THE TAXONOMIC VALUE OF THE MALE GENITALIA OF THE GENUS GERRIS FABRICIUS (HEMIPTERA: HETEROPTERA: GERRIDAE)

by

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TABLE OF CONTENTS

LIST OF FIGURES

Figures

LIST OF PLATES

THE TAXONOMIC VALUE OF THE MALE GENITALIA OF THE GENUS GERRIS FABRICIUS (HEMIPTERA: HETEROPTERA: GERRIDAE)

INTRODUCTION

The male genitalia has proven to be of considerable taxonomic value in various groups of insects. This study was undertaken to determine if the male genitalia, in the Hemiptera family Gerridae, would be of value in separating the various species of the North American fauna. Sharp (17) was one of the first workers to investigate Hemiptera genitalia and to note the taxonomic value of the various structures. Singh Pruthi (18) produced the first comprehensive study of the male genitalia of the entire Order Hemiptera, using numerous examples from most of the families. He was followed shortly by Ekblom (9) who studied both the male and female genitalia in a limited number of hemipterous families. Various papers appeared during the next 30 years, dealing with selected groups of Hemiptera. Dupuis (6) presented a comprehensive review of the work previously completed by other workers and attempted to arrive at a uniform nomenclature of the various structures normally associated with the male genitalia. These papers have been of considerable value in this study.

An attempt is made in this study to separate the three subgenera of the genus Gerris Fabricius on the basis of the male genitalia. In addition, all but one of the species of

Gerris found in America north of Mexico have been examined to determine if sufficient characters could be found in the male genitalia to separate the species.

The terminology used by the different authors who have done some work on the male genitalia of the Gerridae was not uniform, as will be pointed out later. To avoid confusion, only the terms used by Matsuda (13) will be used here. His study is the most recent one concerned with the morphology of the male genitalia of the genus Gerris.

Most of the structures associated with the reproductive activities of the gerrids examined were found to be of considerable taxonomic importance. The pygophore, the suranal plate, and the parameres can be used to separate the species either on the basis of their size or shape.

The phallic organ of the male external genitalia presented the most striking differences. The phallotheca and the distal segment of the endosoma presented some stable characters among the three subgenera: Aquarius, Limnoporous, and Gerris. These two structures, plus the basal plate were different enough to separate the species examined. Special attention was given to the plates found in the distal segment of the endosoma and, as pointed out by Poisson (14), they were of considerable taxonomic significance. However, in this study emphasis has been placed on all parts of the male external genitalia.

The following eighteen species were studied:

G. nyctalis Drake and Hottes, G. remigis Say, G. nebularis Drake and Hottes, G. conformis (Uhler), G. notabilis Drake and Harris, G. rufoscutellatus Latreille, G. dissortis Drake and Harris, G. canaliculatus Say, G. gilletei Lethierry and Severin, G. pingreensis Drake and Hottes, G. incognitus Drake and Hottes, G. alacris Hussey, G. insperatus Drake and Hottes, G. buenoi Kirkaldy, G. incurvatus Drake and Hottes, G. comatus Drake and Hottes, G. marginatus Say, and G. argenticollis Parshley.

LITERATURE REVIEW

Although the male genitalia of the family Gerridae have been studied previously by other workers, no previous attempt has been made to use the resulting characters to separate species for any faunal region. Previously, only the plates found in the distal portion of the endosoma have been considered. Poisson (14) was the first to study the male genitalia of the family Gerridae. He worked with the structures associated with the distal portion of the endosoma and referred to them as chitinous plates. He used letters to refer to other portions of the genital structures. It appears that he failed to understand completely the true position of the genital capsule as he referred to it as the 8th urite. In reality, the 9th segment is involved rather than the 8th. However, his paper is of considerable value as he was the first to recognize the taxonomic value of the male genitalia in the family Gerridae. He discussed and illustrated a limited number of species in his paper.

One of the most important studies concerned with the male genitalia of the Hemipteroid insects is that of Singh Pruthi (18). His detailed study of this structure, the first one to be done in this group, has become a model upon which further works must be based. In his work he mentioned and illustrated the genital parts of two species of

the genus Gerris. He fully investigated them and identified their different structures, but he incorrectly identified the suranal plate by calling it the 10th tergum. He divided the endosoma into three regions and referred to the plates found in this structure as thickenings.

Ekblom (9) made a similar study on the male genitalia. The terminology he used is completely different from the one used by Singh Pruthi except for the suranal plate, which he considered to be the 10th tergum. The basal plate was referred to as the lever, the parameres as the copulatory hook, and the endosoma as the swell body. He merely mentioned the chitinous pieces referred to by Poisson (14) in his paper. His work is very good in that he tried to make a morphological comparison of the genitalia between the different families. On the basis of his work the family Gerridae was found to be related to the families Veliidae and Hydrometridae.

Schroeder (16) in a study of the genus Rheumatobates, gave some notes on the male genitalia of some other Gerridae, including a limited number of species of the genus Gerris. He based his description of the male genitalia on Singh Pruthi's work. He gave some good descriptions, but only the plates found in the distal portion of the endosoma were illustrated. He clearly defined them and was the first one to name them more or less correctly, making their use in a taxonomic study easier. He followed the

terminology used by Singh Pruthi (18).

Tamanini (19) in his review of the genus Velia Latreille gave a good description of the male genitalia. He stated: "Nella parte interna della capsula genitale vi e una placca chitinosa, simile al fallobase dei Gerris descritto da Poisson (1940)" (1947, p. 20). He also illustrated the apical portion of the phallus that appears to be analogous to the apical segment of the endosoma present in the gerrids. The plates of this structure found in the Velia balcanica Tam. and Velia rhadamantha Hoberl. appear to be closely related to those of Gerris incurvatus Drake and Hottes, Gerris marginatus Say, and other related species. This seems to agree with the statement made by Ekblom (9) on the close relationships of the two families, Gerridae and Veliidae. In his considerations, Tamanini (19, p. 47) called the plates: armatura basale, armatura dorso-laterale, and armatura ventrale.

Dupuis (5) gave an excellent review of all the previous works concerned with the male genitalia of the Hemipteroid group. His work is very important for a good understanding of the male genitalia of the gerrids. The glossary he inclosed in the second chapter of his publication is very valuable for the purpose of the present study, since it cites all of the terms used by various authors for the different parts of the genitalia.

By far the most recent work concerned with the male genitalia of the gerrids is that of Matsuda (13). He gave a broad and important picture of the evolutionary processes of the male genitalia of this group. Based on his valuable considerations, an attempt is made in the present study to show the evolution of the male genitalia in the group of species examined during the course of this investigation. The terminology of Matsuda (13) is used throughout this paper, with minor variations as indicated.

MORPHOLOGY OF THE MALE GENITALIA

The abdomen of the male is composed of ten visible segments. For the purpose of this study only the segments eight to ten will be considered, since they were found to be directly related to the reproductive activities of the insects in this group. When the insect is not copulating, the segments telescope into each other, and only part of them can be seen exteriorly.

The eighth abdominal segment (Figs. 4, 6. 8th segment) is simple. It is a complete, well-sclerotized ring presenting no apparent differentiation into a tergum, pleuron, and sternum. Narrow in its proximal region, it is widely opened in its distal part (Fig. 6. 8th segment) in order to receive and protect the anterior portion of the genital capsule when retracted (Fig. 4. 8th segment). Anteriorly and ventrally the segment is more or less finely attached to the seventh segment by a lightly sclerotized piece. Dorsally the joint is completely membranous. It appears that in copulation the eighth segment can be directed only downward as a result of the peculiar type of attachment with the preceding segment (Fig. 6. 8th segment). As a result of a postero-dorsal extension and a slight ventral extension, the posterior margin is somewhat irregular. Dorsally the eighth segment presents a more or less flat surface, slightly elevated posteriorly

(Fig. 6. 8th segment). Ventrally, the shape varies with the species. It can either present a keel-like structure when the segment is deeply impressed laterally, or it can be plump when the sides are scarcely impressed. The spiracles are present.

The ninth abdominal segment (Figs. 1, 4, 5, 6, 7) is the one that presents the most striking modification. Its sternal region resembles the shape of a wooden shoe and forms the genital capsule or pygophore (Figs. 1, 5, 6. pygophore). It is narrowed anteriorly and presents a reduced point of attachment for the membranous area which binds it to the eighth segment (Fig. 6. pygophore). This makes it more flexible. In the dorsal region anteriorly there is a narrow bridge formed by two small schlerotized plates that at first were thought to be the remnants of the ninth tergum. These are attached to the anterior margins of the pygophore and bound together by a membrane. They serve as a point of articulation for the suranal plate (Figs. 1, 5. suranal plate) and permit a freer motion of this part. The opening of the pygophore is located in a postero-dorsal position.

Interiorly, the pygophore presents a hollow structure divided into two regions (Fig. 7). The anterior region that is connected to the body cavity contains the posterior portion of the digestive tract and the muscles that activate the suranal plate and the phallus. The second region

is called the genital chamber and contains the copulatory organs. This chamber appears to be formed by the inside folding of the membranous area which binds the ninth sternum to the tenth sternum. The phallus appears to be the outside extension of this membrane.

Matsuda (13, p. 409) considers the suranal plate as the ninth tergum. In order to avoid confusion, no attempt has been made in this study to criticize or to prove the validity of this practice. As mentioned before, only the terminology used by Matsuda (13) will be used in this paper; therefore the suranal plate will be considered as the ninth tergum.

The tergum of the ninth segment, or suranal plate, (Figs. 1, 4, 5, 6, 7. suranal plate) is modified to cover the opening of the genital chamber (Figs. 4, 7. suranal plate) and to protect the structures found inside. It articulates anteriorly with the schlerites found on the dorsal portion of the genital capsule. When the insect is about to copulate, it opens up and gives passage to the erected phallic organ (Figs. 1, 5). At rest, it lies flat on the top of the capsule, and nothing can be seen exteriorly except the parameres. This has been made possible by a special modification of its lateral margin (Figs. 1, 5, 6. suranal plate). On the ventral side the membrane joining the ninth sternum to the tenth forms a lining which protects the posterior portion of the digestive tract

(Fig. 7).

Posteriorly and ventrally the suranal plate bears the tenth segment. Only the tenth sternum is present (Figs. 1, 4, 5, 6, 7. 10th sternum). It is a small rounded structure which forms the lower boundary of the anus and opens between the suranal plate and the tenth sternum.

No trace of the eleventh segment was found. It appears as though it has either fused with the tenth segment or else is represented by a membranous ring around the anus, as shown in Figure 47.

Phallic Organs

Morphologically the phallic organ is composed of these structures: the basal plate, the phallotheca, the endosoma, and the parameres which are normally associated with it (Figs. 1, 2).

The basal plate is a very simple structure. Triangular in shape, it varies from species to species, making it a good taxonomic tool in this study. It lies within the genital chamber, with its base directed proximad and attached to the lining formed by the inside folding of the genital capsule and also to its side (Figs. 1, 5, 7. basal plate). Its role is to sustain the elongated portion of the phallic organ when erected. Its articulation with this part is reduced to a point (Figs. 1, 2, 5) in order to give it freedom of movement.

The phallotheca (Figs. 1, 2, 5, 7. phallotheca) in some species forms a completely sclerotized ring, while in others only the ventral side is sclerotized and the dorsal portion is membranous. This is found particularly in the small species, where the membranous portion allows the phallotheca to extend in width, thus enabling the endosoma to telescope within it when deflated. When at rest, the phallotheca lies within the genital chamber (Fig. 7. phallotheca), partly enclosed within the groove formed by the basal plate, with its distal portion directed anteriorly (Fig. 7). Its articulation with the basal plate, as stated before, is reduced ventrally to a point while dorsally and on both sides it is attached to the intersegmental membrane which joins the ninth sternum to the tenth sternum.

The endosoma (Fig. 2. Endosoma) is the apical, membranous portion of the aedeagus. Singh Pruthi (18) stated that the Gerridae have genitalia of what he termed the Reduvioid type, that is, the aedeagus is divided into a phallosoma and an endosoma. Matsuda (13, p. 409) further divided the endosoma of the Gerridae into a basal segment and an apical segment. As stated earlier, the terminology of Matsuda is followed in this study.

The basal segment of endosoma (Fig. 2. basal segment) is completely membranous except for a small, sclerotized area (Figs. 1, 2) found on the dorsal portion and a short distance before the distal end. This structure is absent

in the male genitalis of the subgenus Gerris. Basally it is in continuation with phallotheca, and distally it connects to the apical segment of the endosoma. It forms a lining inside of the phallotheca in the resting position and surrounds part or all of the retracted apical segments of the endosoma.

The apical segment (Fig. 2. apical segment) of the endosoma is the portion that has been used most widely by taxonomists working with the gerrids. It presents some modifications from one species to another. Exteriorly it can be either sclerotized or membranous. There is an anterior prolongation of the apical segment (Fig. 2. anical sclerotized part of endosoma) in some of the more generalized species (Gerris remigis and G. nyctalis). There is a gradual reduction of this extension as the species become more specialized. This character has been extremely useful, along with the phallotheca and other structures, in separating the three subgenera. It was also useful in separating species to a limited extent. There are usually 4 sclerotized structures found internally, which are referred to as the dorsal, ventral, and lateral structures.

The ventral structure is absent in the subgenera Aquarius and Limnoporus. In this case it is replaced by a membranous lobe which seems to carry the secondary gonopore. This is well illustrated in the Gerris nyctalis and

G. remigis (Figs. 9, 22). In the other species having this structure, the lack of specimens made it so difficult to obtain complete inflation that their shape was not determined. In the subgenus Gerris the ventral structure is present and well sclerotized. In one species it forms a unique sclerite; in two others the length of this sclerite was very much reduced; and in the other species observed it was branched distally. In two species of the subgenus Limnoporus this structure was reduced to two small sclerotized plates (Figs. 29, 30, 34, 35) found in the dorsal plate and apical plate. It has been called: "piece b" by Poisson (12), "thickening" by Singh Pruthi (18), "ps 2" by Ekblom (9), "ventral shaft" by Schroeder (17), and "ventral plate" by Matsuda (13).

The dorsal structure (Fig. 2. dorsal plate), which forms only a single sclerite, as stated by Matsuda, is formed by the fusion of three plates called basal plate, dorsal plate, and apical plate. Where the dorsal plate joins the basal and the apical plate, the plate is sharply curved. The part of the plate which represents the basal plate is branched at the free end and serves as the articulation point for the ventral shaft. The apical plate has a particular structure at its free end, whose function has not yet been determined. The dorsal plate of the species studied forms a simple shaft fused to the

basal and apical plate. This structure, which was considered by the previous workers as one plate, was called "piece a" by Poisson (14), "th (thickening)" by Singh Pruthi (18), "ps 1" by Ekblom (9), and "dorsal shaft" by Schroeder (13).

There are two lateral plates (Fig. 2, Lateral Plate). In the inflated specimens they were found to be used as a support for the membranous area. Also in the specimens where the sclerotized area was present in the basal segment of the endosoma, it articulates with this structure. As observed in some fresh specimens, the sclerite of the basal segment of the endosoma plays a role in the retraction of this part when not inflated. Likewise for this structure, the terminology used by the different authors was not uniform. Poisson (14) called them "piece c" or "d"; Singh Pruthi (18) used the term "th (thickening) 2 in his study; Ekblom (9) designated them by the abbreviation "ps 3"; and Schroeder (13) called them "lateral plates."

Another good structure used in separating the species is the paramere (Fig. 3). It is very simple in appearance, but the shape varies from one species to another. Greatly reduced in size, in some species they are not sclerotized at all. They are firmly attached to the apices of the lateral angles of the basal plate and to the wall of the genital chamber.

MATERIALS AND METHODS

Only dry specimens were used in this study. They were first dipped in hot water in order to soften the intersegmental membrane and the structures inside. After fifteen to twenty minutes of this treatment the genital capsule was removed from the rest of the abdomen, and drawings were made. The suranal plate was then lifted to get the telescoped phallic organ out of the genital chamber. By means of fine forceps the endosoma was freed from the phallosoma either by pulling on the prolongation of the apical segment of the endosoma, where present, or by squeezing the phallosoma gently above the basal apparatus. During this operation care was taken not to puncture the genitalia.

The whole capsule with the genitalia everted was placed into a small vial containing glycerine and allowed to stand over night. This softened the membranous areas of the phallus.

The softened capsule, with the phallus still attached, was placed in a small glass dish containing lactophenol. The dish was placed in an oven set at a temperature of 120°F. Fifteen minutes later the inflation of the phallus started. The capsule was then transferred to distilled water, where inflation was completed. It was found

that in this time the lacto-phenol did not completely destroy the muscles, permitting some observation of attachment. Drawings were made from the left side of the inflated phallus while the latter was still attached to the genital capsule.

The phallus was then dissected from the capsule and placed in a 10 per cent solution of potassium hydroxide to clear the membranous portions and to make visible the various sclerites within the endosoma. After proper clearing, drawings were made of the plates from the left side and, in several instances, from the ventral side. In a number of cases it was necessary to dissect out the internal plates to determine their exact shape.

The basal plate and the parameres were dissected free and mounted on microscope slides. The basal plate was mounted flat, with the ventral side facing upward. Drawings were made from the slide preparations.

An alternate method can be used when specimens are scarce, although the chances for complete inflation are not as good as in the above method. The genital capsule is removed from the insect and placed in a hot 10 per cent solution of potassium hydroxide. After about fifteen minutes the capsule is placed in water. By squeezing the phallosoma at the base, it is usually easy to withdraw the endosoma. The phallus is then dissected out and drawn.

The general lack of complete inflation is the drawback of using this method. It is possible that alcoholic specimens or fresh specimens would greatly enhance the success of achieving complete inflation.

All observations were made with a binocular dissecting microscope and the figures prepared by means of an occular grid at 75x.

GENUS GERRIS FABRICIUS 1794

The genus Gerris is one of the nine gerera of the tribe Gerrini. In the past few years this genus has been the subject of considerable work by taxonomists. Torre Bueno in 1932 considered it as divided into four subgenera: Aquarius Schellenberg, Limnogonus Stal, Limnoporus Stal, and Gerris Fabricius. However, these four subgenera have been considered as distinct genera. Matsuda (13, p. 173-187) in his latest classification divides this genus into three subgenera: Aquarius Schellenberg, Gerris Fabricius, and Limnoporus Stal. He considers Limnogonus as a distinct genus. His classification has been followed in this study.

The members of this genus are world-wide in distribution. Drake and Harris (7, p. 182) noted that twenty-eight species have been recorded from continental and insular America. Of these, seventeen species are treated here on the basis of the male genitalia. One species studied, Gerris rufoscutallatus, is mentioned by Torre Bueno (4, p. 662) as being present in the Americas, but not by Drake and Harris (7).

Subgenus AQUARIUS Schellenberg 1800

The male genitalia of two determined species, G. (A). Nyctalis and G. (A). remigis were studied. The group of specimens that has proven to be different from the others were also considered as belonging to this subgenus. These three groups appear to be closely related. The distal margin of the apical segment of the endosoma extends into a well sclerotized and pigmented structure. No sclerotized ventral plate was present, and the membranous area found on the ventral portion of this segment was extremely large. During the process of inflation the basal portion of the dorsal plate moves backwards, drawing along with it the membranous ventral plate attached to it.

The ventral plate forms a lobe distally and seems to bear the secondary gonopore. Basally there is a very small sclerotized area articulating with the base of the dorsal plate. The dorsal region of the basal segment of the endosoma forms a heavily sclerotized box enclosing the plates and folded membranous area when at rest. The other portions of the phallic organ look similar except for a few differences.

General considerations

Distal margin of seventh abdominal segment double emarginate. Connexival spines equal to or slightly shorter than eighth abdominal segment when at rest. Venter of eighth abdominal segment laterally impressed, forming a more or less distinct keel medially. Apical margin of eighth venter strongly produced.

Male Genitalia

Pygophore, very large. Only basal one-third is telescoped into the eighth abdominal segment. It is widest at about one-third the distance from the basal end, narrows progressively to form an elongate distal region. Laterally it is more or less shoe-shaped.

Suranal plate, reaching apex of pygophore or slightly longer than this structure. Dorsally the lateral margin forms almost an acute angle with apex directed distally.

Basal plate, heavily sclerotized and pigmented on each side with median region moderately sclerotized and pigmented. Distal region forming a small triangular basal region, which is more or less rectangular.

Parameres, well developed and well sclerotized.

Phallotheca, heavily sclerotized and pigmented. Dorsal region completely sclerotized throughout whole length. Venter with only a small region sclerotized, the rest membranous or moderately pigmented.

Endosoma: basal segment long and membranous, with punctures on the sides. Well defined sclerotized area present dorsally at distal limit. Apical segment of endosoma well developed, distally produced into a well developed and highly sclerotized region. Basal region forming basally a well sclerotized box enclosing plates when at rest. Venter, membranous and capable of inflating.

GERRIS NYCTALIS Drake and Hottes 1925

(Figs. 8, 9, 10, 11, 12, 13, 14, 110)

Male Genitalia

Pygophore, very large, wider at about one-third from the base, more or less angulate at apex. Suranal plate as in figs. 13, 14.

Basal plate, heavily sclerotized and pigmented on the sides, with a small, moderately pigmented triangle along median margin and basally. Apex of basal plate more or less rounded, with a small groove in the middle.

Parameres, elongated, with a broad cleft basally and laterally.

Phallotheca, heavily pigmented, with a groove on venter, not forming a complete sclerotized ring. Ventral portion entire dorsal portion reduced to a narrow sclerotized bridge.

Endosoma: basal segment of endosoma well developed,

punctate laterally. Sclerotized plate heavily pigmented, broad in the middle and tapered at both ends. Distal projection very long, well developed, heavily sclerotized, more or less curved. Narrowed at base, this prolongation slightly enlarged at the apex, which is rounded. Dorsal plate slender in the middle portion, with distal end modified into a groove-like structure. Basal extremity furcate. Ventrally, when membranous area is inflated, not produced distally; very wrinkled. Membranous ventral plates form more or less three distinct lobes, with median lobe well elongated and lateral ones small.

Plesiotype: 3.5 miles northeast. Summit, Benton County, Oregon. 700 feet. March 5, 1959. John D. Lattin.

The above description was based on an apterous specimen. Thirty-seven specimens from Oregon, California, Idaho, and Washington, including nine macropterous forms from Oregon, California, and Idaho were dissected. No differences were found between the macropterous and apterous forms.

This species is very distinct by reason of its well elongated projection of the apical region of the distal segment of the endosoma; the peculiar shape of the inflated membranous area and the distinct trilobed ventral plate. This species is closely related to G. (A) remigis and G. (A) species a. Drake and Harris (7, p. 184) used

color and certain features of the terminal abdominal segments to separate nyctalis and nemigis but found that these characters were not stable enough to assure complete separation of the two forms. Further, the discovery of another form, referred to in this paper as Gerris (Aquarius), species a, further complicates the separation of these forms. The genital characteristics of these three forms will serve very well to distinguish them from one another. Ultimately, the three forms may prove to be subspecies of a single species. If this proves to be the case, the nominal species will be Gerris (Acquarius) remigis Say.

GERRIS Species A

(Figs. 15, 16, 17, 18, 19, 20, 111)

Male Genitalia

Pygophore, very small, when compared to that of G. nyctalis. Not very broad, more or less elongated distally. Suranal plate like in figs. 19, 20.

Basal plate, moderately pigmented except on the sides where there are two heavily pigmented stripes.

Parameres, as in figure 111.

Phallotheca, heavily pigmented, with small sclerotized bridge on venter, pointed basally.

Endosoma: basal segment of endosoma with not too many punctures on the side. Apical segment of endosoma

with side of dorsal region not very broad. Lateral plates with a slender well pigmented area ventrally, while dorsally there is a broad, moderately pigmented region. Ventral plate forming a distinct, unique elongated lobe. Dorsally it has a trilobed appearance but with no distinct lateral lobes. Distal projection of apical segment of endosoma distinctly folded on the sides, more or less straight and angulate ventrally.

Plesiotype: Ft. Davis, Texas, Jeff Davis County. 5000 ft., Davis Mts., Mrs. O. C. Polling coll. Nov. 3, 1927.

The above description was based on an apterous specimen. Thirteen specimens from Texas, Arizona, Virginia, including seven macropterous forms from Texas and Arizona were examined.

This species is separated from nyctalis on the basis of the apical segment of the endosoma. The lateral plates are irregular in shape and structure; the membranous area when inflated is different from other species of this group. The structure that appears to be the most valuable in differentiating this species is the distal projection of the apical segment of the endosoma. It is more or less straight, folded on the sides, and angular at the apex. This species appears to be confined to the southern United States.

GERRIS REMIGIS Say 1832

Male Genitalia

Pygophore relatively small. Suranal plate like in (Figs. 21, 22, 23, 24, 25, 26, 27, 28, 112). Basal plate, with apical region cone-shaped. Heavily sclerotized and pigmented on the sides, with a non-pigmented triangle medially extending from the apex to the base, pointed laterally where it articulates with parameres.

Parameres, short and moderately pigmented.

Phallotheca, heavily sclerotized.

Endosoma: basal segment of endosoma elongated, with heavy punctures on the sides.

Apical segment of endosoma produced distally into a short structure in comparison to that of nyctalis, rounded at apex. Dorsal plate relaaively short, with slender middle, furcate at basal end. Lateral plate moderately pigmented, regular in shape. Inflated membranous area on venter forms a very large lobe, with the apical region extending well beyond the extremity of the apical projection. The single lobe articulates with basal extremity of dorsal plate.

Plesiotype: Storrs, Connecticut. June 21, 1926. M. H. Sweet

The above description was based on an apterous specimen. Twelve specimens from Iowa, Missouri, Michigan,

Connecticut, and Ohio, including one macropterous form from Iowa, were examined. No differences were noted between the two forms.

The male genitalia of this species can be distinguished from G. nyctalis and G. species a on the basis of the structures found in the apical segment of the endosoma. When inflated, the membranous area forms a big lobe, extending well beyond the distal region of this segment. The lobe formed at the basal end of the dorsal plate is larger than the one found in G. species a. The projection of the distal margin of the apical segment of the endosoma is short as in G. species a, but simple with no particular foling laterally; it is rounded at the apex. No attempt has been made to distinguish this species from G. species a on the basis of the external morphology; but they look different in coloration. In their distribution the members of this species G. remigis appears to be confined to the eastern portion of the United States.

Subgenus LIMNOPORUS Stal 1868

Six species were examined in the subgenus Limnoporus: G. nebularis Drake and Hottes, G. conformis Uhler, G. notabilis Drake and Hottes, G. canaliculatus Say, G. rufoscutellatus Latrielle, and G. dissortis Drake and Harris. Matsuda (13, p. 175) considers the first two as belonging to the subgenus Aquarius. On the basis of the strong similarities of the male genitalia they were found to be more closely related to Limnoporus than to Aquarius and were considered in this study as members of the subgenus Limnoporus.

Distal margin of seventh segment broadly concave. Connexival spines extending beyond the eighth abdominal segment when at rest. Venter of eighth segment either rounded or having a groove of various shapes in the median region, not forming a keel. Distal margin of venter not strongly produced; when produced, it is slightly convex.

Male Genitalia

Pygophore small, forming a bulb-like structure on the apical region of the venter inside the eighth segment, half-way telescoped. From a dorsal view the shape is highly variable within the species, but its greatest width is usually found at about one-third the distance from the distal end.

Suranal plate distinctly longer than pygophore. Dorsally it can be angular at the apex but mostly rounded.

Here the triangular appearance of the basal plate is better shown than in the subgenus Aquarius, and the apex forms a more or less acute angle.

Parameres reduced, sometimes not sclerotized, not pigmented, and completely transparent.

Phallotheca, strongly sclerotized; in some species the dorsal region forms a cleft at its distal limit. Where the phallotheca is limited basally, the lateral margin, starting from the dorsal region is first concave, then suddenly forms a more or less right angle before joining the dorsal line.

Endosoma: basal segment of endosoma, membranous and smooth. It forms a broad structure. The sclerotized area is still present here, but its size is reduced, and it is less sclerotized and more irregular in shape than in subgenus Aquarius. Apical segment of endosoma not present, or, if present, reduced to a very short truncate structure. Because of the lack of specimens and the difficulty encountered in working with the male genitalia in this group, a complete inflation of the endosomal area was impossible to obtain. This made it impossible to compare the membranous area of the apical segment of the endosoma of the subgenus Limnoporus with that of the subgenus

Aquarius, but on the basis of the other structures of the male genitalia, it was easy to observe two distinct subgenera.

GERRIS NEBULARIS Drake and Hottes 1925

(Figs. 29, 30, 31, 32, 33, 113)

Male Genitalia

Pygophore and suranal plates as in figs. 32, 33.

Basal plate, heavily pigmented, forming an acute angle at the apex. No true projection laterally for articulation with parameres.

Parameres, moderately pigmented, more or less rounded at apex.

Phallotheca, not heavily sclerotized, apical margin deeply concave. Basal lateral margin starting from dorsal margin broadly concave, bends sharply to form an acute angle before joining dorsal margin.

Basal segment of endosoma short and smooth. Sclerite in apical region of its dorsal part, slender, moderately sclerotized.

Apical segment of endosoma: dorsal portion as a whole is moderately sclerotized and pigmented, enclosing the dorsal and lateral plates. Apical portion extended into a truncate structure, well sclerotized. Dorsal plate sharply bent apically to form a small modified

sclerite. Lateral plates affecting a broad, irregular shape; reaching apex of dorsal plate but not fused with it. Heavily sclerotized only at the extremities. Ventrally, the membranous projection is short; two small sclerites present distally. Another sclerite articulates basally with dorsal segment.

Plesiotype: Ottawa, Kansas, May 20, 1925. B. M. Harrison.

The above description was based on macropterous forms only. This species allied to conformis in general color and markings, as mentioned by Drake and Harris (7, p. 186) was also found to be closely related to the latter on the basis of the male genitalia. The truncate appearance of the distal margin of the apical segment of the endosoma, the shape of the plates found in this segment, and the small size of the sclerites found in the membranous ventral plate appeared to be the chief characteristics in differentiating these two species. To some extent the shape and the size of the pygophore and the suranal plate can be used in classifying them.

GERRIS CONFORMIS Uhler 1878

(Figs. 34, 35, 36, 37, 38, 114)

Male Genitalia

Pygophore and suranal plate as in figs. 37, 38.

Basal plate, triangular in shape, forming more or less an acute angle. Laterally there is a projection for articulation with the parameres. Medially and basally there is a small portion not heavily sclerotized and pigmented.

Paramere, very slightly sclerotized, almost completely transparent. Long and slender, pointed at the apex.

Phallotheca, heavily sclerotized, forming more or less a complete ring. Barrel-shaped, dorsally a cleft at the apical region. Apical margin is concave. Basal margin when starting from the ventral margin is concave at first, then bends sharply at a right angle to join the ventral line.

Endosoma: basal segment of endosoma is membranous, long and sclerotized; circles the dorsal region of this part and limits it apically.

Apical segment of endosoma: distal region forming a V-shape laterally, not heavily sclerotized and pigmented at the end point; the sclerotization diminishes gradually on the dorsal portion and stops half way between

the two extremities of this segment. Dorsal plate almost reaching the apex of this segment; at this point it bends sharply and ends in two modified structures. The lateral plates touching the distal extremity of the dorsal plate but not fusing with it it. They are long and heavily sclerotized parts. Ventrally there is a membranous projection which consists of two small sclerotized pieces distally. Basally there is a small branched sclerotized area that articulates with the basal end of the dorsal plate. Dorsally the membranous projection is partly sclerotized, forming a thin layer on the median line.

Plesiotype: Storrs, Connecticut. June 21, 1956. M. H. Sweet.

The above description was based on a macropterous form. Another macropterous form from the same place was also examined. This species can be determined on the basis of the distal shape of the apical segment of endosoma. The dorsal and lateral plates are more or less regular in appearance. The sclerite of the membranous plate is well developed and conspicuous.

The presence of these sclerites in the membranous ventral plate appears to be the first step taken towards a well developed sclerotized ventral plate, as found in what appears to be the most advanced species of this group. Matsuda (13, p. 76) in his publication on the Gerridae of the world clearly evaluated the evolution of the

plates found in the apical segment of the endosoma. He also considers the membranous condition of the venter a primitive condition, which is found in the less advanced species of Aquarius and Limnopetra.

It appears also, as illustrated by the species nebularis and conformis that there has been a gradual reduction of the prolongation of the distal margin of the endosoma. This prolongation is well developed in nyctalis and becomes shorter in remigis, Species a affecting a truncate structure in nebularis and disappearing completely in the other species of the subgenus Limnoporus. A gradual desclerotization and depigmentation of the apical segment of the endosoma can be noted throughout the different species of the subgenus Limnoporus until we get to the subgenus Gerris, where a more or less complete desclerotization and depigmentation of this structure can be seen.

GERRIS NOTABILIS Drake and Hottes 1925

(Figs. 39, 40, 41, 42, 43, 115)

Male Genitalia

Pygophore and suranal plate as in figs. 42, 43.

Basal plate, more or less triangular with irregular margins. Moderately sclerotized, extending on the sides into a point where the parameres articulate with it. Apical margin forming a heavy line.

Parameres, having more or less a rectangular shape. Not heavily sclerotized.

Phallotheca, heavily sclerotized. Ventral surface entire, no cleft present. Lateral distal margin not really concave, forming more or less an angle at the middle. Basal margin forms at first a concave line from the dorsal margin, then turns at a right angle to join the ventral surface.

Endosoma: basal segment of endosoma membranous, broad, with some punctures on the lateral region. Sclerite at apex of dorsal region, slender at the apices, enlarged in the middle, heavily sclerotized.

Apical segment of endosoma: apically, one third of the apical segment of endosoma is heavily sclerotized. The rest of it is membranous. Dorsal plate long and slender, modified apically. Lateral plate slender in the middle, enlarged at both extremities, particularly the one

in contact with the apical region of the dorsal plate. Ventrally there is a membranous area with no particular sclerotized structure in it.

Plesiotype: 1 mile North Walport, Oregon, Lincoln County. July 21, 1959. John D. Lattin.

The above description was based on a macropterous specimen. Another specimen from the same place was also dissected and examined. This species can be easily distinguished from the others by the apical segment of the endosoma, which appears to have a distinct, moderately sclerotized and pigmented area at its distal margin. The distal portion of the dorsal plate affects a special structure peculiar to this species. The parameres can also be used to separate this species.

GERRIS RUFOSCUTELLATUS Latreille 1807

(Figs. 44, 45, 46, 47, 48, 116)

Male Genitalia

Pygophore and suranal plate as in figs. 47, 48.

Basal plate lightly sclerotized with a triangular shape at distal portion and extended in two lateral wings. Apex forming an acute angle. Basal margin with a broad V-shape.

Parameres, broad, rectangular.

Phallotheca, heavily sclerotized, dorsal portion

entire. Apical margin forming almost a broken line. Sclerotized portion on venter, narrow. Basal margin looks more or less like notabilis.

Endosoma: basal segment of endosoma lightly sclerotized, broad, very flexible, heavily punctured. Sclerotized area present, enlarged in the middle, tapered at both ends.

Apical segment of endosoma: dorsal portion heavily sclerotized, forming a band enclosing only the middle portion of the dorsal plate. Produced distally into a very short truncate sclerotized region. Dorsal plate long and slender, apical portion hidden by the heavy pigmentation of the apical region. Lateral plate conspicuously twisted in the middle to form ventrally an enlarged area. Ventrally this segment is membranous.

Plesiotype: Fairbanks, Alaska. May 14, 1948. R. I. Sailer, Fairbanks Ins. Project.

The above description was based on a macropterous specimen. The male genitalia of this species is closely related to that of G. dissortis Drake and Harris and G. notabilis Drake and Hottes, but could be easily distinguished from these species by its rectangular suranal plate. The shape of the basal plate, the parameres, the phallotheca, and the distinct, heavily sclerotized band found on the dorsal region of the apical segment of the endosoma.

GERRIS DISSORTIS Drake and Harris 1925

(Figs. 49, 50, 51, 52, 117)

Male Genitalia

Pygophore and suranal plate as in Figs. 51, 52.

Basal plate moderately sclerotized except for two small regions on the lateral wing and for the apical median line. Laterally the basal plate is extended into two slender wings.

Parameres, very short and stubby, heavily sclerotized near the base and moderately sclerotized at the apex.

Phallotheca, heavily sclerotized in the middle but only moderately so on both ends.

Endosoma: basal segment of endosoma, membranous, heavily punctured dorsally. Sclerotized area slender and flexible.

Apical segment of endosoma: dorsal surface with a limited sclerotized area. Sclerotization is very heavy at the apex, reduces progressively in intensity towards the base. Not too much produced apically but truncate. Dorsal plate heavily sclerotized, reaching apex of apical segment of endosoma, then bends sharply to end in a modified structure ventrally. Lateral plates slender and also heavily sclerotized and pigmented. Ventral surface entirely membranous.

Plesiotype: Kazubazu, Quebec, Canada. July 22, 1927. G. S. Walley.

The above description was based on a macropterous specimen. The specimen examined in this study is a paratype and comes from the collection of Dr. Drake, who described it. The specimens found in the United States have been long confused with G. rufoscutellatus Latreille. Drake and Harris (7, p. 188) in a review of this group isolated it as a distinct species.

Even the male genitalia of G. dissortis looks very similar to that of the rufoscutellatus; it can be easily separated from the latter on the basis of the suranal plate, which is more angulate apically. The small sclerites which form a bridge on the anterior dorsal portion of the pygophore seem to meet medially. The apical region of the basal plate is angulate. The sclerotized region situated dorsally on the apical region of the endosoma does not form a distinct band as in rufoscutellatus, but extends laterally on a larger area. Also the plates found in the apical portion of the endosoma have a distinct feature.

GERRIS CANALICULATUS Say 1832

(Figs. 53, 54, 55, 56, 57, 58, 118)

Male Genitalia

Pygophore and suranal plate as in figs. 57, 58.

Basal plate, moderately sclerotized and pigmented except for two small portions on the lateral wings and the apex of the distal angle.

Parameres, moderately sclerotized, affecting a horn-shape.

Phallotheca, forming an almost completely sclerotized ring. Broad basally, it narrows a little on the distal portion.

Endosoma: basal segment of endosoma slender and smooth; lightly sclerotized and pigmented sclerite on the dorsal region and distally.

Distal segment of endosoma entirely membranous with only a faint pigmentation which distinguishes it from the basal segment. Apically it assumes a rounded shape. Dorsal plate, long and slender, heavily sclerotized, fulcate basally, apically it bends sharply to form a broad V-shape structure. Lateral plate broad on the basal region at three-fourths of its length from its basal end it is twisted to form ventrally an enlarged structure situated below the modified structure of the dorsal plate but not in contact with it. Ventral region of distal segment

completely membranous.

Plesiotype: Friendship, New Jersey. August 26, 1951. John D. Lattin.

The above description was based on a macropterous form. Another macropterous form from Ohio was also studied in the course of this investigation. This species, in contrast to the other species found in the subgenus Limnoporus is very small; consequently the male genitalia is very small too. On the basis of size the species is closely related to the species of the subgenus Gerris, but on the morphological basis, that is: the concave condition of the distal margin of the seventh venter, the connexival spines extending beyond the apex of the abdomen, the presence of small sclerites on the dorsodistal region of the basal segment of the endosoma, and the membranous ventral plate, it was found to be more closely related to the subgenus Limnoporus to which it belongs.

This species can be easily separated from the other species of the same genus, primarily on the basis of size. The particular shape of the pygophore and the suranal plate, the cone-shaped parameres, the completely sclerotized phallotheca, and the more or less complete membranous apical segment of endosoma. As it can be seen, this species possesses a special set of characteristics which make of it a unique member of this group.

SUBGENUS GERRIS FABRICIUS 1794

The following species of the subgenus Gerris Fabricius 1794 have been considered in the present study: G. gillettei Lethierry and Severin, G. pingreensis Drake and Hottes, G. incognitus Drake and Hottes, G. alacris Hussey, G. insperatus Drake and Hottes, G. buenoi Kirkaldy, G. incurvatus Drake and Hottes, G. comatus Drake and Hottes, G. marginatus Say, and G. argenticollis Parshley. Some of these species are widely distributed throughout the Americas, while others are found restricted to a particular area.

Distal margin of seventh abdominal segment doubly emarginate and affecting a different shape depending on the species considered. Connexival spines not strongly produced into a distinct structure; if so it is very short. Eighth abdominal segment varying in size and shape, elongated or very short. Dorsal surface almost completely hides the ninth dorsal segment. Venter, shorter, leaving part of the ventral side of the pygophore exposed, either forming a keel or merely rounded.

Male Genitalia

Pygophore very small; varies greatly in shape with the species considered, forming posteriorly and ventrally a bulb-like structure. Suranal plate slightly extending beyond the apex the pygophore, sometimes greatly extending beyond this part. Apically it forms more or less an angle. Basally, it can present some lateral processes. Basal margin can be either straight or rounded, split in the middle or protruding exteriorly.

Basal plate, not heavily sclerotized.

Parameres, greatly reduced.

Phallotheca: ventral region of phallotheca heavily schlerotized. Dorsal region completely membranous except in Gerris buenoi, where a small sclerite is present medially and basally.

Endosoma: basal segment of endosoma completely membranous, smooth. No sclerotized area is present at the distal end of its dorsal region.

Apical segment of endosoma distinctly divided in two parts. Dorsal region assuming the shape of a boat or a box enclosing the dorsal plate and the lateral plates. It can be either slightly sclerotized or completely membranous. Ventral region is in contact basally with the dorsal region and the basal segment of endosoma. It forms a lobe when inflated and encloses the ventral plate,

always well sclerotized apically. The segment of endosoma never produced apically into a sclerotized area.

The relationships of these species are based particularly on the phallotheca, which consists of a sclerotized ventral region and a membranous dorsal region and the ventral plate, which is sclerotized. Throughout the members of this group there is a tendency for the ventral plate to develop from a short structure to an elongate structure. Later on this ventral plate has been divided into two branches. If we consider the subgenus Aquarius on the basis of the male genitalia, as the most primitive group; the subgenus Gerris appears to be the more advanced with the subgenus Limnoporus as the link between the two groups.

The facts seem to support this statement. First of all the change from a well sclerotized phallotheca to a structure partly membranous, partly sclerotized evolved in order to fit the apical portion of the phallus it encloses when at rest, then followed a gradual development of the ventral plate from a minute sclerite attached to the basal end of the dorsal plate to a well developed and sclerotized structure. The last step appears to be the gradual reduction of the dorso-apical prolongation of the apical segment of the endosoma and later on its complete reduction involving the desclerotization of the segment.

Another significant factor is the reduction in size

of the sclerite found in the dorso-apical region of the basal segment of the endosoma followed by its reduction. The elimination of this structure that appears to play a great role in the retraction of the endosoma into the phallotheca involves the development of a more specialized structure, which facilitates the telescoping of the apical segment into the phallotheca.

GERRIS PINGREENSIS Drake and Hottes 1925

(Figs. 19, 60, 61, 62, 63, 119)

Male Genitalia

Pygophore and suranal plate as in Figs. 62, 63.

Basal plate, not assuming a triangular shape.

Parameres, slender, with a projection directed medially at its point of articulation with the basal plate.

Phallotheca, strongly produced at dorso-apical margin, more heavily pigmented apically than basally.

Endosoma: basal segment of endosoma elongate, smooth, entirely membranous. A moderately pigmented region is found dorsally on apical segment of endosoma. It is distinct and extends laterally in a peculiar fashion. Dorsal plate apically curved and forming a large plate. Lateral plate not reaching apex of segment, large apically and slender basally. Ventral plate short, heavily sclerotized, pigmented, and twisted slightly to give it an irregular shape.

Plesiotype: Deep Springs, Inyo County, California. July 15, 1953. John D. Lattin.

The above description was based on a macropterous specimen. Three more macropterous forms from the same place were also examined. They were all identified by the collector. The special shape of the basal plate facilitates the separation of the species G. pingreensis Drake and Hottes from G. gillettei Lethierry and Severin; also the parameres are different. The enlarged apical region of the dorsal segment, the shape of the lateral plate, and the twisted ventral plates together with the above cited structures form the characteristic features of this species.

GERRIS GILLETTEI Lethierry and Severin 1896

(Figs. 64, 65, 66, 67, 68, 120)

Male genitalia

Pygophore and suranal plate as in Figs. 67, 68.

Basal plate, triangular in shape, with more or less rounded angles.

Parameres, rounded apically with a lateral projection basally for articulation with basal plate.

Phallotheca, distinctly pointed at apex on ventral region.

Endosoma, basal segment of endosoma membranous, smooth and short.

Apical segment of endosoma highly sclerotized dorsally and pointed at the apex. Dorsal plate well sclerotized basally, partly sclerotized apically, simple, not reaching apex of the segment. It is curved distally and forms a short process. Lateral plates irregular in shape, almost reaching distal end of dorsal plate, enlarging progressively until reaching the apex. Ventral plate short, not branched, well sclerotized, affecting progressively a more or less regular shape except at apex where there is an irregular scleriotized margin.

Plesiotype: Dolores, Colorado. August 15, 1925. C. J. Drake.

The above description was based on one apterous form. The species was collected by Dr. C. J. Drake and was borrowed from his personal collection. The male genitalia of this species shows some similarities with that of G. pingreensis Drake and Hottes, but can be distinguished from this one on the basis of the shape of the basal plate and the parameres. It shows some distinct characteristic features in the plates found in the apical segment of endosoma. Dorsal plate is produced apically into a short process. Ventral plate is simple, not twisted. Externally it can be easily separated on the basis of the "conspicuous silvery spots on the outer angle of the connexival segments" mentioned by Drake and Harris (7, p. 195).

GERRIS INCOGNITUS Drake and Hottes 1925

(Figs. 69, 70, 71, 72, 73, 74, 121)

Male Genitalia

Pygophore and suranal plates like in Figs. 73, 74.

Basal plate, not forming a complete triangle. Apically it is more square than angulate. Laterally and near the base there are two small projections, one on each side, for articulation with the parameres.

Parameres, with basal region well pigmented and sclerotized and apical half not pigmented, transparent.

Phallotheca, ventral sclerotized region small, rather stout.

Endosoma: basal segment of endosoma long, slender.

Apical segment of endosoma with dorsal region faintly pigmented basally; remainder of the segment completely membranous; more or less rectangular. Dorsal plate simple; curves distally to form a short process. Lateral plates simple, not reaching apex of dorsal plate. Ventral plates forming a unique structure, elongate, well sclerotized and pigmented basally, but not so at distal end, more or less irregular in shape.

Plesiotype: 3.5 miles N.E. Summit, Benton County, Oregon. 700 feet. March 5, 1959. John D. Lattin.

The above description was based on a macropterous form. Five more specimens from the same place, including three apterous forms were also examined. They did not

seem to show any difference between the two forms. This species was the only one of all the species studied in this subgenus to exhibit this elongate unbranched ventral plate. It forms a distinct species exhibiting no relationship with the other species except for the characters of the subgenus. The shape of its basal plate, the shape and morphological constitution of its parameres, the rectangular shape of the apical segment of the endosoma, and the elongate sclerotized ventral shape are among the characters that distinguish it from other species.

GERRIS ALACRIS Hussey 1921

(Figs. 75, 76, 77, 78, 79, 122)

Male Genitalia

Pygophore and suranal plate as in Figs. 78, 79.

Basal plate, small, triangular in shape, heavily sclerotized. Pigmented.

Parameres, forming a stout body apically, slender basally.

Phallotheca, with a small cleft apically and on both sides of the ventral sclerotized region. Lateral margin of this area broadly convex.

Endosoma: basal segment of endosoma not very long, membranous. Apical segment of endosoma, basally and on the dorsal region with a moderately pigmented and sclerotized area forming a shield-like structure enclosing

basal portion of dorsal plate. Dorsal plate, broad in the middle, apical section appearing to fuse with apical end of dorsal plate to form a highly modified structure. Basal portion of this plate very slender and furcate. Ventral plate divided into two branches, very long and slender with base articulating with furcate region of dorsal plate.

Plesiotype: Manfield, Connecticut. June 25, 1959. D. E. Leonard.

The above description was based on a macropterous specimen. One more macropterous form from the same region was also examined. With this species there is a partial fusion of the dorsal plate to the ventral plates at their apical regions. This species can be readily distinguished from other members of the same subgenus on the basis of the stout pygophore and suranal plate, the shape of the basal plate and of the parameres, the broadly concave lateral margin of phallotheca's sclerotized portion. It exhibits some strong similarities with G. insperatus Drake and Hottes, but they are readily separated on the basis of the characteristics mentioned above.

GERRIS INSPERATUS Drake and Hottes 1925

(Figs. 80, 81, 82, 83, 84, 123)

Male Genitalia

Pygophore and suranal plate as in Figs. 83, 84.

Basal plate, not angular at the apex; on both sides there are two small projections for the articulation of the paramere.

Parameres, forming a more or less compact structure.

Phallotheca, heavily sclerotized and pigmented on ventral portion with apical margin forming a more or less straight line. Lateral margins limiting the ventral sclerotized portion of the phallotheca from the dorsal membranous portion, also forming a line more or less straight. Two small clefts are present laterally on apical margin of sclerotized region.

Endosoma: basal segment of endosoma membranous area form a very flexible portion.

Apical segment of endosoma, with a moderately sclerotized and pigmented area at the base and dorsally forming a shield-like structure as in the alacris. Dorsal plate forming a very strong process distally with the apical ends of the lateral sclerites. Basal portion is very elongated. Lateral plates form a broad structure on the side; ventral plate heavily sclerotized and slender.

Plesiotype: Storrs, Connecticut. May 18, 1955. R. Nudak.

The above description was based on a macropterous form. Three more macropterous specimens from the same region were dissected and examined. This species resembles G. alacris on the basis of the strong similarities of the pygophore and suranal plate and also the shape of the plates found in the apical segment of endosoma, but it can be easily distinguished from alacris on the basis of the shape of the basal plates and the parameres; also by the straight lateral margin of the ventral sclerotized region of the phallotheca.

GERRIS BUENOI Kirkaldy 1911

(Figs. 85, 86, 87, 88, 89, 124)

Male Genitalia

Pygophore and suranal plate as in Figs. 88, 89.

Basal plate, more or less rectangular, pointed at the apex and laterally exhibiting two small projections for articulation with parameres.

Parameres, reduced, angulate at apex forming a small process basally where they articulate with basal plate.

Phallotheca, with ventral sclerotized region strongly produced apically and broad basally. Membranous area with a small sclerite basally on dorsal region forming a bridge between the lateral margins of sclerotized region, but not fused to them.

Endosoma: basal segment of endosoma short, membranous, and smooth.

Apical segment of endosoma ventrally boat-shaped, dorsally moderately sclerotized and pigmented, distally pointed. Lateral plates slender, reduced in size. Dorsal plates greatly modified apically, with a well sclerotized region forming a spoon-like structure; basally it is furcate, articulating with the branched ventral plate. Ventral plate, not very long, barely reaching apex of apical segment.

Plesiotype: Cheboygan County, Michigan. May 18, 1955. John D. Lattin.

The above description was based on a macropterous form from Michigan. Other macropterous forms from Michigan and Oregon were dissected. It exhibits some distinct morphological features which separate it from the rest of the group. The basal plate, instead of being triangular, is more or less rectangular and on this basis is related to Gerris pingreensis. The very short lateral plate is not common here, and other structures make for a fairly distinct species.

GERRIS INCURVATUS Drake and Hottes 1925

(Figs. 90, 91, 92, 93, 94, 125)

Male Genitalia

Pygophore and suranal plate as in Figs. 93, 94.

Basal plate, more or less rounded at the apex. Not heavily sclerotized in the middle portion, but heavily sclerotized and pigmented at both lateral extremities, not produced on the sides.

Parameres, extremely reduced, rounded at the apex and having an angular shape at the base, where it articulates with the basal plate.

Phallotheca, with ventral margin broadly rounded. Lateral line of sclerotized portion of phallotheca convex, forming an oval-shaped structure, with the ventral line. No clefts are formed here on apical ventral margin.

Endosoma: basal segment of endosoma short and broadly membranous.

Apical segment of endosoma, with the shield formed on the basal portion of the dorsal part, highly sclerotized and pigmented. Dorsal plate forming by its fusion with the distal ends of the lateral plate a modified structure not heavily sclerotized and pigmented, and square-shaped. Basal end elongate and heavily sclerotized and pigmented. Lateral plates not very long, with an enlarged basal end. Ventral plate divided into two long

and slender branches. The whole structure is heavily sclerotized and pigmented. At the junction of the two branches there is a small evagination medially.

Plesiotype: Nr. Bijou, Lake Tahoe, California. July 19, 1929. R. L. Usinger.

The above description was based on a macropterous form. Six other species from Oregon and California, including five macropterous forms were examined. No differences between the two forms were noted. This species appears to be closely related to G. comatus Drake and Hottes, G. marginatus Say on the basis of the general appearance of the male genitalia, but some special morphological structures distinguish it easily from the two mentioned species.

The antero-dorsal bridge formed by the two sclerites forms a simple structure; the sclerites appear to be firmly attached to the lateral margin of the pygophore. The suranal plate exhibits two small lateral processes basally. The parameres have a distinct shape. There is a small, moderately sclerotized shield-like structure at the base of the dorsal region of the apical segment of the endosoma. This structure, even greatly modified, is present in most of the species of the subgenus Gerris, and it appears to aid in the retraction of the segment into the phallotheca after copulation. The lateral plates are

comparatively short and enlarged basally. The junction of the apical ends with the distal portion of the dorsal plate forms a structure that differs with the species comatus and marginatus.

GERRIS COMATUS Drake and Hottes 1925

(Figs. 95, 96, 97, 98, 99, 126)

Male Genitalia

Pygophore and suranal plate as in Figs. 98, 99.

Basal plate, more or less triangular in shape with a rounded apex. No lateral projection for articulation or parameres; small region on the median line moderately sclerotized and pigmented; the rest is heavily sclerotized and pigmented.

Parameres, elongate, rounded at the apex and pointed at the base, basal portion not very uniform.

Phallotheca: dorsal line moderately convex. Lateral lines limiting the sclerotized portion of the phallotheca, forming a more or less straight line apically, but suddenly curved at the basal portion to join the articulation.

Endosoma: basal segment of endosoma membranous, not very short.

Apical segment of endosoma with a distinct area on the dorsal portion enclosing the middle region of the

dorsal plate; remainder of segment entirely membranous. Dorsal plate, with apical portion joined to apex of lateral plates. A half-sclerotized structure is formed at the junction point, but differs in shape with the one found in the other species. Lateral plate twisted and slender in middle portion, but enlarged at the base.

Endosoma, as in figure 96.

Plesiotype: Hamden, Connecticut. May 28, 1911. B. W. Walden.

The above description was based on a macropterous form. Three other macropterous forms from Nebraska, Connecticut, and Ohio were dissected and studied. They exhibit some close affinities with G. incurvatus and G. marginatus. The characters that can distinguish it from the other two species are: the shape of the suranal plate, the parameres, and the structures found in the endosoma.

GERRIS MARGINATUS Say 1832

(Figs. 100, 101, 102, 103, 104, 127)

Male Genitalia

Pygophore and suranal plate as in Figs. 103, 104.

Basal plate, more or less triangular in shape, produced laterally and near the basal portion into a small process for articulation with the parameres. Moderately sclerotized and pigmented except basally and apical margin.

Parameres, greatly reduced in size, stout.

Phallotheca: dorsal margin strongly convex. Lateral margins limiting sclerotized portion of phallotheca irregular. Dorsal region not strongly sclerotized, produced apically into a moderately sclerotized and pigmented area.

Endosoma: basal segment of endosoma short and smooth. Apical segment of endosoma with its limited area on the dorsal region very lightly sclerotized and pigmented, almost inconspicuous. Dorsal plate with its apical region touching the distal end of the lateral plates, but not appearing to fuse with it. Apically it is modified into a moderately sclerotized structure. Basally it is strongly sclerotized. Lateral plate with its main body slender distally and sickle-shaped basally, heavily sclerotized. Dorsally it is extended into a moderately sclerotized portion. Ventral plate short and slender, divided into two branches.

Plesiotype: New Haven, Connecticut. June 14, 1941. B. H. Walden.

The above description is based on a macropterous form. Five other macropterous forms from the same locality were examined during the course of this investigation. Drake and Harris (7, p. 191) in their last review of this species noted that "The literature pertaining to this

species is much involved, for until quite recently incognitus, comatus, incurvatus, alacris, pingreensis, inperatus, and perhaps one or two other distinct forms have been confused in collections, and included in scientific papers under the name marginatus." On the basis of the male genitalia this species was found to be closer to incurvatus and comatus than to any other species. As a distinct species it can be recognized on the basis of the long projections found laterally at the base of suranal plate; also a close observation of the plates found in the apical segment of endosoma reveals very distinct structures.

GERRIS ARGENTICOLLIS Parshley 1916

(Figs. 105, 106, 107, 108, 109, 128)

Male Genitalia

Pygophore and suranal plate as in Figs. 108, 109.

Basal plate, small, rounded at apex and more or less rectangular basally. No projections are present laterally for attachment of parameres.

Parameres, very much reduced, elongate at both ends but rounded apically.

Phallotheca, with sclerotized portion entire, dorsally more or less convex, not produced apically, but rounded, well developed laterally.

Endosoma: basal segment of endosoma, short, membranous.

Apical segment of endosoma not completely membranous but moderately sclerotized dorsally and exhibiting a faint pigmentation, more or less rectangular in appearance. Dorsal plate simple, not modified apically. Lateral plates almost reaching apex of dorsal plate, modified dorso-apically to form a moderately sclerotized area and a well sclerotized whip-like structure projected dorso-caudally. Ventral plate well split into two branches extending slightly beyond apex of apical segment of endosoma.

Plesiotype: Hampton, Connecticut. June 14, 1955. K. C. Stevens.

The above description was based on a macropterous form. This species can be easily distinguished on the basis of the shape and size of the pygophore and the suranal plate. The portion of the genitalia that appears to be of great taxonomic significance in this group is the modification of the apical region of the lateral plates. The conspicuous whip-like structure that they exhibit dorso-apically is the key characteristic of the male genitalia of this species.

CONCLUSIONS

The male genitalia of the Gerridae consists of the ninth abdominal segment, the phallus and the parameres.

Ventrally, the ninth abdominal segment presents a structure specially modified into a cup-like structure. This cup is interiorly divided into two chambers: the proximal chamber containing the posterior structures of the reproductive organ and the distal chamber, the male phallus when at rest. Dorsally, the tergum is modified into the suranal plate, which covers and protects the phallus exteriorly. It bears ventrally and on the distal portion the tenth sternum and remnants of the eleventh segment.

The phallus is a very simple structure formed proximad by the basal plate, which normally lies within the genital chamber and partly encloses the retracted phallus when at rest. During copulation it supports the apical portion of the phallus and directs its movement. Articulating with the phallus is the phallotheca, which encloses the endosoma when not expanded and inflated, or supports it basally when the insect is copulating. The last structure associated with the phallus is the endosoma, which is made up of two regions: basally a normally membranous region called basal segment of endosoma and the apical part, variable in morphology and constitution, termed

apical segment of endosoma. It presents some modifications which can be of considerable taxonomic value and forms a box-like structure enclosing the dorsal, lateral plates and ventral plates.

As a whole all these structures were highly significant in separating the species of the genus Gerris, examined during the course of this investigation. Particularly, the basal plate, the parameres, the apical segment of the endosoma and its modifications appeared to be relatively variable between the different species and stable within the species. The pygophore and the suranal plate can be used to some extent in a primary classification of the group studied, and the phallotheca is more variable between the subgenera than between the species. The present study clearly shows that the male genitalia can be used in classifying species both at the subgeneric and specific level. Further investigations of other genera of the family Gerridae should produce similar results.

SUMMARY

The present study was an attempt to classify nineteen of the species of Gerris found in the North American fauna on the basis of the morphological structures of the male genitalia. By using these structures, it was clearly possible to distinguish these subgenera: Aquarius Schellenberg, Limnoporus Stal, and Gerris Fabricius. The distal margin and the connexival spines of the seventh segment, the shape and size of the pygophore, the complete or partial sclerotization of the phallotheca, the presence or absence of the sclerite on the dorso-distal margin of the basal segment of the endosoma, the sclerotized condition of the apical segment of the endosoma, the presence or absence of the sclerotized ventral plate, and the shape of the apical sclerotized part of endosoma, where the more apparent morphological characteristics are present, are used to separate these subgenera. They were found to be highly stable except for some slight differences between the different species.

All of the characteristics of the male genitalia were used to separate the species. Some of them appeared, to some extent, to be highly variable between the different species, such as the shape and size of the pygophore, the basal plate, the parameres, the morphological constitution of the apical segment of endosoma and the

sclerotized plate found in this structure. These characteristics were specially valuable in separating closely related species. As illustrated in figures 9, 16, and 22, the male genitalia of the G. nyctalis Drake and Hottes, G. species a, and G. remigis Say appeared to be very similar, only a few structures being different enough to separate them. On the basis of the external morphological structure, it is almost completely impossible to separate them at the present time. The collecting places of the specimens studied showed a particular distribution for these three species. It seems that these are three subspecies and that further investigation, based on the morphology and distribution in the North American region, needs to be done.

In the subgenus Limnoporus Stal other species were found to be closely related, G. nebularis Drake and Hottes and G. conformis Uhler. On the basis of the external characters Drake and Harris (7, p. 185) mentioned that they were recognizable by the first antennal segment, larger in G. conformis Uhler and the conexival spines. The species G. notabilis Drake and Hottes, G. rufoscutellatus Latreille, and G. dissortis Drake and Harris showed a strong resemblance in the general appearance of their male genitalia, but the basal plate (Figs. 41, 46, 50), the parameres (Figs. 114, 115, 116), the shape of the apical

segment of the endosoma and the plates associated with it (Figs. 39, 40, 44, 49, 50) are particularly useful in classifying them. The species G. canaliculatus Say, because of its small size, was completely different from other members of the same subgenus, but presented the general characteristics of the subgenus Limnoporus Stal and was included in it. It was easy to distinguish it on the basis of the small size, the particular shape of its genital capsule (Figs. 57, 58), and the shape of its parameres (Fig. 118).

In the subgenus Gerris Fabricius, the species G. pingreensis Drake and Hottes, and G. gilletei Lethiery and Severin are closely related on the basis of the general appearance of the phallus (Figs. 60, 65), but detailed studies of this structure showed good differences between the two. The species G. incognitus Drake and Hottes was the only one among the species examined in this subgenus to present the elongate, well sclerotized ventral plate (Figs. 69, 71), and on the basis of this structure it could easily be distinguished from the rest of the group. The species G. alacris Hussey and G. insperatus Drake and Hottes, on the basis of the phallotheca particularly (Figs. 76, 81), presented strong similarities, but the shape of this structure was different. The species G. buenoi Kirkaldy had almost rectangular parameres (Fig. 87)

not common in this subgenus, where this structure affects a triangular shape. On the dorsal region of the phallotheca and basally a small sclerite could be seen, a unique feature in this subgenus, where this part normally is completely membranous. The small lateral plates and the particular shape of the apical region of the dorsal plate with the other structures already cited made of this species an isolated member of the group. Three other species in this group showed strong relationships between them on the basis of the phallic organs. These are G. incurvatus Drake and Hottes, G. comatus Drake and Hottes, and G. marginatus Say. However, after full investigation these structures revealed to be different, as illustrated by the parameres (Figs. 125, 126, 127) and other structures examined. The last species examined in this group was G. argenticollis Parshley. The shape of its genital capsule (Figs. 108, 109), the modifications of the apical region of the lateral plates made it a distinct species in this group. On the basis of the male genitalia, it was not found to be related to G. buenoi Kirkaldy, as stated by Drake and Harris (7, p. 196). However, for all the other species studied, the relationships observed between them, on the basis of the male genitalia, agreed with the relationships suggested by Drake and Harris (7) on the basis of the external morphology.

Beside the differences and relationships observed between the species examined, it was also noted during the course of these investigations a more or less gradual modification of some of the structures of the male genitalia. The most striking changes observed were: the desclerotization of the dorsal region of the phallotheca, disappearance of the sclerite of the dorso-apical region of the basal segment of endosoma, the gradual sclerotization of the ventral plate, and the gradual reduction of the apical sclerotized part of endosoma to its ending in complete disappearance.

The male genitalia as a whole was used to separate the species examined. Its structures also were found to have good evolutionary characteristics. With a complete study based on all the species of the genus Gerris found in the North American fauna and with a complete knowledge of their distribution, it seems possible to trace the evolutionary development that has taken place within this group.

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PLATE 1

Fig. 1. Lateral view of 9th abdominal segment showing the protracted phallus extending outside of the pygophore. Gerris nyctalis Drake and Hottes.

Fig. 2. Lateral view of protracted phallus separated from pygophore. Gerris nyctalis Drake and Hottes.

Fig. 3. Dextro-lateral view of right clasper. Gerris nyctalis Drake and Hottes.

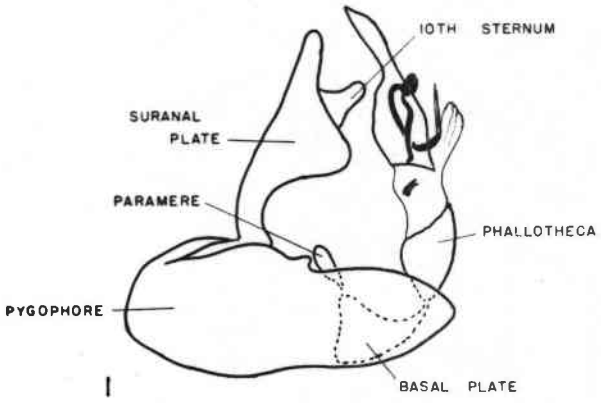
Fig. 4. Lateral view of tip of abdomen with genital segments 8 and 9 retracted into normal position. Gerris nyctalis Drake and Hottes.

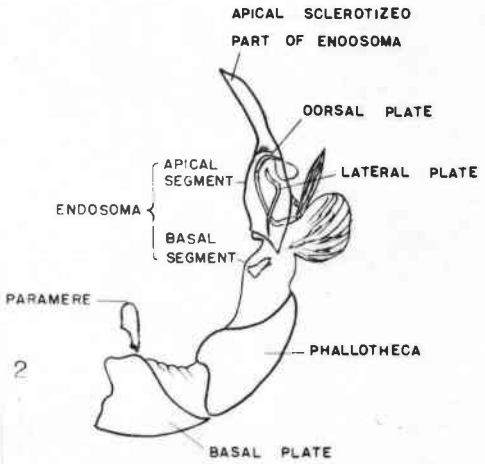
Fig. 5. Lateral view of 9th abdominal segment showing non-expanded male genitalia with endosoma retracted inside of the phallotheca. Gerris nyctalis Drake and Hottes.

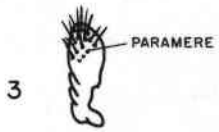
Fig. 6. Lateral view of tip of abdomen with genital segments pulled out. Gerris nyctalis Drake and Hottes.

Fig. 7. Parasagital section of tip of abdomen showing the phallus inside the pygophore. Gerris nyctalis Drake and Hottes.

PLATE I


10TH STERNUM
SURANAL PLATE
PARAMERE
PHALLOTHECA
PYGOPHORE
BASAL PLATE
1


APICAL SCLEROTIZED PART OF ENDOSOMA
DORSAL PLATE
APICAL SEGMENT
LATERAL PLATE
ENDOSOMA
BASAL SEGMENT
PARAMERE
PHALLOTHECA
BASAL PLATE
2


PARAMERE
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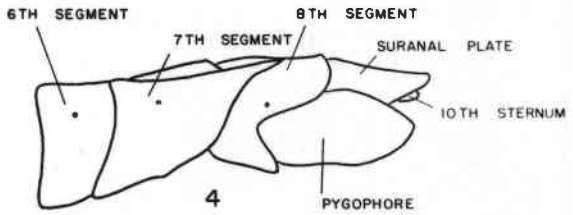
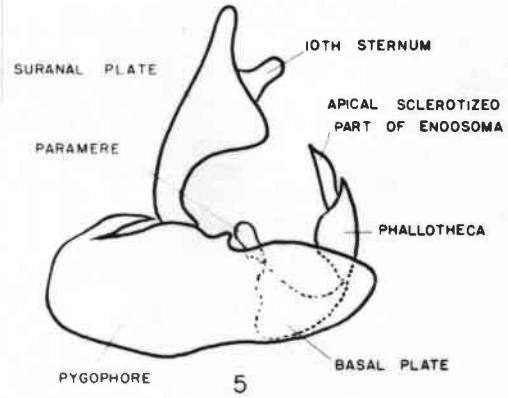

6TH SEGMENT
7TH SEGMENT
8TH SEGMENT
SURANAL PLATE
10TH STERNUM
4
PYGOPHORE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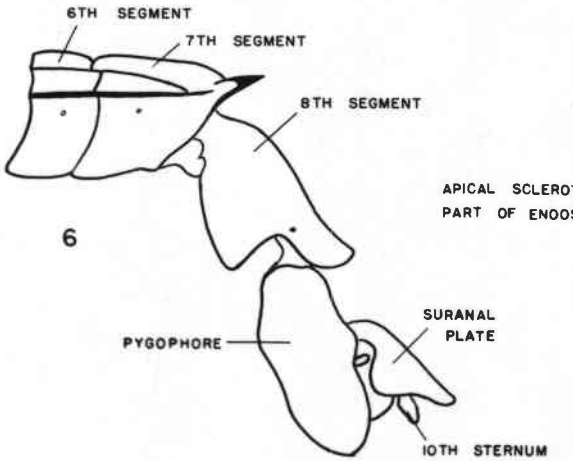
PARAMERE
PHALLOTHECA
BASAL PLATE
PYGOPHORE
5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PYGOPHORE
SURANAL PLATE
10TH STERNUM

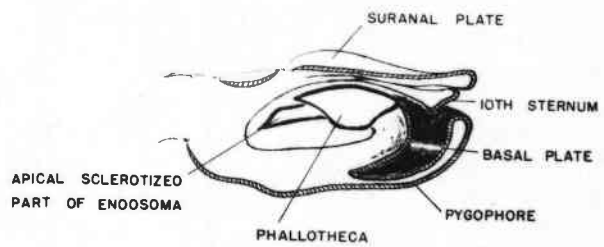

SURANAL PLATE
10TH STERNUM
BASAL PLATE
APICAL SCLEROTIZED PART OF ENDOSOMA
PYGOPHORE
PHALLOTHECA
7

PLATE 2

Fig. 8. Ventral view of basal plate. Gerris nyctalis Drake and Hottes.

Fig. 9. Lateral view of the completely inflated phallus. Gerris nyctalis Drake and Hottes.

Fig. 10. Ventral view of apical segment of endosoma. Gerris nyctalis Drake and Hottes.

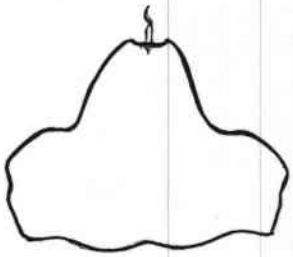
Fig. 11. Dorsal view of apical segment of endosoma. Gerris nyctalis Drake and Hottes.

Fig. 12. Lateral view of apical segment of endosoma when phallus is not inflated. Gerris nyctalis Drake and Hottes.

Fig. 13. Lateral view of ninth abdominal segment. Gerris nyctalis Drake and Hottes.

Fig. 14. Dorsal view of ninth abdominal segment. Gerris nyctalis Drake and Hottes.

PLATE 2



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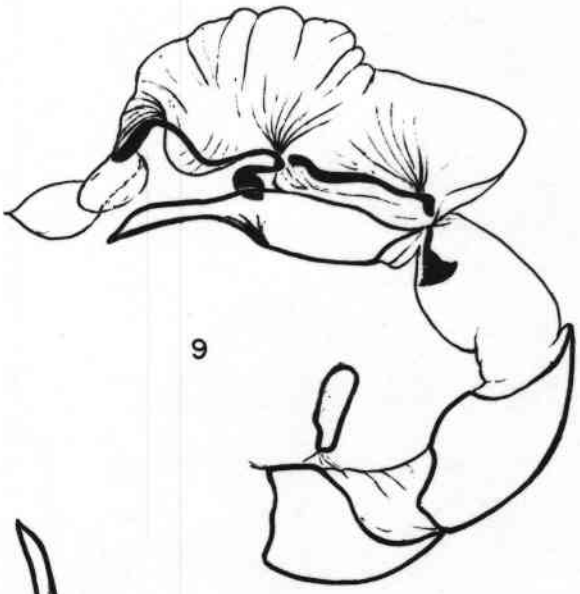

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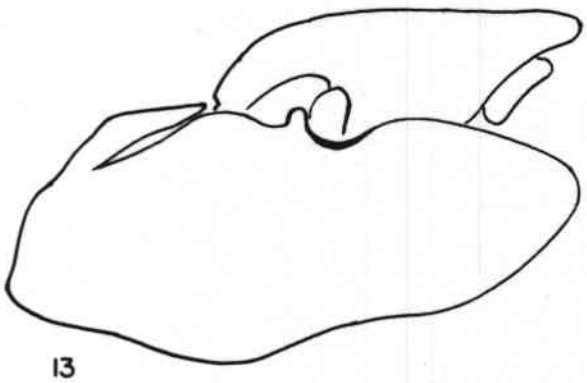

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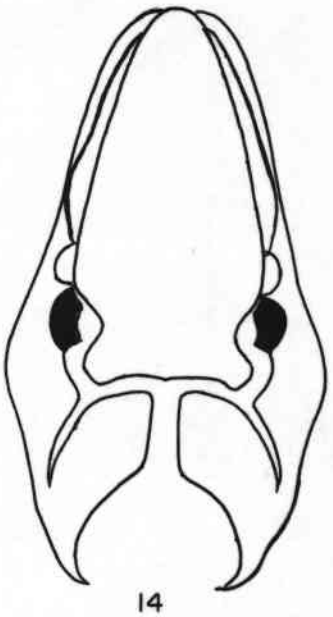

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PLATE 3

Fig. 15. Ventral view of basal plate. *Gerris* species *a*.

Fig. 16. Lateral view of extended phallus. *Gerris* species *a*.

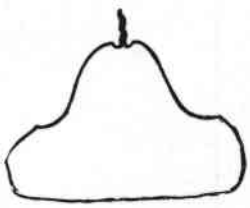
Fig. 17. Ventral view of apical segment of endosoma. *Gerris* species *a*.

Fig. 18. Dorsal view of apical segment of endosoma. *Gerris* species *a*.

Fig. 19. Lateral view of ninth abdominal segment. *Gerris* species *a*.

Fig. 20. Dorsal view of ninth abdominal segment. *Gerris* species *a*.

PLATE 3



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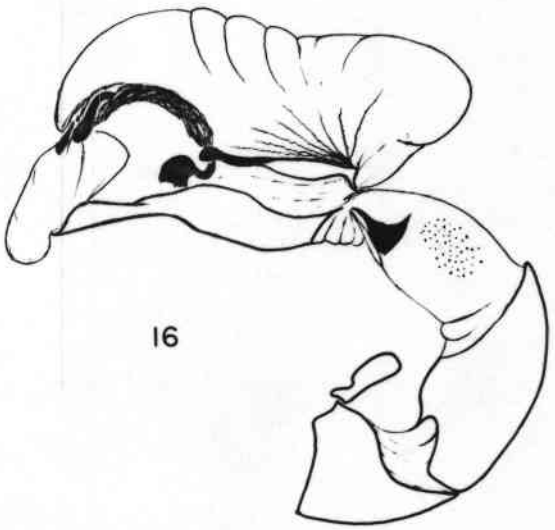

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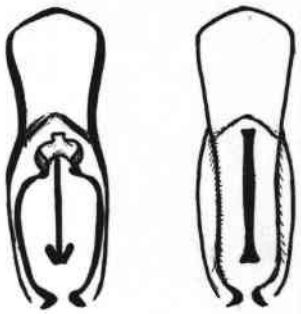

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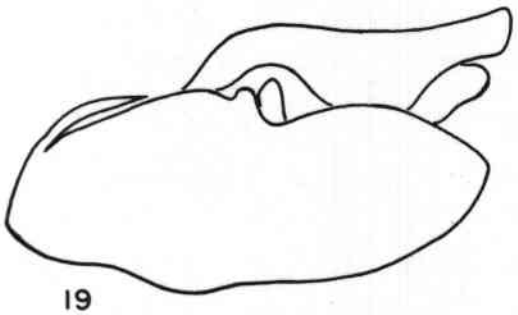

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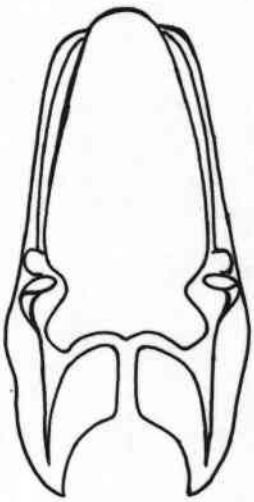

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PLATE 4

Fig. 21. Ventral aspect of basal plate. Gerris remigis Say.

Fig. 22. Lateral view of expanded phallus. Gerris remigis Say.

Fig. 23. Dorsal view of apical segment of endosoma. Gerris remigis Say.

Fig. 24. Ventral view of apical segment of endosoma. Gerris remigis Say.

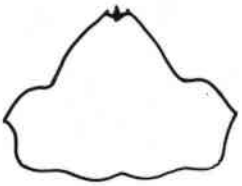
Fig. 25. Ventral view of apical segment of endosoma with a modification of distal margin found in only one specimen. Gerris remigis Say.

Fig. 26. Dorsal view of apical segment of endosoma showing a modification of the distal margin. (Same specimen as figure 25). Gerris remigis Say.

Fig. 27. Lateral view of ninth abdominal segment. Gerris remigis Say.

Fig. 28. Dorsal view of ninth abdominal segment. Gerris remigis Say.

PLATE 4



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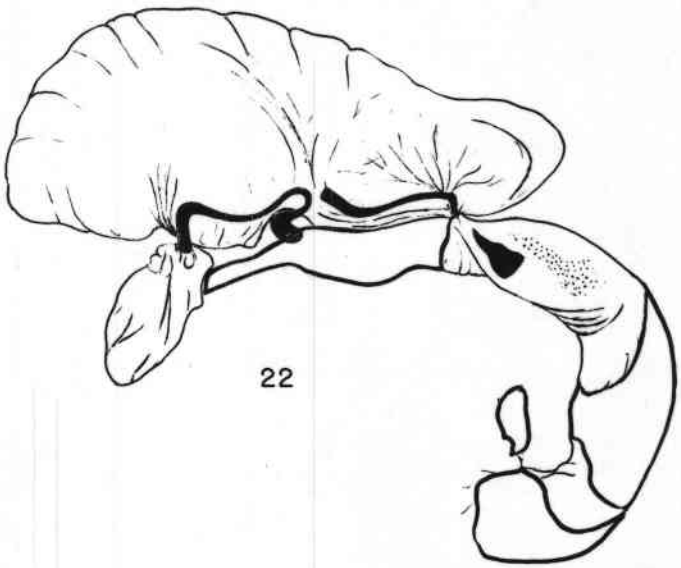

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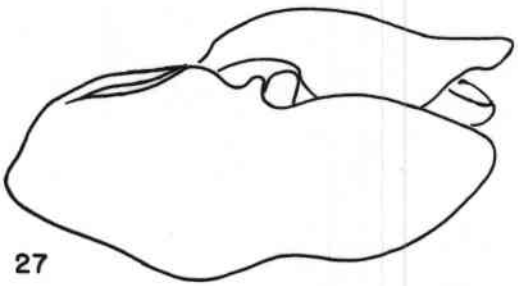

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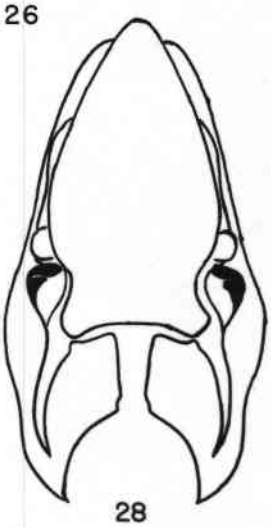

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PLATE 5

Fig. 29. Ventral view of apical segment of endosoma. Gerris nebularis Drake and Hottes.

Fig. 30. Lateral view expanded phallus. Gerris nebularis Drake and Hottes.

Fig. 31. Ventral view of basal plate. Gerris nebularis Drake and Hottes.

Fig. 32. Lateral view of ninth abdominal segment. Gerris nebularis Drake and Hottes.

Fig. 33. Dorsal view of ninth abdominal segment. Gerris nebularis Drake and Hottes.

PLATE 5

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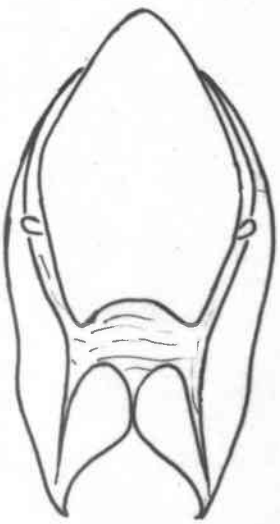

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PLATE 6

Fig. 34. Ventral view of apical segment of endosoma. Gerris conformis (Uhler).

Fig. 35. Lateral view of expanded phallus. Gerris conformis (Uhler).

Fig. 36. Ventral view of basal plate. Gerris conformis (Uhler).

Fig. 37. Lateral view of ninth abdominal segment. Gerris conformis (Uhler).

Fig. 38. Dorsal view of ninth abdominal segment. Gerris conformis (Uhler).

PLATE 6

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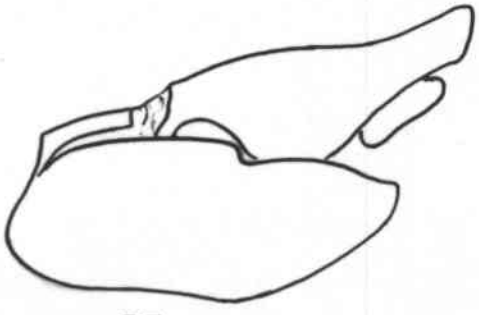

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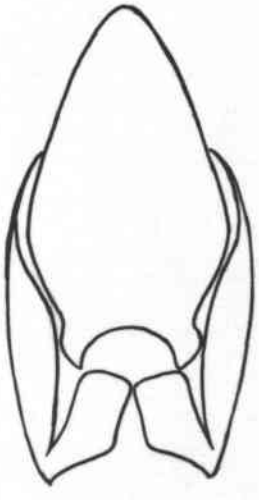

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PLATE 7

Fig. 39. Lateral view of apical segment of endosoma. Gerris notabilis Drake and Hottes.

Fig. 40. Lateral view of expanded phallus. Gerris notabilis Drake and Hottes.

Fig. 41. Ventral view of basal plate. Gerris notabilis Drake and Hottes.

Fig. 42. Lateral view of ninth abdominal segment. Gerris notabilis Drake and Hottes.

Fig. 43. Dorsal view of ninth abdominal segment. Gerris notabilis Drake and Hottes.

PLATE 7

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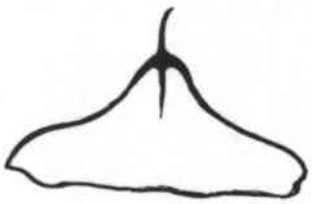

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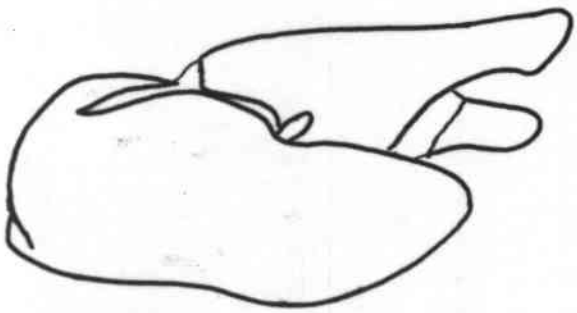

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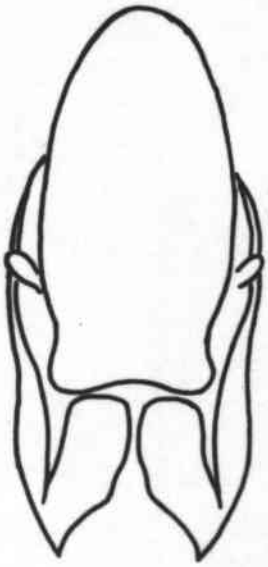

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PLATE 8

Fig. 44. Ventral view of apical segment of endosoma. Gerris rufoscutellatus Say.

Fig. 45. Lateral view of expanded phallus. Gerris rufoscutellatus Say.

Fig. 46. Ventral view of basal plate. Gerris rufoscutellatus Say.

Fig. 47. Lateral view of ninth abdominal segment. Gerris rufoscutellatus Say.

Fig. 48. Dorsal view of ninth abdominal segment. Gerris rufoscutellatus Say.

PLATE 8

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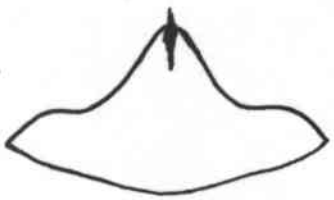

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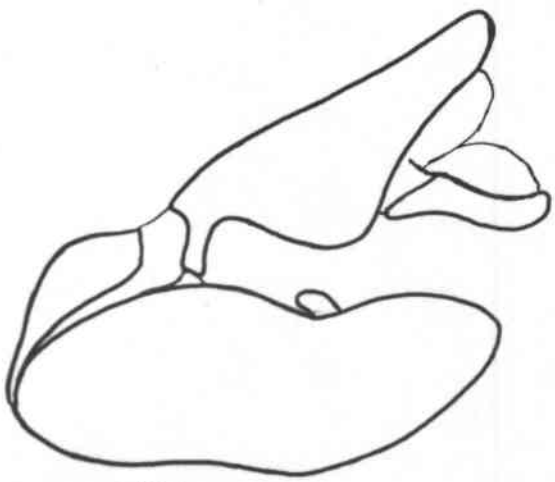

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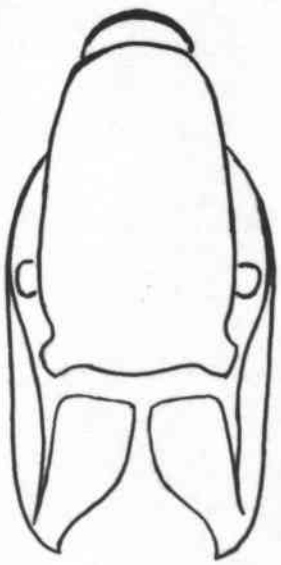

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PLATE 9

Fig. 49. Lateral view of expanded phallus. Gerris dissortis Drake and Hottes.

Fig. 50. Ventral view of basal plate. Gerris dissortis Drake and Hottes.

Fig. 51. Lateral view of ninth abdominal segment. Gerris dissortis Drake and Hottes.

Fig. 52. Dorsal view of ninth abdominal segment. Gerris dissortis Drake and Hottes.

PLATE 9

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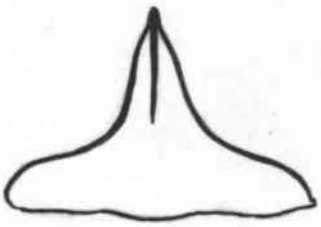

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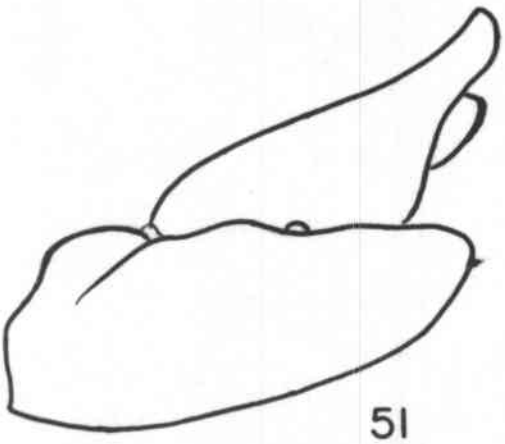

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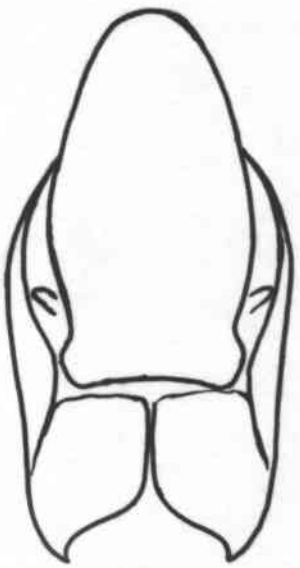

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PLATE 10

Fig. 53. Ventral view of apical segment of endosoma. Gerris canaliculatus Say.

Fig. 54. Lateral view of apical segment of endosoma. Gerris canaliculatus Say.

Fig. 55. Lateral view of expanded phallus. Gerris canaliculatus Say.

Fig. 56. Ventral view of basal plate. Gerris canaliculatus Say.

Fig. 57. Lateral view of ninth abdominal segment. Gerris canaliculatus Say.

Fig. 58. Dorsal view of ninth abdominal segment. Gerris canaliculatus Say.

PLATE 10

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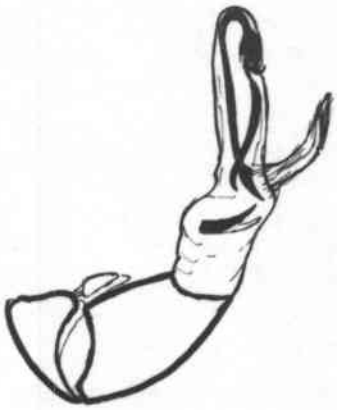

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PLATE 11

Fig. 59. Ventral view of apical segment of endosoma. Gerris pingreensis Drake and Hottes.

Fig. 60. Lateral view of expanded phallus. Gerris pingreensis Drake and Hottes.

Fig. 61. Ventral view of basal plate. Gerris pingreensis Drake and Hottes.

Fig. 62. Lateral view of ninth abdominal segment. Gerris pingreensis Drake and Hottes.

Fig. 63. Dorsal view of ninth abdominal segment. Gerris pingreensis Drake and Hottes.

PLATE II

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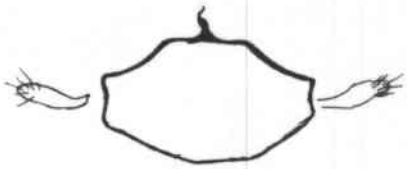

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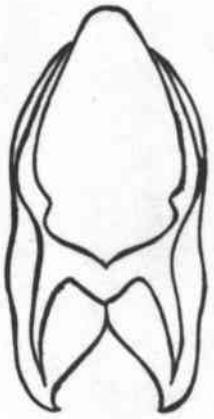

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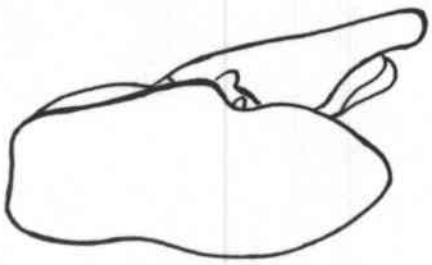

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PLATE 12

Fig. 64. Ventral view of apical segment of endosoma. Gerris gilletei Lethiery and Severin.

Fig. 65. Lateral view of expanded phallus. Gerris gilletei Lethiery and Severin.

Fig. 66. Ventral view of basal plate. Gerris gilletei Lethiery and Severin.

Fig. 67. Lateral view of ninth abdominal segment. Gerris gilletei Lethiery and Severin.

Fig. 68. Lateral view of ninth abdominal segment. Gerris gilletei Lethiery and Severin.

PLATE 12

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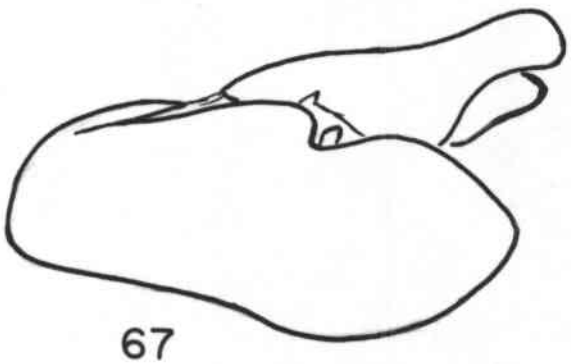

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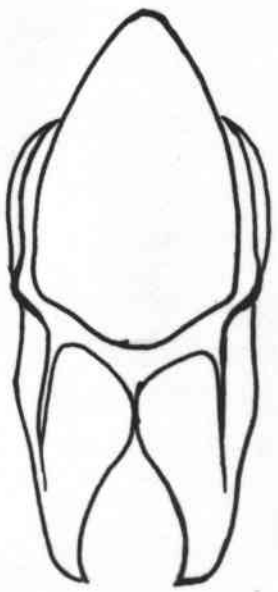

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PLATE 13

Fig. 69. Ventral view of apical segment of endosoma. Gerris incognitus Drake and Hottes.

Fig. 70. Lateral view of apical segment of endosoma. Gerris incognitus Drake and Hottes.

Fig. 71 Lateral view of expanded phallus. Gerris incognitus Drake and Hottes.

Fig. 72. Ventral view of basal plate. Gerris incognitus Drake and Hottes.

Fig. 73. Lateral view of the ninth abdominal segment. Gerris incognitus Drake and Hottes.

Fig. 74. Dorsal view of the ninth abdominal segment. Gerris incognitus Drake and Hottes.

PLATE 13

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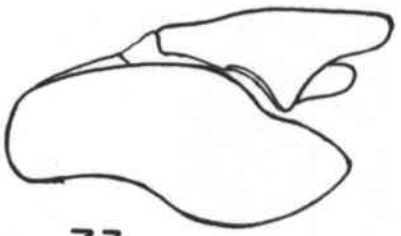

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PLATE 14

Fig. 75. Ventral view of apical segment of endosoma. Gerris alacris Hussey.

Fig. 76. Lateral view of expanded phallus. Gerris alacris Hussey.

Fig. 77. Ventral view of basal plate. Gerris alacris Hussey.

Fig. 78. Lateral view of ninth abdominal segment. Gerris alacris Hussey.

Fig. 79. Dorsal view of ninth abdominal segment. Gerris alacris Hussey.

PLATE 14

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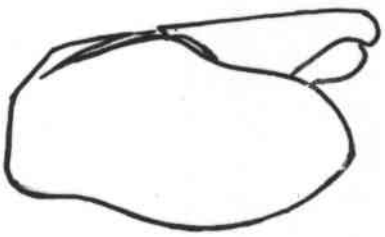

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PLATE 15

Fig. 80. Ventral view of apical segment of endosoma. Gerris insperatus Drake and Hottes.

Fig. 81. Lateral view of expanded phallus. Gerris insperatus Drake and Hottes.

Fig. 82. Ventral view of basal plate. Gerris insperatus Drake and Hottes.

Fig. 83. Lateral view of ninth abdominal segment. Gerris insperatus Drake and Hottes.

Fig. 84. Dorsal view of ninth abdominal segment. Gerris insperatus Drake and Hottes.

PLATE 15

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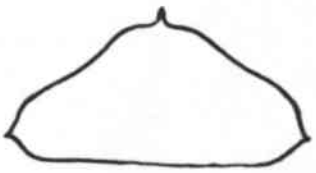

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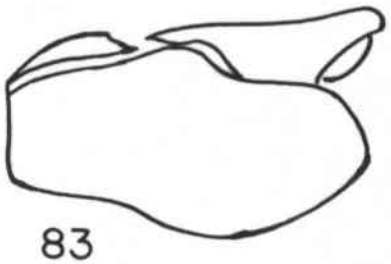

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PLATE 16

Fig. 85. Ventral view of apical segment of endosoma. Gerris buenoi Hussey.

Fig. 86. Lateral view of expanded phallus. Gerris buenoi Hussey.

Fig. 87. Ventral view of basal plate. Gerris buenoi Hussey.

Fig. 88. Lateral view of ninth abdominal segment. Gerris buenoi Hussey.

Fig. 89. Dorsal view of ninth abdominal segment. Gerris buenoi Hussey.

PLATE 16

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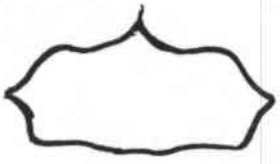

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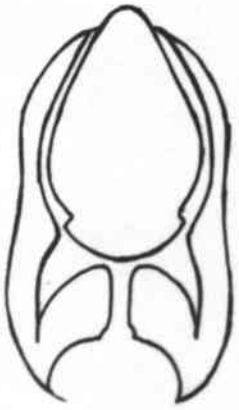

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PLATE 17

Fig. 90. Ventral view of apical segment of endosoma. Gerris incurvatus Drake and Hottes.

Fig. 91. Lateral view of expanded phallus. Gerris incurvatus Drake and Hottes.

Fig. 92. Ventral view of basal plate. Gerris incurvatus Drake and Hottes.

Fig. 93. Lateral view of ninth abdominal segment. Gerris incurvatus Drake and Hottes.

Fig. 94. Dorsal view of ninth abdominal segment. Gerris incurvatus Drake and Hottes.

PLATE 17

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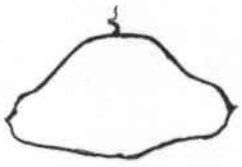

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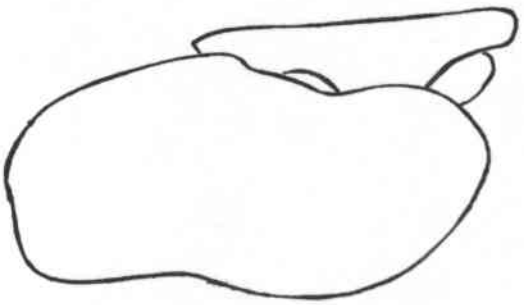

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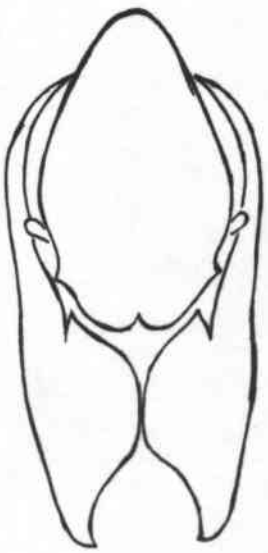

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PLATE 18

Fig. 95. Ventral view of apical segment of endosoma. Gerris comatus Drake and Hottes.

Fig. 96. Lateral view of expanded phallus. Gerris comatus Drake and Hottes.

Fig. 97. Ventral view of basal plate. Gerris comatus Drake and Hottes.

Fig. 98. Lateral view of ninth abdominal segment. Gerris comatus Drake and Hottes.

Fig. 99. Dorsal view of ninth abdominal segment. Gerris comatus Drake and Hottes.

PLATE 18

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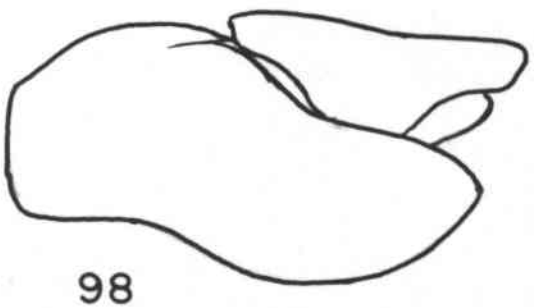

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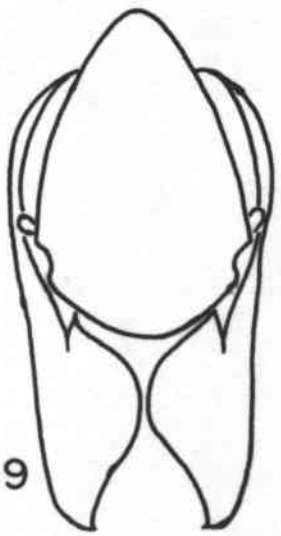

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PLATE 19

Fig. 100. Ventral view of apical segment of endosoma. Gerris marginatus Say.

Fig. 101. Lateral view of expanded phallus. Gerris marginatus Say.

Fig. 102. Ventral view of basal plate. Gerris marginatus say.

Fig. 103. Lateral view of ninth abdominal segment. Gerris marginatus Say.

Fig. 104. Dorsal view of ninth abdominal segment. Gerris marginatus Say.

PLATE 19

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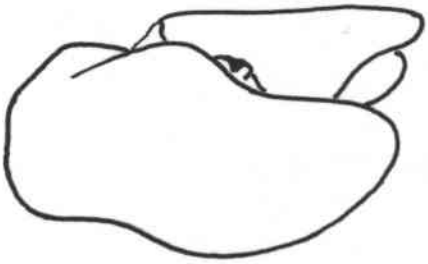

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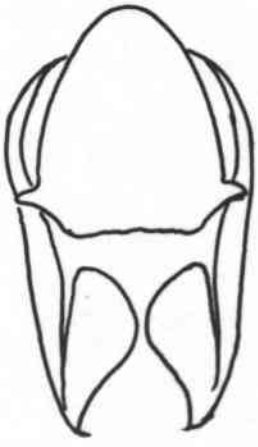

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PLATE 20

Fig. 105. Ventral view of apical segment of endosoma. Gerris argenticollis Parshley.

Fig. 106. Lateral view of expanded phallus. Gerris argenticollis Parshley.

Fig. 107. Ventral view of basal plate. Gerris argenticollis Parshley.

Fig. 108. Lateral view of ninth abdominal segment. Gerris argenticollis Parshley.

Fig. 109. Dorsal view of ninth abdominal segment. Gerris argenticollis Parshley.

PLATE 20

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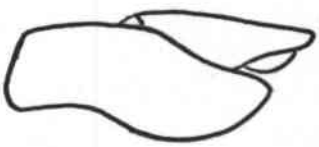

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109

PLATE 21

PARAMERES

Dextro-lateral view of right claspers of the different species of the genus Gerris Fabricius.

PLATE 21

PARAMERES

NYCTALIS

SPECIES A

REMIGIS

NEBULARIS

CONFORMIS

NOTABILIS

RUFOSCUTELLATUS

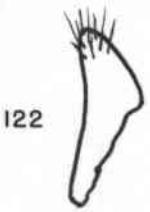
DISSORTIS

CANALICULATUS

PINGREENSIS

GILLETEI

INCOGNITUS



ALACRIS

INSPERATUS

BUENOI

INCURVATUS

COMATUS

MARGINATUS

ARGENTICOLLIS