with lighter brown along the eyes; pronotum with a large rectangular lighter brown spot; mesonotum distinctly set off from the pleuræ by a black suture; intermediate acetabulæ yellow below and at the apex above; metanotum and abdomen very dark, sometimes covered with a silvery bloom, the genital and sometimes the pregenital segment yellow; basal antennal segment yellow, second segment brown, third and fourth black. Acetabulæ of the prothorax, coxæ, trochanters and basal three-fourths of anterior femora yellow; coxæ, trochanters and base of femora of intermediate legs yellow, with black areas at the apices of the coxæ and trochanters; coxæ and basal half of posterior legs yellow, remainder of leg black.

Structural characters. Head: Quadrate, as broad as long, lightly tapering anteriorly, tylus very prominent, a stout hair between the eyes and the base of the antennæ, two hairs directed forward from the posterior margin of the eyes. The beak is smooth and hairless.

Thorax: Pronotum short as in *crassifemur* Esaki, mesonotum sharply defined from the pleuræ, length and width equal (.62 mm.), metanotum a little more than half as long as the mesonotum.

Antennæ: Basal antennæ segment as long as the head including the tylus, slender, much thinner than the femur of the anterior legs, not or hardly thickened at the middle, unarmed; second segment very short, about as thick as it is long, with two fine hairs on the outer margin; third segment thinner and about one and one-half times as long as the second with two hairs on the inner margin; fourth segment as long as the first, curved outward in a regular arc, basal third thin and apical two-thirds flattened laterally, apex pointed, but not hooked, armed with a few hairs scattered around the middle of the segment.

Anterior legs: Anterior legs as in *R. crassifemur* Esaki with the apical half of the tibia expanded a little more. The ventral row of hairs on the femur extending over the basal third and apical third, the median third bare, hairs at the base very long.

Intermediate legs: Coxa large, hairy at the apex, tubercle present, trochanter comparatively longer than in *R. crassifemur* var. *esakii* var. new, also hairy at the apex. Femur not as greatly incrassated as in *R. crassifemur* Esaki and armed only with three or four stout setæ near the base. Tibia about one-fifth longer than femur, armed with a row of hairs at apex; tarsus hairy at the base, basal segment a little longer than the terminal segment.

Posterior legs: Posterior legs slightly longer than in *R. crassifemur* var. *esakii* var. new, base of trochanter thickened, but not globular as in *R. crassifemur* Esaki, the tuft of stout setæ at the upper basal corner much lighter and shorter and not bent; two tufts of setæ at the ventral base, a heavy ventral tooth a little beyond the middle. The trochanter is attached a little beyond the base of the femur; femur about one and one-half times as long as the trochanter, bowed and flattened laterally, armed with a short stout tooth on the anterior end and with a brush of long stout setæ just below the tooth directed forward to the middle of the trochanter; a comb of short stout setæ on the inner ventral edge opposite and somewhat beyond the point of attachment to the trochanter. The inner surface of the apical third is concave and has a fringe of hairs on each edge at the apex.

Description of Apterous Female. Size: Length, 3 mm.; width, 1.4 mm.

Color: Body dark brown or black with bluish bloom on the mesonotum, metanotum, pleuræ and dorsal surface of the abdomen. Head black with brown posterior and lateral margins. Pronotum with a broad median light brown spot. Connexiva black except at the apex, which is tipped with light brown. First genital segment is brownish-yellow with a black anterior margin, last segment black. First, second and basal half of third antennal segment yellow, apical half of third and fourth black. Coxæ, trochanters, femora and sometimes the base of the tibiæ of fore legs light yellow, joint between femora and tibiæ black, apical half of tibiæ and tarsi black. Coxæ, trochanters and base of femora of intermediate and posterior legs yellow, remainder black. Under side of head, prosternum and anterior half of mesosternum dark yellow with two divergent brown bands; abdomen light brown; pregenital segment yellow on the posterior margin.

Structural characters: Body much flatter than in the male, also broader and very spindle-shaped. Head less angular at the corners than in the male, antennæ slender, formula 23:8:20:30. Fourth joint slightly thickened toward the apex, four or five setæ scattered around the third segment, fourth joint with one dorsal seta at a little beyond the middle. Pronotum very short, mesonotum four times as long as the pronotum, metanotum about one-half as long as the pronotum and mesonotum together. Anterior legs as in *R. crassifemur* Esaki, but with a ventral row of long white hairs on the femur; three or four long setæ on the tibiæ. Intermediate legs long and slender, coxa well developed, trochanter somewhat thicker than femur, tarsus very slender, a little more than three-fifths as long as the tibia. Posterior legs one-half as long as intermediate legs, femur as long as tibia and tarsus taken together,

tarsus less than one-half the length of the tibia, basal joint a little shorter than apical joint.

Notes. The male of this species differs from *R. crassifemur* Esaki and its variety *esakii* var. new, in being decidedly more spindle-shaped. The eyes are not as parallel, being closer together in front. All appendages are much more slender except the femora of the anterior legs, which are slightly thicker. The first segment of the antennæ, instead of being thicker than the anterior femur is hardly two-thirds as thick. The apical two-thirds of the fourth segment is almost unarmed. The length of the middle femur compared to the tibia is as 5 is to 4, much more nearly equal than the 3:2 ratio given for *R. crassifemur*. The posterior legs are longer and more slender than those of either *R. crassifemur* or its var. *esakii*. The tooth on the protruding base of the femur is greatly reduced and the brush below it is absent in both *R. crassifemur* and its variety *esakii*. The ventral tooth of the trochanter in this species is about twice as large as that of *R. crassifemur* var. *esakii*. The brush on the inner basal corner of the trochanter is also much lighter in this species; it is straight and much thinner, not meeting across the abdomen when the legs are parallel.

R. crassifemur Esaki, its variety *esakii* var. new, and *R. klagei* sp. new, form a distinct group in the genus as they have characters in common that the other species do not have. The relative lengths of the antennal segments are entirely different, as are also the segments of the posterior tarsi. In all other species the third antennal segment is at least as long as the fourth segment, while in these species the third segment is only about one-fourth as long as the fourth segment. The spongy pit of the third segment present in a fully developed form in the other species is entirely lacking in *R. crassifemur* and *R. klagei* with merely an indication of it in *R. Crassifemur* variety *esakii*.

Distribution. Taken only from the type locality on the Solimoes river, Amazonas, Brazil, South America.

Types. Holotype, male; allotype, female; paratypes, many males and females. All types are apterous. (The macropterous form is unknown.) Types deposited in the Snow collection, Kansas University, Lawrence.

Rheumatobates crassifemur var. *esakii* var. new.

Description of Apterous Male. Size: Male, length, 2.5 mm.; width, 1.2 mm.

Color: Body brown or blackish-brown, head with lighter brown along the posterior margin and the margin along the eyes; eyes black indistinctly mottled with brown; pronotum with a light brown, sometimes yellow, rectangular spot; middle actabula yellow, dorsal half sometimes black, genital segment yellow, in some species the pregenital and the connexiva of the last three abdominal segments are brownish-yellow. In the lighter species the posterior half of the ventral side of the abdomen is yellow, coxæ, trochanters and basal three-fourths of anterior legs yellow; coxæ, trochanters and base of femora of intermediate legs yellow; sometimes the coxæ are blackish-brown; coxæ and basal half of trochanters of posterior legs yellow.

Structural characters; Head: Quadrate, slightly longer than broad between the eyes, a prominent hair between the eyes and the base of the antennæ, four or five short hairs on the margin near the eyes. Two hairs extending forward from the posterior surface of the eyes.

Thorax: Pronotum comparatively short, about .2 mm. long. Width and length of mesonotum equal (.67 mm.), a distinct suture separating at least the anterior portion of the mesonotum and the mesopleura. Metanotum slightly more than half as long as the mesonotum.

Antennæ: Basal segment as long as the head, greatly thickened at the middle, much thicker than the anterior femur, unarmed. Second segment very short, as thick as it is long with two hairs on the outer side, more or less geniculately joined to the first segment. Third segment longer, but thinner than the second, with two hairs on the inner side. Fourth segment much the longest, one-third longer than the first and almost as long as the first three taken together. Basal third thin with a sharp pointed clavate spine attached laterally at the extreme base; apical third dilated vertically toward the apex, then sharply constricted into a recurved hook. Dorsal margin of dilation fringed with a row of very stout setæ decreasing in length toward the apex. Three smaller setæ near the middle of the segment. The whole segment is bowed outward.

Anterior legs: As in *R. crassifemur*, except that the femur is slightly thickened a little beyond the middle, the ventral fringe of hairs is quite sparse, broken in the middle and develops into two rows toward the apex.

Intermediate legs: Strongly developed as in *R. crassifemur*, coxa very large with a tubercle on the outer apex, trochanter much larger than the base of the femur loosely joined to the coxa. Femur club-shaped, with a row of stout short setæ along the inner margin. Tibia one-fifth longer than the femur, unarmed except for a few hairs at the apex. Tarsus hairy at the base, first segment about twice as long as the second.

Posterior legs: As in *R. crassifemur*, but somewhat longer than the intermediate tibia. Coxa twice as long as thick. A small tooth directed downward from a little beyond the middle of the ventral surface of the trochanter; trochanter articulates dorsally a little beyond the base of the femur; a comb of very short stout setæ on the inner ventral margin near the base, and a fringe of hairs on the dorsal apical third.

Notes. The general shape and appearance of this species is about the same as that of *R. crassifemur* Esaki. It differs, however, in the following manner: The middle tibia instead of being one and one-half times as long as the femur is only one and one-fifth times as long. The femur of the fore leg is somewhat thickened and the row of hair on the posterior margin is not continuous, the middle being bare. The fourth antennal segment of *crassifemur* is bowed outward regularly to the tip, while in *crassifemur* var. *esakii* var. new the tip is sharply and almost completely recurved. The fringe of long stout setæ near the apex of the fourth segment is absent in *R. crassifemur*. The description of *R. crassifemur* does not indicate the presence of the tooth on the ventral margin of the trochanter. The hind legs instead of being nearly as long as the middle tibiæ are somewhat longer.

Distribution. All specimens in the collection were taken from the Solimoes river, Amazonas Brazil.

Types. Holotype, apterous male; paratypes, three apterous males. All taken at the locality given above in association with *R. klagei* sp. new. Collected by Klages.

THE MALE GENITALIA OF *RHEUMATOBATES* AND SOME OTHER GERRIDÆ.

In recent years the genitalia have begun to play an important part in taxonomical work. At the suggestion of Doctor Hungerford that a study of the genitalia of *Rheumatobates* might be of value, especially if made a comparative one with other members of the family, the following study was made.

The so-called hemipterous orders are among the last of the more common orders of insects to receive the attention of morphologists and taxonomists in their attempt to homologize the various structures and appendages of the male genitalia.

The first substantial contribution to our knowledge of the genitalia of Hemiptera was a paper by David Sharp (9) on "The Structure of the Terminal Segment of the Abdomen in Some Male Hemiptera," which appeared in 1890. In this paper he described and illustrated the genital segment of numerous species of Pentatomidæ. However, as pointed out by Singh-Pruthi and other morphologists since that time, his conclusions were erroneous in several respects. He did not recognize the true interrelationship of the several parts of the ædeagus. He considered the phallosoma, which he called the "theca," as merely a protective covering of the ædeagus proper. Closer examination would have shown the two to be a continuous structure and capable of being evaginated. He credited the parameres, which he termed "lateral appendages," with being merely protective organs whose function was to serve as feelers to properly direct the ædeagus during copulation, and considered it improbable that they are clasping organs. Sharp was struck by the great differences between homologous structures, so much so in fact that it seemed incredible to him that species closely related systematically should have common ancestry.

In 1895 Peytoureau (7) in his paper, "Contribution a l'etude de la Morphologie de l'armure genital des Insects," gives the results of his examination of *Velia currens* (Veliidæ). He seemingly accepts Sharp's conclusions without question as he, too, considers the phallosoma as a distinct structure from the rest of the ædeagus and, like Sharp, failed to mention the basal plates at all.

In 1899 Heymans first investigated the embryological development of the genital segment.

Berlese, in 1909, was the first morphologist to study the genitalia in greater detail and was the first to describe and figure the basal

plates. Even he, however, confuses them with the parameres in certain instances.

In 1922 Christophers and Cragg (2) gave an excellent description of the basal plates in their paper on the genitalia of *Cimex lectularius* in referring to it as a "circumphallic chitinization encircling the base of the phallosoma and usually forming a bed for its reception . . . from this the whole organ is slung."

In the same year Raymond Poisson (8) investigated the chitinous structures of the ædeagus in an endeavor to determine their value as specific characters in taxonomic work. He considered the genitalia as arising from the eighth abdominal segment in which he is now generally believed to be in error. In 1924 he published his work "Contribution a l'étude des Hemipteres Aquatiques," including some of various species of *Limnotrechus*, *Hygrotrechus* and *Velia*.

The most important contribution to our knowledge of the genitalia of Hemiptera and Homoptera, especially the former, appeared in 1925, when Dr. Hem Singh-Pruthi released his work on "The Morphology of the Male Genitalia in *Rhynchota*." For the first time detailed descriptions and drawings of the male genitalia of representatives of all the families and most of the subfamilies were made. However, a paper covering so large a field must necessarily be brief at some points and his treatment of the Gerroidea group is one of these. His descriptions are brief and his drawings lack the necessary detail to make them clear and comprehensive. Singh-Pruthi's work has done more to place the morphology of the male genitalia of these two orders on a firm and workable basis and to unify the terminology than has any other.

In 1926 Ekblom's (3) "Morphology and Biology of the Swedish Families of Hemiptera-Heteroptera" appeared. In this paper six families are treated. Among these are the Hydrometridæ, Veliidæ and Gerridæ. This paper is contemporary with the one by Singh-Pruthi, consequently neither one could benefit from the work of the other; there is therefore not the uniformity of terminology of homologous parts which there otherwise might have been. Parameres and copulation hooks are synonymous terms, as are basal plates and lever. Ekblom refers to the whole ædeagus as the penis and calls the endosoma the swell body. Neither one definitely names the chitinous pieces in the endosoma, merely referring to them as chitinous thickenings.

It is often quite difficult to determine the exact number of ab-

dominal segments in an insect, which in turn makes it difficult to tell with any degree of certainty from which segment the genitalia arise. It is now generally supposed that there are ten abdominal segments in Hemiptera, and that the genitalia arise from the eighth and ninth; the tenth bearing the end of the alimentary canal.

The external genitalia are composed of the ædeagus and the parameres. The ædeagus is an evagination of the intersegmental membrane of the ninth and tenth segments, or to be more exact, the ninth and tenth sternites. It is therefore a tubular structure continuous with the body wall, having numerous appendages and chitinous* thickenings, terminating in a gonopore through which the ejaculatory duct pours the seminal fluid. The attachment of the ædeagus to the abdomen is strengthened by the basal plates. This is a stirrup-shaped structure composed of two triangular chitinated sclerites which have become fused at their base. The basal portion of the ædeagus lies cradled in the basal plates when in the resting position. These plates also serve as a point of attachment for powerful muscles which assist in protracting the ædeagus during copulation. Ekblom observed a definite relation between the basal plates and the ninth sternite as they lie close together and both form a basal support for the ædeagus. When the sternite is small the basal plates are well developed and when the sternite is large the basal plates are less strongly developed.

The parameres are a pair of appendages lying on either side of the ædeagus, attached to the apices of the basal plates on their inner side and to the abdominal wall on their outer side. The size of the parameres varies greatly. In some species they are very large and may be covered with hairs. In others they are quite rudimentary and may even be entirely absent as in *Rheumatobates*. When sufficiently developed they serve as instruments to grip the female during copulation. Ekblom states that they are also used to pry open the genital valves of the female.

The ædeagus lies in a cavity or genital chamber with the basal end caudad and the distal end pointing cephalad, the basal end as stated above resting on and partly surrounded by the basal plates. During copulation the ædeagus is raised upward and backward then down and forward transcribing almost a complete circle. This is accomplished by the contraction of the muscles attached to the base

* I have used "chitinous" and "chitinated," although fully aware that "sclerotized" is recommended.

of the ædeagus and by contraction of the abdomen, causing the body fluid to exert pressure upon the organs in question. Covering and protecting the ædeagus from above is the last abdominal segment bearing the anus and forming the anal lid. In some cases the anal lid has an underflap probably formed by the tenth sternite. In the normal resting position the whole ædeagus and the parameres are protected and completely hidden from view. The only visible structures are the anal lid, its underflap when present and the ninth sternite which curves up to meet the anal lid.

The ædeagus is divided into three parts, the phallosoma, the endosoma and the conjunctiva which lies between the other two. In the resting position the phallosoma surrounds and encloses the endosoma and conjunctiva, its base is attached to the basal plates and communicates with the body cavity through the basal foramen. The phallosoma is usually somewhat barrel-shaped, open at the distal end, through which the endosoma is extruded. The degree and manner of chitinization varies to some extent. It never bears any appendages, but serves as a base and protective covering for the rest of the ædeagus.

The conjunctiva joins the phallosoma to the endosoma, being connected with the distal end of the former and the basal of the latter. In the resting position it serves as a lining between the two, and is, of course, turned inside out. It is always membranous except that either end may sometimes be slightly thickened. Like the phallosoma it never bears any appendages.

The endosoma is the distal portion of the ædeagus and is the most complicated of the three. In the resting position it lies within the other two regions, the end often protruding beyond the mouth of the phallosoma. In the larger gerrids the end is prolonged into a curious duck-bill-shaped chitinization almost as long as the endosoma itself. The endosoma contains four appendages which we shall call: (1) the median dorsal shaft, (2) the median ventral shaft, and (3) a pair of lateral plates.

The median dorsal shaft is a heavily chitinized structure lying close to the dorsal wall of the endosoma for the greater part of its length. Its shape varies greatly in the different species. Usually, however, the ends turn down and may be forked and thickened.

The median ventral shaft articulates with the anterior end of the dorsal shaft and is in some cases so completely fused as to appear continuous. Like the dorsal shaft, it also varies greatly with the

species, being broad and membranous as in some of the *Gerris* species, or it may be slender and heavily chitinized as in *Trepobates*. The median ventral shaft appears to carry the ejaculatory duct.

Lying close to the median lateral walls is the pair of lateral plates. These are chitinized structures sometimes having the appearance of shafts and sometimes appearing as broad plates. Their point of attachment does not seem to be constant. In most species they fasten to the posterior end of the median dorsal shaft; in certain species of *Gerris* they seem also to be fastened to the endosoma at their other end. In *Rheumatobates* they seem to have no definite point of attachment.

In making the dissections the specimens were first cleared in caustic potash. Because of the minuteness of the genitalia they were placed in glycerin and dissected with the aid of transmitted light. The drawings were made from a lateral view after the ædeagus had been turned out of its chamber and pointed directly backward. The dorsal views were drawn slightly from the left side to prevent the overlying structures from obstructing the view of the lower.

Trepobates pictus H. Sch.

(Plate IX, Figure 4.)

Parameres well developed, tapering toward the apex which is curved upward, flattened only at the base. Basal plates not heavily chitinized except at the apices and at the point of attachment to the phallosoma where the chitinization continues as a keel almost to its mouth. Area around the mouth thickened somewhat, especially laterally. Conjunctiva with a narrow sagittate granular patch near the phallosoma, otherwise quite membranous. Endosoma also membranous except at the very end, which is somewhat thickened. Median dorsal shaft well developed, recurved at the posterior end for almost one-third its length, not thickened or expanded; anterior end furcate, branches widely separated, curved down then back. Median ventral shaft simple and chitinized, articulating with the dorsal shaft between the tips of its branches and extending anteriorly as far as the shafts, then doubling back half their length.

Metrobates sp.

(Plate X, Figures 1 and 2.)

The parameres in this species are strikingly large. In the resting position they curve up over the ædeagus, being flattened and curved toward the dorso-medial line, to give ample room for that organ, greatly dilated toward the apex. Basal plates well developed and heavily chitinized at the apices where they join the parameres. Phallosoma uniformly chitinized slightly thickened where it joins the basal plates. Conjunctiva very membranous. Endosoma membranous except for a large area on either side which is heavily chitinized

and hides the lateral plates from view. The median dorsal shaft is curiously formed in that the anterior end is trifurcate, forming two auricular structures and one median branch directly continuous with the shaft. The posterior end is curved downward, ending in a slightly recurved hook, not enlarged or expanded. Articulating with the anterior end of the dorsal shaft are two triangular plates which probably form the base of the greatly reduced ventral shaft. Lateral plates large, ovoid and thin. The ventral half is bent outward along the longitudinal axis.

Gerris Fabr.

The species of this genus examined vary remarkably. As mentioned above, the parameres are present but hardly of sufficient size to be functional. In some species, as in *G. marginatus* Say, only the lower half of the phallosoma is chitinized, the upper half being membranous. In *orba* as well as in some of the other larger species the end of the endosoma is greatly extended and expanded. The dorsal shaft is always furcate at the anterior end and usually thickened or broadened at the posterior end.

Gerris marginatus Say.

(Plate X, Figures 3 and 4.)

Parameres very short and stubby, basal plates strongly developed and heavily chitinized. The phallosoma is remarkable in that only the lower half is chitinized, the upper half being membranous, giving the region a boat-like appearance. To compensate for the lack of protection afforded by the membranous portion the upper half of the endosoma is heavily chitinized. This arrangement is unusual. The conjunctiva is membranous. The dorsal shaft is comparatively slender, furcate at the anterior end. Ventral shaft has two chitinized ribs running the whole length and is not membranous as in some members of this genus.

Gerris gillettei L. & S.

(Plate X, Figures 7 and 8.)

Dorsal shaft almost as broad as in *G. buenoi* Kirk, furcate at both ends, anterior and posterior ends quite similar in appearance. Anterior fork somewhat thicker and longer. Ventral shaft broad with the sides turned up, forming a trough, but with the posterior end thin and flattened. Lateral plates long and slender. Parameres very small. Basal plates moderately developed.

Gerris buenoi Kirk.

(Plate X, Figures 5 and 6.)

Dorsal shaft very broad, developed into a broad thick head at the posterior end. Ventral shaft articulating well up in the fork of the dorsal shaft, two ribs as in *marginata* but not so heavily chitinized. Lateral plates very broad distinctly joined to the posterior end of the dorsal shaft, much larger than in any other species examined. Parameres and basal plates as in *gillettei*.

Rheumatobates Bergroth.

The genitalia of this genus differ from the others examined in several respects. The most notable feature is the absence of the parameres. The shafts do not exist as two separate pieces, but are completely fused so that no joint is perceptible. The dorsal shaft does not extend so far caudad. The ventral shaft is long and slender and in some species terminates in a long slender coiled thread. The endosoma instead of opening on the ventral side opens at the extreme end with the coil, when present lying just outside the mouth.

Rheumatobates rileyi variety *palosi* Blatchley.

(Plate XI, Figures 1 and 2.)

Parameres absent, basal plates well developed, Phallosoma only lightly chitinized. Conjunctiva has chitinous granular thickenings where it meets the endosoma, otherwise it is very membranous. Endosoma with a chitinous thickening on either side. Dorsal shaft divided except for a short distance near the posterior end, which is dilated into two broad lamellate structures. The ventral shaft is prolonged into a coiled thread which when extended is about four times as long as the whole endosoma. Lateral plates well developed, about twice as long as wide. These plates lie in a vertical plane just outside the expanded base of the dorsal shaft.

Rheumatobates hungerfordi Wiley.

(Plate XI, Figures 3 and 4.)

Parameres absent, basal plates well developed, but not as heavily chitinized as in *rileyi*. Dorsal shaft divided as in *rileyi*. The expanded lamella of the posterior end distinctly triangular and much smaller. The coiled thread of the ventral shaft somewhat shorter. The lateral plates are ovoid and tapering toward the anterior end.

Rheumatobates trulliger Bergroth.

(Plate XI, Figures 5 and 6.)

This species is closely related to *R. rileyi* and *R. hungerfordi*; it differs from them in the shape of the expanded area of the dorsal shaft, which is sharply angled as in *hungerfordi* but not triangular and much smaller than in *rileyi*. The lateral plates are rectangular and about twice as long as broad. The coiled thread is about twice as long as in *rileyi*.

Rheumatobates klagii n. sp.

(Plate XI, Figures 7 and 8.)

Parameres absent. Lamella of the dorsal shaft very narrow and not angled. Bent cephaled dorsal shaft divided as in other species of this genus. Lateral plates greatly reduced, very narrow. The ventral shaft is not prolonged into a coiled thread. The shaft extends only to the mouth of the endosoma.

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EXPLANATION OF PLATES.

(87)

PLATE VI.

FIG. 1. *R. imitator* var. *meinerti* var. new. Male.

FIG. 2. *R. imitator* var. *meinerti* var. new. Female. Third and fourth antennal joints missing.

FIG. 3. *R. trulliger* Bergroth. Male.

PLATE VI.

R. imitator meinerti
(male)

R. imitator meinerti
(female)

R. trulliger (male)

PLATE VII.

- FIG. 1. *R. klagei* sp. new. Male.
FIG. 2. *R. klagei* sp. new. Female.
FIG. 3. *R. crassifemur* var. *esakii* var. new. Male.

PLATE VII.

(male)
R. klagei

(female)
R. klagei

(male)
R. crassifemur esakii

PLATE VIII.

FIG. 1. Trochanter and femur of right posterior leg of *R. imitator* var. *meinerti* var. new. Male.

FIG. 2. Trochanter and femur of right posterior leg of *R. klagei* sp. new. Male.

FIG. 3. Trochanter and femur of right posterior leg of *R. crassifemur* var. *esakii* var. new. Male.

FIG. 4. Right antenna of *R. crassifemur* var. *esakii* var. new. Male.

FIG. 5. Left antenna of *R. klagei* sp. new. Male.

PLATE VIII.

R. imitator meinerti

R. klagei

R. crassifemur esakii

R. crassifemur esakii

R. klagei

PLATE IX.

FIG. 1. *Gerris remigis* Say. The endosoma has been removed from the phallosoma and the shafts and lateral plates are somewhat extruded. In the normal position these structures are completely inclosed by the endosoma.

FIG. 2. Dorsal view of shafts and plates of *Gerris remigis* Say.

FIG. 3. Dorsal view of the curiously expanded tip of the endosoma.

FIG. 4. The genitalia of *Trepobates pictus* H. Sch. In the normal position the endosoma lies within the phallosoma and the whole swings forward, resting between the parameres covered by the tenth tergite.

FIG. 5. Dorsal view of shafts and plates of *T. pictus*. IX, Ninth segment of the abdomen. X, Tenth segment of the abdomen. *bp.*, Basal plates or lever. *pr.*, Parameres. *ph.*, Phallosoma. *cj.*, Conjunctiva. *end.*, Endosoma. *ejd.*, Ejaculatory duct. *ds.*, Dorsal shaft. *vs.*, Ventral shaft. *lp.*, Lateral plates.

PLATE IX.

PLATE X.

FIGS. 1 and 2. *Metrobates* sp.

FIGS. 3 and 4. *Gerris marginatus* Say.

FIGS. 5 and 6. *Gerris buenoi* Kirkaldy.

FIGS. 7 and 8. *Gerris gillettei* L. and S. *ds*, Dorsal shaft. *vs*, Ventral shaft.
lp., Lateral plates.

PLATE X.

Metrobates sp.

Metrobates sp.

G. marginatus

G. marginatus

G. buenoi

G. buenoi

G. gillettei

G. gillettei

PLATE XI.

FIGS. 1 and 2. *Rheumatobates rileyi* var. *palosi* Blatchley.

FIGS. 3 and 4. *Rheumatobates hungerfordi* Wiley.

FIGS. 5 and 6. *Rheumatobates trulliger* Bergroth.

FIGS 7 and 8. *Rheumatobates klagei* sp. new. *ds.*, Dorsal shaft. *vs.*, Ventral shaft. *lp.*, Lateral plates.

PLATE XI.

1 *R. rileyi palosi*

3 *R. hungerfordi*

2 *R. rileyi palosi*

4 *R. hungerfordi*

5 *R. trulliger*

7 *R. klagei*

6 *R. trulliger*

8 *R. klagei*

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