THE TAXONOMIC VALUE OF THE EXTERNAL FEMALE GENITALIA IN THE GENUS NABIS LATREILLE (HEMIPTERA: HETEROPTERA: NABIDAE)

by

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INTRODUCTION

This study was undertaken in an attempt to discover structures in the genitalia of the female Nabidae that could be used for taxonomic purposes. It was hoped that on the basis of these structures, some conclusions concerning the relationships between and among the various species and subgenera of the genus Nabis could be drawn.

The genus Nabis Latreille was selected because it is the largest genus in the family Nabidae, its species are common, and specimens representing most of the subgenera of the genus were available.

Preliminary study of the external female genitalia indicated that the seminal depository, the sclerotized rings, the interramal sclerites, the ovipositor blades, the apodeme and the setose areas appeared to show variation among the species of the genus Nabis.

Davis (10 p. 144) pointed out that Kullenberg (15) found a seminal depository in the female Nabidae. The present study showed that a seminal depository is found in the female of the genus Nabis and presumably in the other genera of the family Nabidae. The seminal depository is a large bladder or bag attached to the

anterior margin of the anterior and posterior walls of the genital chamber. The size, shape and degree of sclerotization of the seminal depository differ in different species.

The sclerotized rings appeared to be either united or separated on the seminal depository. They are located dorsally, ventrally, dorsally and ventrally, ventrolaterally, or in an anterior invagination. They may be comparable to the sclerotized rings of the mirids which are located on the dorsal labiate plate. They appeared to be more comparable to the two sclerotized ridges that encircle the two lateral patches on the seminal depository of the mirids described by Davis (10 p. 144).

The posterior wall of the genital chamber extends between the second rami of the second valvulae. It consists of two bilateral sclerites (interramal sclerites) and sometimes a median sclerotized process not comparable to the sigmoid process of the mirids.

The ovipositor blades consist of median second valvulae and two lateral first valvulae. The teeth on the second valvulae differ in number and shape in different species. The first valvulae appeared to be constant throughout the species studied.

The anterior margin of the seventh abdominal sternum of the ventral plate is extended anteriorly

forming a structure to which some genital muscles are attached. This structure is referred to here as the apodeme. It is well developed in the females and very much reduced in the males.

The setose areas are paired patches of setae on both sides of the external body surface of the ventral plate, sometimes forming invaginated sockets. These setose areas are also found in the males.

The structures (except the setose areas) mentioned above are the most heavily sclerotized portions of the female genetalia and are readily available for study with relatively little preparation. The seminal depository and the sclerotized rings were found to be very useful in separating the species of the genus Nabis. Most of the other structures were not of sufficient taxonomic value to be considered.

The following twenty-one known species and two varieties were studied: N. subcoleoptratus (Kirby), N. flavomarginatus Scholtz, N. vanduzeei (Kirkaldy), N. heidemanni (Reuter), N. deceptivus Harris, N. dentipes Harris, N. sordidus Reuter, N. annulatus Reuter, N. propinquus Reuter, N. limbatus Dahlbom, N. nigrovittatus Sahlberg, N. lovetti Harris, N. roseipennis Reuter, N. rufusculus Reuter, N. kalmii Reuter, N. capsiformis Germar, N. ferus (Linnaeus), N. inscriptus

(Kirby), N. alternatus Parshley, N. alternatus, color form uniformis Harris, N. ferus var. pallidipennis Harris, N. major Costa, N. boops Schiodte. Two other unknown species of Nabis named A and B, were studied during the course of this study. All dissected material has been deposited in the collection of the Entomology Department of Oregon State College.

It is hoped that this exploratory study will stimulate further investigations into the taxonomic value of the female genitalia both in Nabis as well as related genera.

LITERATURE REVIEW

Several workers have considered the female reproductive systems of other Heteroptera. Davis (10 p. 132) mentioned that Kullenberg (14) investigated the anatomy and function of the various parts of the male and female reproductive systems of twenty-four species of Miridae.

Slater (18) used certain sclerotized portions of the female genitalia to determine phylogenetic relationships between the various subfamilies and genera of the Miridae. Alphabetical letters were applied to structures of unknown function or significance. Davis (10) studied the morphology of the female organs of reproduction in the Miridae and applied names to the structures Slater gave alphabetical letters. Many of the names he used were used in this study. The studies of Slater and Davis were of great help during this study due to the similarities in structures between the Miridae and the Nabidae.

The Cimicidae and Anthocoridae are generally considered related to Nabidae. Therefore, it is of interest to review some of the work that has been done on these families.

Davis (11) published a detailed study on the morphology and functional anatomy of the male and female reproductive systems of <u>Cimex lectularius</u> L.

Carayon (1, 2, 3, 4, 5, 6, 7, 8) published a series of papers on the reproductive organs of Nabidae, Anthocoridae and Cimicidae.

Pendergrast (16, p. 49) published an investigation on the internal reproductive organs of Heteroptera considering their value in classification. He pointed out that the seminal depository (which he called the bursa copulatrix) of Nabidae is very similar to that of the Miridae. He added that both families do not possess a spermatheca but possess a median tubular accessory gland. It is interesting to note that Davis (10, p. 146) described a spermatheca in the Miridae. The present writer followed Davis (10) in calling the tube that opens in the common oviduct, the spermatheca.

Most of the work that has been done on the family Nabidae has been concerned largely with the description of new species. The internal male reproductive organs in the genus Nabis Latreille were studied by Woodward (22, p. 111). He illustrated and described the male reproductive organs of three subgenera, Himacerus, Nabis and Dolichonabis. He concluded (p. 117) that the various types of structures in the species studied of the genus Nabis correspond to the taxonomic subgenera of the genus which have been erected on the basis of external

morphological characters. Woodward's paper was followed by Carayon (2, p. 1), who described the general anatomical characters of the male reproductive organs in the family Nabidae. He stated (p. 10) that the differences of the reproductive system among the subgenera of Nabis are minute and are sometimes without any significance. His study was based on the following subgenera: Nabis, Dolichonabis, Himacerus, Stalia and Aspilaspis.

Harris (14) included in his monograph of the family Nabidae of North America a key, synonymies, description, distribution and some biology of the species of the genus Nabis and other genera. A part of his study was based on the male claspers by means of which he was able to separate the species of the genus. Harris's review of the genus was of great help during this study.

Ekblom (13) published an important work on the female genitalia of Nabidae in his study of the morphology and biology of some of the Swedish families of Heteroptera. Only the female genital organs of N. flavomarginatus Scholtz were studied in some detail. However, the terminology used then is not in common use today. His work has contributed considerably to the knowledge of the female nabid reproductive system.

Kullenberg (15) published a paper on the morphology and function of the apparatus of copulation in Nabidae.

Unfortunately, the writer was unable to examine this paper.

Recently, Dupuis (12) published a review on the external genital organs of both sexes of Heteroptera. His review included an extensive glossary and bibliography. Tuxen (21, p. 158) published a glossary on the genitalia of insects which included a description of the male and female genital organs of Heteroptera by Dupuis and Carvalho. Snodgrass (19) contributed to the knowledge of the genital ducts and ovipositor in his book on the morphology of the insect abdomen.

METHODS AND MATERIALS

The specimens were first softened by dipping in hot water. The insect was removed and placed in a watch glass of water where the abdomen was removed from the body. The abdomen was then placed in a 10-per cent solution of hot potassium hydroxide for two or three minutes. The rest of the specimen was removed, allowed to dry and remounted. The abdomen was returned to the watch glass and dissected under a microscope at approximately 37.5 X. Holding the abdomen sideways, one side was cut through with a sharp scalpel. The other side was also cut in the same manner. The tergum was then dissected away. The half abdomen was returned to the hot potassium hydroxide solution to remove any remaining non-sclerotized structures. The time of this clearing process differed from one species to the other and from one specimen to the other according to the age.

It was necessary to dissect away the valvifers, valviferal apodemes, rami, ramal plates, ovipositor sheath and paratergites.

After dissection and study, the parts were placed in a micro-vial containing glycerine and attached to the pin holding the specimen.

Drawings were made with the use of a squared,

ocular lens on a Spencer microscope using 30, 40 and 80 X.

For measurements, the maximum width is the distance between the two lateral limits of the structure and the maximum length is the distance between the anterior and posterior limits of the structure. All measurements are given in millimeters or fractions thereof.

THE FEMALE ABDOMEN

Most of the descriptive names used here follow Davis (10) unless otherwise indicated.

The abdomen of the female Nabis is oval and pointed at the posterior end (Figs. 1, 2, 3, 4). It consists of eleven segments. Laterally the connexiva (Fig. 3, Cnx) separate the dorsal and ventral plates.

The first segment of the ventral plate is reduced to a narrow membrane (Figs. 2, 4 mb) which joins the abdomen to the thorax. The second ventral segment is inflexed to receive the metacoxae. The second and third segments are partially fused with an indication of their fusion. The anterior margin of the seventh ventral segment is extended mesally inside the abdomen to form an apodeme (Fig. 4 Ad) to which some of the genital muscles are attached. The meson of the caudal margin of the same segment is membranous and covers the base of the ovipositor. Spiracles (Figs. 2, 3 sp) are located in the folds of the ventral plate (connexivum of authors) of segments two through eight. Setose areas (Figs. 2, 3, 4 SA) of unknown function are located antero-mesally of the spiracles. These areas differ in number, size and shape between the species. Some of these areas are invaginated into the abdomen.

Between the first and second segments of the dorsal plate are two symmetrical markings (Fig. 1). The mid-region of the anterior margin of segments 4, 5, 6 bear remants of the nymphal scent glands (Fig. 1 SG). The tenth segment is annuliform and covers the eleventh segment.

Segments eight and nine are the genital segments. Ventrally they are divided mesally by the second valvifers (Figs. 2, 3, 2 Vlf). The paratergites (Fig. 2, 3 ptg) extend from the second valvifers dorso-laterally to the connexiva. The genital frame consists of the ninth segment, the valvifers, valvulae and their processes. Muscles are attached to the different parts of the genital frame.

The ovipositor (Figs. 4, 8 Ovp) consists of median second valvulae (Figs. 6, 9, 2Vl) and two lateral first valvulae (Figs. 7, 10 1Vl). The fibula (Figs. 7, 8, 10 Fb) extends from the lateral margin of the first valvula for a short distance. The outer margin of each fibula is joined to the connecting piece (Figs. 4, 8, 10 CP) which extends dorso-caudally and fuses with the ramal plate (Figs. 4, RP). The inner margin of the first valvula is joined to a long rod which is arched dorso-canually and broadens before its proximal end and fuses to the connecting piece. This rod is referred to here

as the first ramus (Figs. 4, 8, 10 1Ra). It does not appear to be comparable to the first ramus of Davis (10). The arch of the fibula is contiguous with the arch of the second ramus (Figs. 6, 9 2Ra) of the second valvula. The anterior wall (Figs. 8, 10 AW) of the genital chamber extends between the fibula of each first valvula.

The second ramus (Figs. 6, 9, 2Ra) extends dorsolaterally for a short distance from the anterior end of the second valvula. A ridge (Figs. 6, 9 rg) extends along the dorsal surface of each ramus and then continues ventrocaudally on the lateral edges of the second valvulae, terminating a short distance before their apices. These ridges fit into grooves (Figs. 7, 10 gr) on the inner surfaces of the fibulae and lateral edges of the first valvulae. The posterior wall (Fig. 8, PW) of the genital chamber extends between the second rami of the second valvulae. The inter-ramal sclerites (Figs. 8, 9 IrS) are on the dorsal surface of this posterior wall. The seminal depository (Fig. 4 SmDp) is attached to the front edge of the anterior and posterior walls of the genital chamber. The sclerotized rings (Fig. 4 SR) are located on the seminal depository. The spermatheca (Fig. 4 Spt) usually opens into the common oviduct (Fig. 11 Odc). Pendergrast (16 p. 49) calls it the accessory gland and denies that spermatheca is found in the Nabidae.

The third valvulae (Figs. 2, 3, 4, 3Vl) are attached to the ventro-posterior margin of the second valvifers. The inter-valviferal membrane extends between the inner edges of the second valvifers. The ovipositor is ensheathed dorsally when not in use by the inter-valviferal membrane and ventrally by the second valvifers and the third valvulae.

The antero-dorsal margin of the second ramus is fused to the narrow anterior end of the valviferal apodeme (Figs. 4, 8, 9 VlA). The second valvifers, which are fused to the valviferal apodeme, narrow considerably cephalad and fuse to the antero-lateral margins of the second rami. The ramal plates (Fig. 4 RP) are articulated to the mesal portion of the valviferal apodeme.

The first valvulae (Figs. 7, 10 1Vl) are free from one another. The ventral and lateral margins are furrowed transversely like a file throughout almost their entire length. The second valvulae (Figs. 6, 9, 2Vl) are united anteriorly and possess dorsal and lateral teeth. The number and shape of the dorsal teeth differ in different species. The mesal edge is lined to about half its length with uniform teeth.

The lateral oviducts (Figs. 4, 5, Odl) usually meet to form a common oviduct which usually opens into the dorsal surface of the seminal depository. The

spermatheca (Fig. 4 Spt) usually opens medially at the anterior part of the common oviduct. The ovaries (Fig.5) are acrotrophic. Each ovary consists of seven ovarioles extending from the calyx (Fig. 5 clx). Each ovariole ends in a terminal filament (Fig. 5 TF). The terminal filaments of each ovary form a suspensory ligament which extends as far as the thorax.

GENUS NABIS LATREILLE 1802

Nabis is the largest single genus of the family Nabidae composed of approximately 200 species. The genus is world-wide in distribution.

Reuter (17, p. 293) has divided the genus into the following subgenera: Nabicula (x) Kirby 1837, Hoplistoscelis (x) Reuter 1890, Aptus Hahn. 1831, Stalia (x) Reuter 1872, Acanthonabis Reuter 1890, Lasiomerus (x) Reuter 1890, Halonabis Reuter 1890, Nabis (x) Latreille 1802, Stenonabis Reuter 1890, Aspilaspis Stal 1873. The name Himacerus (x) Wolff 1811 is used at present in place of Aptus Hahn 1831. Later the subgenus Dolichonabis (x) Reuter 1908 was included. The subgenera marked (x) were studied during the course of this investigation.

Subgenus NABICULA Kirby 1837

The subgenus Nabicula Kirby originally contained only the species subcoleoptratus. However, two species of the subgenus Nabis, N. flavomarginatus and N. vanduzeei, are now transferred to Nabicula on the basis of the close similarities of the female genitalia. Harris (14, p. 58) indicated in his monograph that the latter two species might ultimately prove to belong to Nabicula. He based his opinion on certain morphological

similarities, notably the converging post-ocular portion of the head. The results of the present study support Harris' assumption.

The dorsal and ventral surface of the seminal depository is heavily sclerotized anteriorly. The rings are heavily sclerotized and located on the ventral surface of the seminal depository. These rings are strongly tapered latero-caudally.

Nabis subcoleoptratus (Kirby)

Nabicula subcoleoptrata Kirby, 1837.

Richardson's Fauna Bor. Am., IV, p. 282.

(Figs. 11, 12, 70)

Seminal depository:

Anterior half heavily sclerotized internally; dorsal sclerotized area shorter than ventral sclerotized area; both areas connected anteriorly; anterior edge almost straight; dorsally a fold runs from the round anterior corners along the sides for about half the length; lateral margins taper gradually in a meso-aphalad direction; common oviduct opens meso-dorsally at base (Plate 4, Fig. 11). Maximum width 1.48 mm., maximum length 1.60 mm.

Sclerotized rings:

Large; heavily sclerotized; on ventral surface of

seminal depository; separate or united mesally; strongly tapered latero-caudally bending mesally; lateral margin runs along the lateral margin of the seminal depository; posterior margin convex, length equal to or slightly longer than width (Plate 4, Fig. 12). The variation of the sclerotized rings is shown on Plate 16, Fig. 70. Maximum width .68 mm., maximum length .74 mm.

Plesiotype: 10 miles Southwest Wheatland, Platte county, Wyoming. July 30, 1958. A. D. Davison.

The above description was based on a brachypterous specimen. Nine more specimens from Michigan, Iowa, Ontario and Wyoming, including one macropterous form from Wyoming, were dissected. No differences were found between the two forms.

This species is very distinct by reason of the almost straight anterior margin of the seminal depository and the previously described sclerotized rings. The present study indicates that the sclerotization of the seminal depository, the general shape and position (ventral surface of the seminal depository) of the sclerotized rings, the interramal sclerites, the apodeme, the teeth of the second valvulae and the setose areas of this species are similar to that of N. flavomarginatus Scholtz and N. vanduzeei (Kirkaldy). This suggests that these species are closely related and the two latter ones should be

placed in the same subgenus, Nabicula, as previously mentioned.

Nabis flavomarginatus Scholtz

Nabis flavomarginatus Scholtz, 1846.

Arb. Schles. Ges. Vat. Kultur, p. 114

(Figs. 13, 14, 71)

Seminal depository:

Posteriorly broad; tapered meso-cephally forming a triangle; anterior end blunt; posterior half lightly sclerotized, anterior half heavily sclerotized dorsally and ventrally; sclerotized area narrows cephally and caudally; caudal narrowing of the heavily sclerotized area associated with a medium sclerotized area; common oviduct opening mesodorsally at posterior end (Plate 4, Fig. 13). Maximum width 1.11 mm., maximum length 1.54 mm.

Sclerotized rings:

Separate or united on venter of seminal depository; broad anteriorly and strongly tapered latero-caudally; anterior margin delimits the anterior sclerotized area (Plate 4, Fig. 14). The variation of the rings is illustrated in Plate 16, Fig. 71. Maximum width .37 mm., maximum length .74 mm.

Plesiotype: New Brunswick, Canada. July 14, 1951.

E. E. Gilbert.

The above description was based on a brachypterous specimen. Five more specimens from Canada and England were dissected. Two were brachypterous and three macropterous. No differences were found to occur between the two forms.

This species is easily distinguished by the tapered, heavily sclerotized seminal depository and the previously described sclerotized rings. It resembles N. vanduzeei (Kirkaldy) and N. subcoleoptratus (Kirby) in having a narrowed post occular portion of the head which is a distinct character of the subgenus Nabicula. Harris (14, p. 58) indicated that the hemelytra of N. flavomarginatus Scholtz is without the usual three known dots so common to the other members of the subgenus Nabis. The present study has indicated the affinity of this species to N. vanduzeei (Kirkaldy) and N. subcoleoptratus (Kirby) on the basis of the sclerotization of the seminal depository, the general shape and position (ventral surface of the seminal depository) of the sclerotized rings, the interramal sclerites, the apodeme, the teeth of the second valvulae and the setose areas.

Nabis vanduzeei (Kirkaldy)

Reduviolus vanduzeei Kirkaldy, 1901.

Wien. Ent. Zett., XX:223.

(Figs. 15, 16)

Seminal depository:

Anterior half heavily sclerotized dorsally and ventrally, broader than posterior half, slightly concave; anterior margin concave medially; posterior half lightly sclerotized, narrows cephally; common oviduct opens mesodorsally at posterior end (Plate 5, Fig. 15). Maximum width 1.11 mm., maximum length 1.42 mm.

Sclerotized rings:

Separate; on venter of seminal depository; broad mesally and strongly tapered latero-caudally; mesal margins subparallel extending along median line for half its total length; anterior margin irregularly round, limiting heavily sclerotized anterior half (Plate 5, Fig. 16). Maximum width .37 mm., maximum length .74 mm.

Plesiotype: 8 miles East Frenchglen, Harney County, Oregon. July 16, 1957. J. D. Lattin.

The above description was based on a brachypterous specimen. Two more brachypterous specimens from the same locality were dissected.

This species is easily recognized by the broad,

incurved, heavily sclerotized anterior portion of the seminal depository and the previously described sclerotized rings. The present study has shown that this species is closely related to N. flavomarginatus Scholtz and to N. subcoleoptratus (Kirby) due to the similarities in the sclerotization of the seminal depository, the general shape and position (ventral surface of the seminal depository) of the sclerotized rings, the interramal sclerites, the apodeme, the teeth of the second valvulae and the setose areas.

Subgenus Hoplistoscelis Reuter 1890

This subgenus contains at least six species, all of which are confined to the Nearctic region and the upper part of the Neotropical region. The female genitalia of four species, N. heidemanni (Reuter) N. deceptivus Harris, N. dentipes Harris and N. sordidus Reuter have been examined. The first three appear to be closely related. The seminal depository in this subgenus is round anteriorly and possesses two postero-lateral projections. The sclerotized rings are fused to form a single round open area on the dorsal surface of the seminal depository. N. sordidus Reuter shows some characteristics that tend to place it somewhat apart from the subgenus Hoplistoscelis Reuter. The affinities of the subgenus appear to be

close to the subgenus Stalia Reuter.

Nabis heidemanni (Reuter)

Reduviolus heidemanni Reuter, 1908.

Mem. Soc. Ent. Belg., XV, p. 100.

(Figs. 17, 18)

Seminal depository:

Circular, wider at the middle; postero-lateral region produced dorsally, forming two large heavily sclerotized protrusions directed latero-cephally; ventrally, wrinkles form two oval lateral areas; common oviduct opens meso-dorsally, a short distance anterior to the concavity formed between the two protrusions (Plate 5, Fig. 17). Maximum width 1.42 mm., maximum length 1.30 mm.

Sclerotized rings:

Fused to form a single dorsal open area, runs in close association with the circular edge of the seminal depository; posteriorly bends cephally and meets mesally (Plate 5, Fig. 18). Maximum width 1.38 mm., maximum length .99 mm.

Plesiotype: Mt. Moscow, Idaho. Oct. 10, 1916. A. C. Burrill.

The above description was based on only one brachypterous specimen. It was first determined as

Nabis crassipes Reuter by H. G. Barber and later as Nabis heidemanni (Reuter) by Harris. The female genitalia of this species is typical to that previously described for the subgenus Hoplistoscelis Reuter. This study has indicated that this species is closely related to N. deceptivus Harris and N. dentipes Harris but not to N. sordidus Reuter the other member of the subgenus studied.

Nabis deceptivus Harris

Nabis deceptivus Harris, 1928. Ent. Amer. IX, Nos. 1 & 2, p. 45.

(Figs. 19, 20)

Seminal depository:

Rounded anteriorly; postero-lateral projections taper laterally; ventrally two lateral somewhat oval, moderately sclerotized areas separated and surrounded caudally by a lightly sclerotized membrane, dorsally the sclerotized areas form a complete band along the round edge; common oviduct elongate, wider at base, opening mesally (Plate 6, Fig. 19). Maximum width 1.14 mm., maximum length 1.36 mm.

Sclerotized rings:

Fused to form a single dorsal open area; runs along the round edge separated by a short distance from the

edge; posterior margin thickened and arched mesally; extended latero-caudally forming two short, irregularly sclerotized areas (Plate 6, Fig. 20). Maximum width 1.05 mm., maximum length .78 mm.

Plesiotype: Clemson College, South Carolina. April 10, 1935. J. N. Todd.

The above description was based on a brachypterous specimen determined by Harris.

The female genitalia of this species are typical of the type described for the subgenus Hoplistoscelis Reuter. It is related to N. heidemanni (Reuter) and N. dentipes Harris by reason of the rounded seminal depository with postero-lateral projections and the dorsal, fused sclerotized rings.

Nabis dentipes Harris

Nabis crassipes, Reuter, 1872.

Of. Akad. Forh., XXIX, No. 6, p. 83.

(Figs. 21, 22)

Seminal depository:

Rounded anteriorly; posterior end shallowly concave, narrowing mesally, produced dorso-caudally; postero-lateral portions heavily sclerotized, slightly raised dorsally; two oval, moderately sclerotized areas, separated and surrounded caudally by a lightly sclerotized

membrane occupying a large portion of the venter; common oviduct opening dorso-mesally, posterior to the rounded anterior portion (Plate 6, Fig. 21). Maximum width 1.00 mm., maximum length 1.20 mm.

Sclerotized rings:

Fused to form a single, dorsal, open area; broad in diameter and moderately sclerotized; running along the edge of the seminal depository, bending mesally forming an indefinite sclerotized area (Plate 6, Fig. 22). Maximum width .99 mm., maximum length .80 mm.

Plesiotype: Puebla, Pue. Mexico, 7,200 feet. June 6, 1958. H. A. Scullen.

The description was based on only one macropterous specimen. The female genitalia of this species are typical to that previously mentioned for the subgenus Hoplistoscelis Reuter. This species appears to be closely related to N. heidemanni (Reuter) and N. deceptivus Harris.

Nabis sordidus Reuter

Nabis sordidus Reuter, 1872.

Of. Vet. Akad. Forh., XXIX, No. 6, p. 85.

(Figs. 23, 24)

Seminal depository:

Lightly sclerotized; almost twice as wide as long;

lateral edges rounded, moderately sclerotized and bent dorsolaterally; invaginated anteriorly forming two margins: ventral anterior margin convex for entire length; dorsal anterior margin convex mesally; common oviduct opening antero-mesally just behind anterior margin, attached to ventral anterior margin by a partition (Plate 6, Fig. 23). Maximum width .96 mm., maximum length .49 mm.

Sclerotized rings:

Separate; transverse; ventrad of the anterior invagination of the seminal depository; anterior margin more strongly convex than posterior margin; lateral angle rounded; mesal margins diverge cephally (Plate 6, Fig. 24). Maximum width .31 mm., maximum length .27 mm.

Plesiotype: Ames, Iowa. June 15, 1930. C. E. McAlister.

The description was based on a brachypterous specimen determined by Harris. Three more specimens from Iowa were dissected.

The female genitalia of this species differed from N. heidemanni (Reuter), N. deceptivus Harris and N. dentipes Harris, the other members of the subgenus Hoplistoscelis Reuter studied. The seminal depository of this species is transverse as compared to round in the other members of the same subgenus. The sclerotized rings are separate in

an anterior invagination of the seminal depository as compared to united and dorsal in the other members. Therefore, the relationship between N. sordidus Reuter and the other three species examined appears to be vague.

Subgenus Lasiomerus Reuter 1890

This subgenus contains at least four species, all of which are confined to the upper part of the Neotropical region and the lower part of the Nearctic region. Only the female genitalia of one species, N. annulatus Reuter, was examined. The remarkable feature of this species is the median connecting bar that extends dorsally between the two rings (Plate 7, Fig. 25). This has not been found in any of the other subgenera studied. The sclerotized rings themselves are dorsal, separate and connect with a ventral sclerotized band (Plate 7, Fig. 26). The seminal depository has two lateral expansions. The lateral oviducts are of an unusual type, opening separately into the seminal depository rather than forming a common oviduct. The spermatheca is also of an unusual type. It opens into the seminal depository rather than into the common oviduct. A study is needed of the genitalia of all the other species of this subgenus, to determine the subgeneric limits. This subgenus does not appear to be close to any of the other subgenera of Nabis studied.

Nabis annulatus Reuter

Nabis annulatus Reuter, 1872

Of. Vet. Akad. Forh., XXIX, No. 6, p. 86, Pl. VIII Fig. 4.

(Figs. 25, 26)

Seminal depository:

Irregularly convex; moderately sclerotized; slightly wrinkled; laterally, with two heavily sclerotized expansions: right expansion more heavily wrinkled than left; expanded postero-laterally; lateral oviducts open separately, right lateral oviduct opens dorsad to the right expansion; left lateral oviduct opens ventrad to the left expansion; spermatheca open meso-dorsally, anterior to the openings of the lateral oviducts (Plate 7, Fig. 25). Maximum width 1.11 mm., maximum length .74 mm.

Sclerotized rings:

Rings separate; on the dorsal surface of the posterolateral expansions of the seminal depository; connected with a median sclerotized bar; posterior margin round, following the edge of the postero-lateral expansions; connected also with a latero-ventral sclerotized band that forms a U-shaped sclerite (Plate 7, Fig. 26). Maximum width .28 mm., maximum length .11 mm.

Plesiotype: Ames, Iowa. July, 1945.

The above description was based on a macropterous specimen from Iowa. This species possesses remarkable characteristics as previously mentioned above under the subgeneric discussion. On the basis of the female genitalia, this species does not appear to be related to any of the other species studied.

Subgenus Dolichonabis Reuter 1908

This subgenus consists of at least three species, all of which are confined in their distribution to the Holarctic region. The female genitalia of three species: N. propinquus Reuter, N. limbatus Dahlbom and N. nigrovittatus Sahlberg, were examined.

The sclerotized rings of these species are fused to form a single large open area on the ventral surface of the seminal depository indicating some relationship between each other. Probably the species named A in this study, in which the sclerotized rings fused to form a large ventral open area may ultimately prove to belong to this subgenus. This subgenus does not appear to be close to any of the other subgenera of Nabis studied.

Nabis propinquus Reuter

Nabis propinquus Reuter, 1872.

Of. Vet. Akad. Forh., XXIX, p. 87.

(Figs. 27, 28, 29)

Seminal depository:

Symmetrical; slightly concave; unilateral, moderately sclerotized, tapering gradually meso-cephally; with heavily sclerotized teeth-like structures at anterior margin of the sclerotized portion; widened anterolaterally, forming a large membranous bag; dorsally, a thickened portion covers the base of the membranous bag; common oviduct opening dorsally, tilted to one side (Plate 7, Fig. 28). Maximum width .74 mm., maximum length 1.17 mm.

Sclerotized rings:

Fused to form a single ventral open area; very lightly sclerotized; irregularly emarginate; broader anteriorly; length greater than width, ring occupying most of the venter of the seminal depository (Plate 7, Fig. 26). Maximum width .59 mm., maximum length .84 mm.

Plesiotype: Belvidere, Illinois. June 27, 1955. Jas. A. Slater.

The above description was based on a brachypterous specimen determined by the collector.

Three additional specimens from Michigan and Iowa were dissected, one of which was macropterous. No differences were found between the brachypterous and macropterous forms. The writer was unable to detect the

seminal depository and the sclerotized rings in some of the specimens dissected. The membranous portions were easily cut off during dissection.

One of the brachypterous specimens dissected was determined and sent by Scudder from England. The female genitalia of this specimen differed from the other specimens dissected. The seminal depository was larger and symmetrical and the sclerotized rings fused to form one open area of a different shape. This ring occupied a small portion of the venter of the seminal depository (Plate 7, Fig. 27).

The female genitalia of this species show some relationship to N. limbatus Dahlbom and N. nigrovittatus Sahlberg, the other members of the subgenus Dolichonabis Reuter studied. The relationship is based on the fact that the sclerotized rings are fused and form one open area on the ventral surface of the seminal depository, a character which relates this species to the species named A in this study. Judging from the standpoint of the opening of the common oviduct, this species appears to be related more closely to N. nigrovittatus Sahlberg than to N. limbatus Dahlbom. The common oviduct in this species and in N. nigrovittatus Sahlberg opens dorso-posteriorly whereas in N. limbatus Dahlbom it opens anteriorly.

Nabis limbatus Dahlbom

Nabis limbatus Dahlbom, 1850.

Konig, Vet. Akad. Handl., p. 227

(Figs. 30, 31, 32)

Seminal depository:

Membranous bag, lightly sclerotized; transverse; horizontally wrinkled; lateral edges convex; common oviduct opening anteriorly; base with a thick, lightly sclerotized transversely invaginated fold (Plate 8, Fig. 30). Maximum width 1.5 mm., maximum length .93 mm.

Sclerotized rings:

Rings form an open area on the ventral surface of the seminal depository; extending horizontally to more than half the length of the seminal depository; broad mesally and gradually tapering to a round end laterally; anterior and posterior margins convuluted (Plate 8, Fig. 31). The different shape of the sclerotized rings are shown in Plate 8, Fig. 32. Maximum width 1.2 mm., maximum length .31 mm.

Plesiotype: Thuring, Germany.

The above description was based on a brachypterous specimen determined by Harris. Four other brachypterous specimen from England were also dissected. No differences were observed.

The female genitalia are unique and are readily distinguished by the compressed seminal depository, anterior opening of the common oviduct and the horizontal sclerotized rings. The sclerotized rings of this species suggest a closer relationship to N. nigrovittatus Sahlberg than to N. propinquus Reuter or the species named A in this study. The uncommon opening of the common oviduct into the anterior portion of the seminal depository was also found in N. sordidus Reuter, a member of the subgenus Hoplistoscelis Reuter.

Nabis nigrovittatus Sahlberg

Nabis nigrovittatus Sahlberg, 1878.

K. Sv. Vet. Akad. Handl., XVI, pp. 36, 162.

(Figs. 33, 34)

Seminal depository:

Lightly sclerotized; produced antero-laterally, dorsally, a flat, heavily sclerotized fold slopes gradually laterally and strongly mesally, common oviduct opening dorsally into an invagination beneath the dorsal fold (Plate 8, Fig. 30). Maximum width 1.11 mm., maximum length 1.32 mm.

Sclerotized rings:

Rings form one open area on the venter of the

seminal depository; lightly sclerotized; almost crescent shaped; width more than twice the length along meson; laterally, bends dorso-caudally with one bend broader than the other (Plate 8, Fig. 31). Maximum width .93 mm., maximum length .27 mm.

Plesiotype: Rabbit Ear Pass, Colorado. August 1941. H. M. Harris.

The above description was based on a brachypterous specimen determined and provided by the collector. Five more brachypterous specimens from Colorado and Maine were dissected. Some minor differences were found within the species in both the shape of the seminal depository and sclerotized rings.

This species, as previously mentioned, appears to be related to N. limbatus Dahlbom and N. propinquus Reuter in having the sclerotized rings fused to form one open area on the ventral surface of the seminal depository. Despite the difference of the position of the openings of the common oviduct, this species shows a close relationship to N. limbatus Dahlbom due to the general shape of the seminal depository and sclerotized rings. The species named A in this study possessed similar sclerotized rings.

Subgenus Nabis Latreille 1890

This subgenus consists of at least 40 species, found in all of the major faunal areas of the world. Within this subgenus, the following species and varieties were examined: N. flavomarginatus Scholtz, N. vanduzeei (Kirkaldy). N. lovetti Harris, N. roseipennis Reuter, N. rufusculus Reuter, N. kalmii Reuter, N. capsiformis Germar, N. ferus (Linnaeus), N. inscriptus (Kirby), N. alternatus Parshley, N. alternatus, color form uniformis Harris, N. ferus var. pallidipennis Harris.

It is difficult in a subgenus of this size to draw definite conclusions as to its affinities unless all the species are studied. Some evidence was found based on the limited number of species examined that the group might be further split into more subgenera.

Of the species usually grouped in the subgenus Nabis Latreille, N. flavomarginatus Scholtz and N. vanduzeei (Kirkaldy) showed a closer relationship to N. subcoleoptratus (Kirby) of the subgenus Nabicula Kirby. Based on genital characters of the female, N. lovetti Harris and N. capsiformis Germar were quite distinct species. N. roseipennis Reuter seemed more closely related to N. rufusculus Reuter. N. alternatus Parshley appeared to be closely related to N. ferus (Linnaeus).*

*United States

N. alternatus Parshley and N. alternatus, color form uniformis Harris were shown to be color varieties. N. ferus (Linnaeus) and N. inscriptus (Kirby) were found to be either very closely related or the same species. N. ferus var. pallidipennis appeared to be a variety of alternatus, not of ferus. (United States).

Nabis lovetti Harris

Nabis lovetti Harris, 1928.

Ent. News, XXXVI, p. 205.

(Figs. 35, 36)

Seminal depository:

Oval, posteriorly constricted; laterally, bent dorsally; lightly sclerotized with fine wrinkles covering most of the dorsal surface; anterior margin round and produced cephalo-laterally, lateral oviducts open separately on the dorsal surface; a raised sclerotized portion between the lateral oviducts which anteriorly bends laterad a short distance anterior to the base of the lateral oviducts; spermatheca opening mesally, posterior to the sclerotized portion; postero-mesally, protruding in a narrow flat projection that covers the base of the ovipositor (Plate 9, Fig. 35). Maximum width 12.35 mm., maximum length .78 mm.

Sclerotized rings:

Oval, lightly sclerotized, on ventro-lateral surface of the seminal depository; lateral margins bend dorsally; distance between anterior mesal margins nearly twice the distance between posterior mesal margins (Plate 9, Fig. 36). Maximum width .37 mm., maximum length .70 mm.

Plesiotype: Winkle Lake, 10 miles South of Corvallis, Benton County, Oregon. Oct. 10, 1957. John D. Lattin.

The above description was based on a macropterous specimen. Four other specimens from Oregon were dissected two of which were brachypterous. No significant differences were found to occur between the two forms.

This species is quite distinct by reason of the shape of the seminal depository and the two separate, oval sclerotized rings. The female genitalia indicate the species to be very distinct and not closely related to any member of the subgenus Nabis or to any of the other subgenera studied. Harris (14, p. 60) states, "This remarkably distinct species is to be separated from all other American nabids by the yellowish to reddish brown color, which has somewhat of an orange to roseous tinge, by the nature of the pubescence of the hemelytra, and specially by the linear, lance-like clasper of the male."

Therefore, the present study suggests that this species may prove to represent a separate subgenus.

Nabis roseipennis Reuter

Nabis roseipennis Reuter, 1872.

Of. Vet. Akad. Forh., XXIX, No. 6, p. 89, Pl. VIII, Fig. 10

(Figs. 37, 38, 39, 40)

Seminal depository:

Lateral margins narrow gradually cephally; incurved for a short distance anteriorly; anterior margin convex for almost its entire length; postero-dorsally, forming two round or oval heavily sclerotized projections; postero-ventrally, two small invaginated, heavily sclerotized extensions at the point of attachment to the fibula; common oviduct opening mesodorsally, anterior to the concavity between the two projections (Plate 9, Fig. 37). Maximum width .83 mm., maximum length .62 mm.

Sclerotized rings:

Fused to form one open area ventrally at the anterior margin of seminal depository; ring bends dorso-laterally; posterior margin almost straight, arched mesally (Plate 9, Fig. 38). Maximum width .62 mm., maximum length .18 mm.

Plesiotype: Stone Park. Sioux City, Iowa.

August 11, 1950. J. D. Lattin.

The above description was based on a macropterous specimen. Six additional macropterous specimens from Washington, Kansas and Iowa were dissected. Eighteen brachypterous specimens from Maine, New York, Manitoba, and Oregon were dissected. The drawings of the brachypterous form (Figs. 39, 40) were from a specimen collected near Saint Rose, Quebec Ile Jesus, 20 miles Northwest of Montreal, Canada. August 19, 1956. J. D. Lattin. The main difference found between these two forms was that the two dorsal heavily sclerotized projections fused to form one projection and the lateral margins were shorter in the brachypterous form.

The female genital organs indicated a closer relationship to N. rufusculus Reuter and N. kalmii Reuter than to any other species of Nabis studied. The sclerotized rings are fused in the three species to form one open area on the antero-ventral surface of the seminal depository. The posterior margin of this area is arched mesally.

Nabis rufusculus Reuter

Nabis rufusculus Reuter, 1872.

Of. Vet. Akad. Forh., XXIX, p. 92

(Figs. 41, 42)

Seminal depository:

Broad medially; almost as wide as long; gradually tapering meso-cephally and forming a tongue-like projection; anterior margin convex; meso-caudally two folds approaching mesally, produced ventrally at the point of attachment to the second ramus and reaching posterior margin of the seminal depository; a V-shaped, moderately sclerotized area anterior to the folds; common oviduct opening meso-dorsally closer to anterior margin (Plate 10, Fig. 41). Maximum width 1.27 mm., maximum length 1.21 mm.

Sclerotized rings:

Rings open and form one open area ventrally; anterior margin convex, running along anterior margin of the seminal depository; posterior margin tapers meso-cephelly forming an arch; lateral angles rounded (Plate 10, Fig. 42). Maximum width .73 mm., maximum length .13 mm.

Plesiotype: McMinnville, Peavine ridge. April 20, 1957. D. McKay-Fender.

The above description was based on a brachypterous specimen. Seven more brachypterous specimens were dissected from New York, Maine, Ontario, Michigan, and Oregon. The dorsal surface of the seminal depository was pulled posteriorly in many of the specimens examined. As a result the shape of the sclerotized ring will

usually appear as in Figs. 43, 44.

This species is quite distinct by reason of the tongue-like projection of the seminal depository. The sclerotized rings, as previously mentioned, show a closer relationship to N. roseipennis Reuter than to any other species of Nabis studied. The present study indicates that the female genitalia of this species are almost identical to N. kalmii Reuter, thus agreeing with Harris' opinion these two species are closely related, if not the same. If the latter proves to be the case, it would be necessary to utilize the previously proposed name, Nabis kalmii Reuter.

Nabis kalmii Reuter

Nabis kalmii Reuter, 1872. Of. Vet. Akad. Forh., XXIX, No. 6, p. 91, Pl. VIII, Fig. 15

(Figs. 43, 44)

Seminal depository:

Same as in N. rufusculus Reuter except somewhat narrower and shorter (Plate 10, Fig. 43). Maximum width .96 mm., maximum length .99 mm.

Sclerotized rings:

As in N. rufusculus Reuter (Plate 10, Fig. 44).

Plesiotype: Birmingham, Alabama. August 10, 1924. Rodney Cecil.

The above description was based on a macropterous specimen. One more macropterous specimen from Tennessee was dissected. Both specimens were determined by Harris.

Harris (14, p. 64) when describing this species, stated "Similar to N. rufusculus from which it differs in its more testaceous color, slenderer and straighter first antennal, slightly narrower head, and narrower clasper of male." He suggested that N. kalmii Reuter may prove, upon further study, to be no more than the macropterous form of N. rufusculus Reuter. The study of the female genitalia indicates that this species does not differ from N. rufusculus Reuter in either the shape of the seminal depository or the sclerotized rings. The writer believes that these two species are the same.

Nabis capsiformis Germar

Nabis capsiformis Germar, 1837.

Silberm Revue Ent., V, p. 132.

(Figs. 45, 46)

Seminal depository:

Membranous; strongly constricted posteriorly; oroduced laterally, forming a round, lightly sclerotized, somewhat flattened projection; common oviduct opening dorso-mesally at posterior end; an arched, lightly sclerotized, dorsal projection between the lateral

projection and the common oviduct (Plate 11, Fig. 45). Maximum width .86 mm., maximum length 1.11 mm.

Sclerotized rings:

Very lightly sclerotized; forming complete irregular sclerotized ring that surrounds the constriction and the anterior edge of the lateral projection of the seminal depository. (Plate 11, Fig. 46). Maximum width .37 mm.

Plesiotype: Pascagoula, Mississippi, March 8, 1921. C. J. Drake.

The above description was based on a macropterous specimen determined by Harris. Three additional macropterous specimens from Missouri and Texas were dissected.

The female genitalia of this species indicate a vague relationship to N. ferus (Linnaeus)* and N. alternatus Parshley but show some rather remarkable characteristics of its own. The two latter species are thought to be related by reason of the open type of sclerotized rings that encircle the seminal depository. N. major Costa, which represents the subgenus Himacerus, shows the same character. Further study may prove that this species is more related to the subgenus Himacerus than Nabis.

* United States

Nabis ferus (Linneaeus) (England)

Cimes ferus Linnaeus, 1758.

Syst. Nat., edn. 10, 1, p. 449.

(Figs. 47, 48, 49)

Seminal depository:

Lightly sclerotized except for a moderately to heavily sclerotized area, produced dorso-posteriorly at the right posterior end; anterior edge nearly round; common oviduct opening dorsally, anterior to the sclerotized area on the left side (Plate 11, Fig. 47). Maximum width .93 mm., maximum length .80 mm.

Sclerotized rings:

Rings not symmetrical, the right one larger than the left and connected to the anterior edge of the seminal depository by a very short sclerotized band; anterior margin of both rings run along the anterior edge of the seminal depository for a considerable distance (Plate 11, Fig. 48). Usually connected, forming one open area (Plate 11, Fig. 49). Maximum width of the right ring .68 mm., maximum length .31 mm. Maximum width of the left ring .52 mm., maximum length .18 mm.

Plesiotype: England. The data available with the specimens included only the name of the species and a code number.

The above description was based on five macropterous specimens determined as N. ferus (Linnaeus) and sent by Southwood from England.

The female genitalia of this species are quite distinct and completely different than that of Nabis ferus (Linnaeus) of the United States. The shape of seminal depository and the sclerotized rings are quite distinct. The affinities of this species do not appear to be close to any other species of Nabis studied.

Nabis ferus (Linnaeus) (United States)

Cimex ferus Linneaus, 1758.

Syst. Nat., edn. 10, 1, p. 449

(Figs. 50, 51, 52, 53)

Seminal depository:

Round; produced postero-laterally; heavily sclerotized dorsally and ventrally; lined inward with irregular ridges; common oviduct opening meso-dorsally in the posterior membranous portion (Plate 12, Fig. 52). Maximum width .80 mm., maximum length 1.30 mm.

Sclerotized rings:

Rings form one irregular sclerotized ring limiting the heavily sclerotized portion of the seminal depository; dorsally, arched mesally, ventrally arched for its entire

width (Plate 12, Fig. 53). Maximum width .80 mm., maximum length .25 mm.

Plesiotype: Powell Butte, Crook County, Oregon. July 3, 1940. H. A. Scullen.

The above description was based on a macropterous specimen determined by Harris. One hundred and one macropterous specimens from Quebec, Ontario, Michigan, Illinois, Kansas, Missouri, Iowa, Indiana, Oregon, California and Arizona were dissected. Nineteen additional bachypterous specimens from Quebec, Michigan, Iowa, and Oregon also were dissected. The ridges of the seminal depository are very distinctive, separating this species from the other species of Nabis studied (except N. inscriptus (Kirby)).

Thirty specimens were examined from Oregon, ten from Klamath Falls (Klamath county), eight from Powell Butte (Crook county), seven from Corvallis (Benton county), and five from Mary's Peak (Benton county) to correlate the form of the wing and the shape of the seminal depository. All of the specimens from Klamath Falls were macropterous and upon dissection, the seminal depository tended to be short and round (Figs. 52, 53). The same was found to be true with the specimens from Powell Butte. All the specimens from Mary's Peak were brachypterous and the seminal depository tended to be elongate (Figs. 50, 51).
Two of the Corvallis specimens were brachypterous and

showed elongated seminal depositories. The other three were macropterous and showed short seminal depositories.

It appears that the macropterous forms possess a short, round seminal depository and the brachypterous forms a long seminal depository. The shape of the seminal depository and accordingly the sclerotized rings differed slightly within the species. Specimens from the other parts of the country showed similar variation. However, some intermediates were found.

Comparing the female genitatia of this species and of the same species provided by Southwood from England, showed that the two were not the same. Possibly misidentification might have occurred or this United States species, called N. ferus (Linnaeus) up to the present time, is actually not N. ferus (Linnaeus). The male claspers of the American species N. ferus (Linnaeus) agree with the description of Southwood and Remane (20, p. 283) of N. pseudoferus Remane. Subsequently, if the seminal depository and sclerotized rings of N. pseudoferus Remane appears to be the same as that of N. ferus (Linnaeus) of the United States, it would be necessary to change the name of the species occurring in the United States to N. pseudoferus Remane.

This species is related to N. alternatus Parshley by reason of the shape and position of the sclerotized

rings. N. inscriptus (Kirby) is very close to N. ferus of the United States and may ultimately prove to be the same species.

Nabis inscriptus (Kirby)

Reduviolus inscriptus Kirby, 1837.

Richardson's Fauna Bor. Amer., IV, p. 280, pl. 6, Fig. 7

(Figs. 54, 55)

Seminal depository:

Somewhat quadrate; broader and more coarsely ridged than in N. ferus (Linnaeus)*; two dorsal longitudinal cancavities separated mesally by a raised portion; anterior margin round; lateral margins incurved posteriorly forming a narrower membranous portion; common oviduct opening meso-dorsally into the membranous portion (Plate 12, Fig. 54). Maximum width 1.02 mm., maximum length 1.11 mm.

Sclerotized rings:

Similar to N. ferus (Linnaeus); rings form one irregular sclerotized ring delimiting the heavily sclerotized portion of the seminal depository; dorso-laterally bends strongly latero-cephally; ventrally arched for almost its entire width (Plate 12, Fig. 55). Maximum width 1.02 mm., maximum length .62 mm.

Plesiotype: Pingree Park, Colorado. August 15-22,

* United States

1924. Drake and Hottes.

The above description was based on a brachypterous specimen determined by Harris. Three more brachypterous specimens from Colorado, determined by Harris, were dissected.

Harris (14, p. 70), in describing N. inscriptus (Kirby) said, "Similar to N. ferus (Linnaeus), from which it differs in its shorter antennae, larger eyes, more incrassate anterior femora, and differently formed clasper of the male." In the same page he described the male clasper, "Male clasper with the blade not so broadly rounded as in ferus." The morphological differences mentioned above are very slight. Moreover, the present study has shown that the seminal depository and sclerotized rings of the female genitalia of the two species are very much alike except that the seminal depository of N. inscriptus (Kirby) is slightly broader and its ridges slightly coarser. The slight differences between these species suggest that they are merely varieties of one species if not the same species.

The shape and position of the sclerotized rings appear to relate this species to N. alternatus Parshley.

Nabis alternatus Parshley

Nabis alternatus Parshley, 1922.

S.D. St. Coll. Tech. Bul. 2, p. 12, Fig. 1

(Figs. 58, 59)

Seminal depository:

Lightly sclerotized, widened medially and tapering gradually cephally; anterior margin round; lateral margins form almost right angles posteriorly; common oviduct opening meso-dorsally at posterior end (Plate 13, Fig. 58). Maximum width .62 mm., maximum length .74 mm.

Sclerotized rings:

Rings form a sclerotized band dorso-ventrally; dorsally, the band forms an arch mesally, interrupted postero-laterally; ventrally, the band is round anteriorly and connects with the dorsal portion postero-laterally (Plate 13, Fig. 59). Maximum width .62 mm., maximum length .43 mm.

Plesiotype: Lava Beds National Monument, Siskiyou County, California. September 5, 1955. Joe Schuh.

The above description was based on a macropterous specimen. Sixteen more specimens were dissected from Colorado, Texas, Oregon and California. The differences in the shape and size of the seminal depository and

sclerotized rings within the species were very slight.

The female genitalia of this species indicate similarity to N. alternatus, color form uniformis Harris and N. ferus var. pallidipennis Harris. It also shows some relationship to N. ferus (Linnaeus)* due to the shape of the seminal depository and the sclerotized rings.

Nabis alternatus, color form uniformis Harris

Nabis alternatus var. uniformis Harris, 1928. Ent. IX, Nos. 1 and 2, p. 67.

(Figs. 56, 57)

Seminal depository:

Same as in N. alternatus Parshley (Plate 13, Fig. 56). Maximum width .68 mm., maximum length .80 mm.

Sclerotized rings:

Same as in N. alternatus Parshley (Plate 13, Fig. 57). Maximum width .68 mm., maximum length .68 mm.

Plesiotype: Pingree Park, Colorado, August 20-25, 1923. C. J. Drake.

The above description was based on a macropterous specimen. Twenty-seven additional specimens from Colorado, Arizona, California and Oregon were dissected. The differences in the female genitalia within this variety were very slight.

* United States

Harris (14, p. 67), in describing this variety stated, "Form and size similar to typical alternatus; differing however, in its paler color, less distinctly spotted hemelytra, pale to brownish abdomen, and uniformly pale connexivum." This study has shown that no differences occur in the seminal depository and sclerotized rings between this color variety and N. alternatus Parshley indicating that it is nothing more than a color variety of the typical alternatus.

This variety showed greater affinity towards N. ferus var. pallidipennis Harris and N. ferus (Linnaeus)* than to any other variety or species of Nabis studied except N. alternatus.

Nabis ferus var. pallidipennis Harris

Nabis ferus var. pallidipennis Harris, 1928. Ent. Amer. IX, Nos. 1 and 2, p. 69.

(Figs. 60, 61)

Seminal depository:

Similar to that of N. alternatus except that it is broader (Plate 13, Fig. 60). Maximum width .86 mm., maximum length .93 mm.

Sclerotized rings:

Similar to that of N. alternatus except that it is

* United States

not so arched mesally and the connection between the dorsal band and the ventral band is at the postero-lateral corner (in N. alternatus it is anterior) (Plate 13, Fig. 61). Maximum width .86 mm., maximum length .76 mm.

Plesiotype: Cedar Falls, Iowa. July 26, 1927. Harris and Johnston.

The above description was based on a macropterous specimen determined by Harris. Two more macropterous specimens from Iowa were dissected.

Harris (14, p. 69), in describing this variety stated, "Usually smaller and slenderer than typical ferus, the color more of a pale yellowish testaceous; hemelytra somewhat translucent, immaculate except for three prominent brown spots on outer vein of corium, abdomen above pale yellowish to brownish." The seminal depository and sclerotized rings of this variety, based on the specimens provided by Harris, are similar to that of N. alternatus, color form uniformis Harris. The only difference found was that the seminal depository of N. ferus var. pallidipennis Harris was a little broader. The author suggests that this variety is a variety of alternatus not of ferus (United States).

subgenus Himacerus Wolff 1811

This subgenus is confined in distribution to the Palearctic and Nearctic regions. The female genitalia of one species, N. major Costa, have been studied.

Despite the fact that only one species was examined, the structures examined appeared to be very distinct. The seminal depository is very short with a narrow anterior end. The common oviduct is broad and opens dorso-anteriorly. The sclerotized rings are fused to encircle the narrow anterior portion of the seminal depository. The anterior wall of the genital chamber, the interramal sclerites and the second valvulae of the ovipositor showed distinctive characteristics.

A study of the other species of the subgenus will be needed before any conclusions can be drawn as to the affinity of this subgenus.

Nabis major Costa

Nabis major Costa, 1842.
Eserc. Ac. Asp. Nat. 1:91.
(Figs. 62, 63)

Seminal depository:

Broad posteriorly; lateral margins gradually narrowing anteriorly, curving abruptly distally; moderately

sclerotized; anterior margin round; common oveduct broad and long, opening dorso-mesally at the plane of the curvature of the lateral oviduct, spermatheca opens mesally into the common oviduct, anterior to the seminal depository (Plate 14, Fig. 62). Maximum width .74 mm., maximum length .62 mm.

Sclerotized rings:

Fused to form one broad, heavily sclerotized open area; encircling the anterior portion of the seminal depository (Plate 14, Fig. 63). Maximum width .37 mm., maximum length .12 mm.

Plesiotype: Corvallis, Benton County, Oregon. July 14, 1957. John D. Lattin.

The above description was based on a macropterous specimen. Six more specimens, three from England and three from Corvallis, Oregon, were dissected.

This species was introduced into the United States from Europe. The study of the female genitalia showed remarkable characteristics discussed under the subgeneric heading above. This species and N. capsiformis Germar of the subgenus Nabis possess sclerotized rings that encircle the seminal depository. This indicates a relationship between the two species but it is rather vague.

Subgenus Stalia Reuter 1872

This subgenus consists of one species, N. boops Schiodte, confined in its distribution to the Palearctic region. The female genitalia of this species were examined. This subgenus appears to be related to the subgenus Hoplistoscelis Reuter (except N. sordidus Reuter) in that the sclerotized rings fuse to form one dorsal open area, the posterior margins of the sclerotized rings are attached to a mesal sclerotized area (except in N. heidemanni (Reuter)); and the position of the openings of the common oviduct are essentially the same (Figs. 64, 17, 19, 21). Further study may prove that the subgenera Stalia Reuter and Hoplistoscelis Reuter are closely related or possibly one of the species is in the wrong subgenus.

Nabis boops Schiodte

Nabis boops Schiodte, 1869.

Naturh. Tidskr. VI. Series 3, p. 200

(Figs. 64, 65)

Seminal depository:

Lightly sclerotized; oval; later edges curve mesally at the posterior end; dorsally a triangular, heavily sclerotized area strongly tapered mesally and extending caudally for a short distance; common oviduct opening

meso-dorsally just posterior to the sclerotized area (Plate 14, Fig. 64). Maximum width .74 mm.; maximum length 1.11 mm.

Sclerotized rings:

Fused to form one open dorsal area, running along the lateral and anterior margins of the seminal depository; whole ring tapering meso-cephally; dorso-posterior margin curving caudally at both ends and attached to the sclerotized area mesally (Plate 14, Fig. 65). Maximum width .74 mm., maximum length .86 mm.

Plesiotype: England. The specimen had a code number and was identified and sent by Southwood from England.

The above description was based on a brachypterous specimen. This species, as previously mentioned under the subgeneric discussion, is closer to N. heidemanni (Reuter), N. deceptivus Harris and N. dentipes Harris, all members of the subgenus Hoplistoscelis Reuter, than to any other species of Nabis studied.

Species a

(Figs. 66, 67)

Seminal depository:

Moderately sclerotized; strongly concave dorsally;

tapers cephally to a blunt anterior end; ventrally forms a fold which covers the anterior margin of ventral wall of the genital chamber; common oviduct opening dorso-mesally at posterior end (Plate 14, Fig. 66). Maximum width .93 mm., maximum length .62 mm.

Sclerotized rings:

Fused to form one broad open area; tapering latero-caudally; posterior margin strongly convex (Plate 15, Fig. 67). Maximum width .89 mm., maximum length .80 mm.

Plesiotype: Montreal, Canada. August 19, 1956. J. A. Slater.

The above description was based on a brachypterous specimen determined as N. limbatus Dahlbom by Slater. It was felt that this species is distinct from N. limbatus Dahlbom. The differences between this species and N. limbatus Dahlbom are: seminal depository tapers cephally; sclerotized rings broad, bending latero-caudally; common oviduct opening meso-dorsally. These characters indicate that the species appears to be a member of the subgenus Dolichonabis or closely related.

Species b

(Figs. 68, 69)

Seminal depository:

Triangular shaped; thickly sclerotized with a blunt

anterior end; shallowly concave; dorsally wrinkled along the sides and ventrally along the base; common oviduct wide and almost half the width of the seminal depository, opening meso-dorsally at posterior end of the concavity (Plate 15, Fig. 68). Maximum width .74 mm., maximum length .70 mm.

Sclerotized rings:

No sclerotized rings were observed on this species (Plate 15, Fig. 69). Possibly they were very lightly sclerotized and disappeared in the clearing process. It is doubtful that they are absent since all other species examined possessed them.

Plesiotype: 2 miles north of Milpitas, Alameda County, California. June 23, 1955. Philip Torchio.

The above description was based on a macropterous specimen. One additional macropterous specimen from the same locality was examined. The specimens were collected by sweeping Salicornia on bare alkali flats near a tide-canal. Efforts were made by the collector to obtain additional specimens of the species from the same area in June 1959 but without success. The specimens did not seem to agree with any of the species treated by Harris (14).

This species did not appear to be related to any species examined during this study. More material and more dissections are needed to decide the affinity of this species.

CONCLUSIONS

The study of the female genitalia of the genus Nabis Latreille has shown that the seminal depository and the sclerotized rings are quite distinct, and are usually good taxonomic characters for separating the species from each other. On the basis of the characters cited above the following species and varieties were found to be either alike or very similar: N. ferus (Linneaus) of the United States and N. inscriptus (Kirby); N. rufusculus Reuter and N. kalmii Reuter; N. alternatus Parshley, N. alternatus, color form uniformis Harris and N. ferus var. pallidipennis Harris.

The subgenera Nabicula Kirby, Hoplistoscelis Reuter, Lasiomerus Reuter, Dolichonabis and Himacerus Wolff based on the species studied proved to be distinct from one another. N. sordidus Reuter did not appear to be related to the other species in the subgenus Hoplistoscelis Reuter.

Too few species of the subgenus Nabis Latreille were examined to allow many definite conclusions. It was apparent, however, that N. flavomarginatus Scholtz and N. vanduzeei (Kirkaldy) were more closely related to N. subcoleoptratus (Kirby) and should be placed in the subgenus Nabicula Kirby. Based on genital characters of the female, N. lovetti Harris and N. capsiformis Germar were quite distinct species. N. roseipennis Reuter seemed

more closely related to N. rufusculus Reuter. N. alternatus Parshley appeared to be closely related to N. ferus (Linnaeus). N. alternatus Parshley and N. alternatus, color form uniformis Harris were shown to be color varieties. N. ferus (Linnaeus) and N. inscriptus (Kirby) were found to be either very closely related or the same species. N. ferus var. pallidipennis appeared to be a variety of alternatus, not of ferus.

N. boops Schiodte, at present placed in the subgenus Stalia Reuter is related to species of the subgenus Hoplistoscelis Reuter.

SUMMARY

1. A comparative study was made of the external female genitalia of the genus Nabis datreille. Two hundred and seventy specimens representing the following subgenera were dissected: Nabicula Kirby, Hoplistoscelis Reuter, Lasiomerus Reuter, Dolichonabis Reuter, Nabis Latreille, Himacerus Wolff and Stalia Reuter.

2. The following twenty-one known species and two varieties were studied: N. subcoleoptratus (Kirby), N. flavomarginatus Scholtz, N. vanduzeei (Kirkaldy), N. heidemanni (Reuter), N. deceptivus Harris, N. dentipes Harris, N. sordidus Reuter, N. annulatus Reuter, N. propinquus Reuter, N. limbatus Dahlbom, N. nigrovittatus Sahlberg, N. lovetti Harris, N. roseipennis Reuter, N. rufusculus Reuter, N. kalmii Reuter, N. capsiformis Germar, N. ferus (Linnaeus), N. inscriptus (Kirby), N. alternatus Parshley, N. alternatus, color form uniformis Harris, N. ferus var. pallidipennis Harris, N. major Costa and N. boops Schiodte, were studied. Two unknown species named A and B were also included.

3. The structure of the female abdomen of Nabis, with special emphasis on the sclerotized genital organs, was described in detail.

4. Discussion of the female genitalia of the subgenera studied was included.

5. Detailed descriptions were given of the seminal depository and sclerotized rings of the species and varieties studied.

6. The relationships between the various taxa studied were given.

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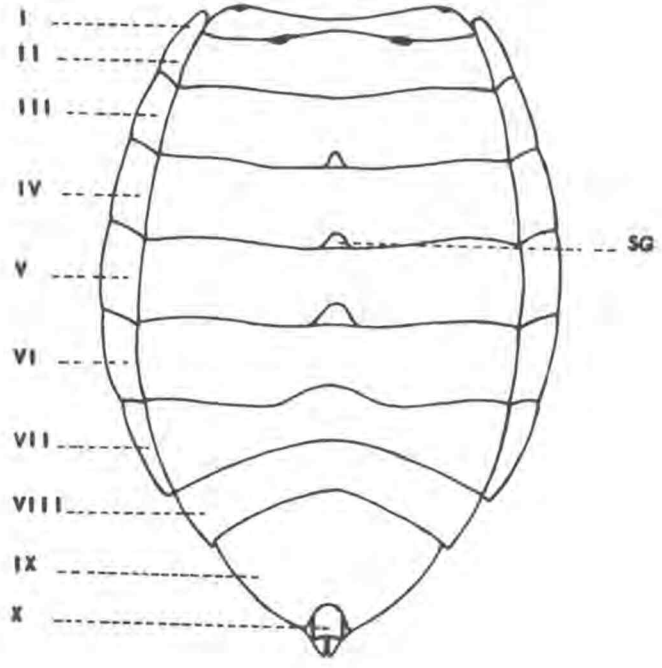
PLATE 1

Fig. 1. Dorsal aspect of the abdomen of the female of N. roseipennis Reuter. x40

Fig. 2. Ventral aspect of the abdomen of the female of N. roseipennis Reuter. x40

PLATE I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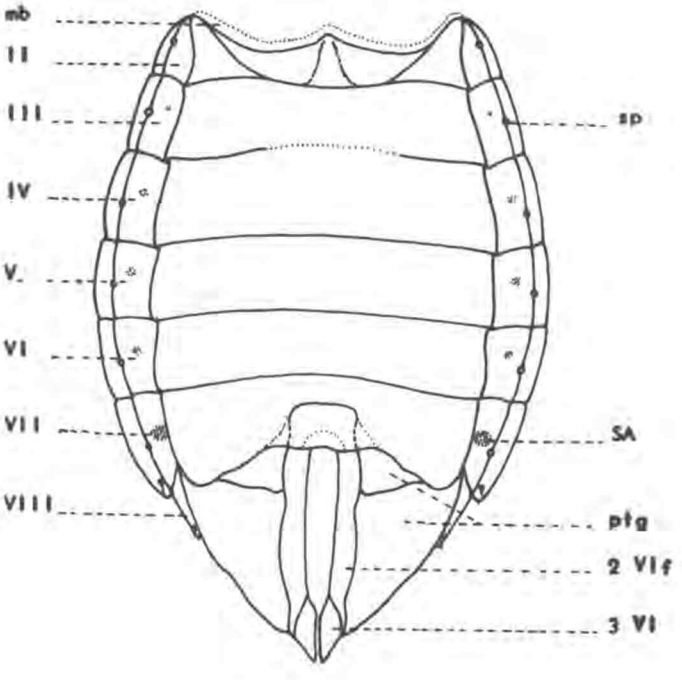
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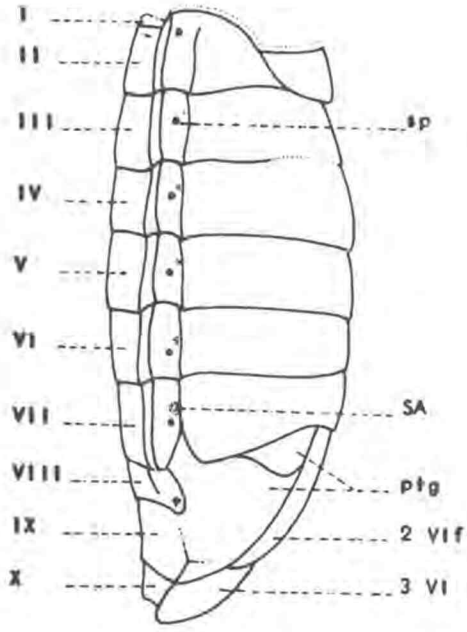
PLATE 2

Fig. 3. Lateral aspect of the abdomen of the female of N. roseipennis Reuter. x40

Fig. 4. Dorsal view of the ventral plate and genital apparatus of N. roseipennis Reuter. x40

Fig. 5. Dorsal view of the right oviduct and ovary of N. ferus (Linnaeus) dissected out to show the ovarioles. x30

PLATE 2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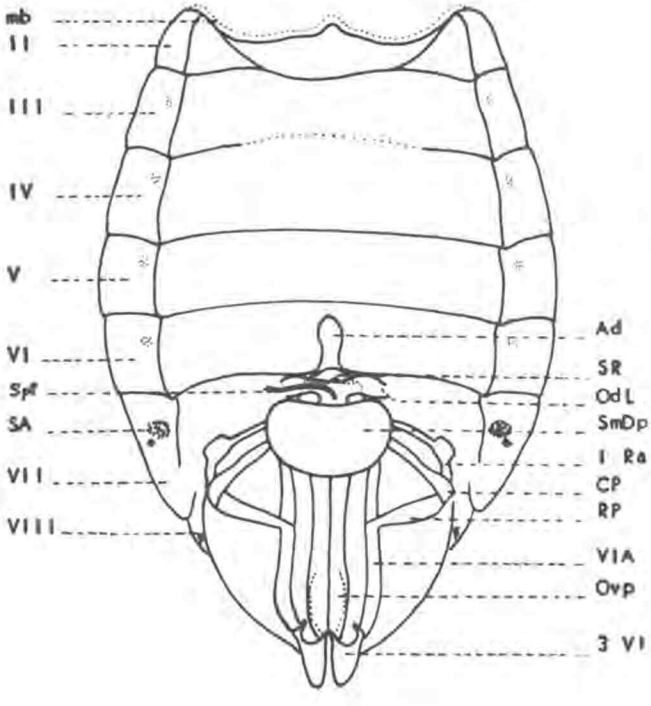
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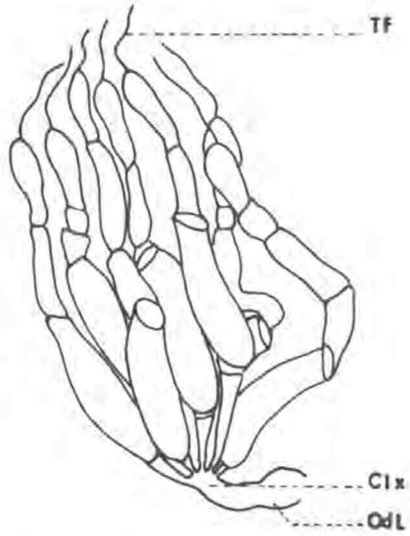
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PLATE 3

Fig. 6. Lateral aspects of the left second valvula and the left second ramus from the left side of the ovipositor of N. rosepennis Reuter. x80.

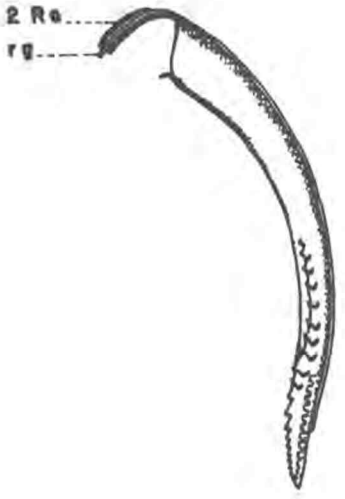
Fig. 7. Dorsal aspect of the left first valvula and the left fibula of the ovipositor of N. roseipennis Reuter. x80

Fig. 8. Dorsal aspect of the genital chamber of N. roseipennis Reuter with the seminal depository removed. x80

Fig. 9. Dorsal aspect of the posterior wall of the genital chamber of N. roseipennis Reuter. x80

Fig.10. Dorsal aspect of the genital chamber with the second valvulae and posterior wall removed of N. roseipennis Reuter. x80

PLATE 3



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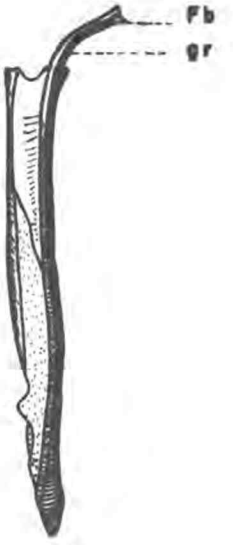

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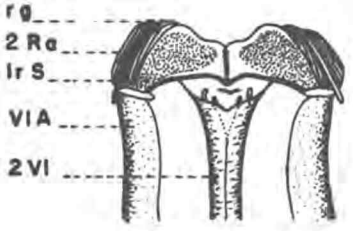

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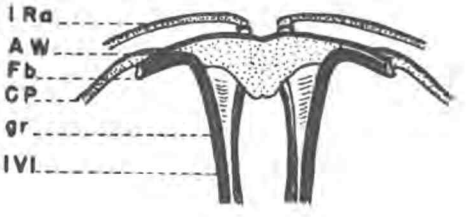

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PLATE 4

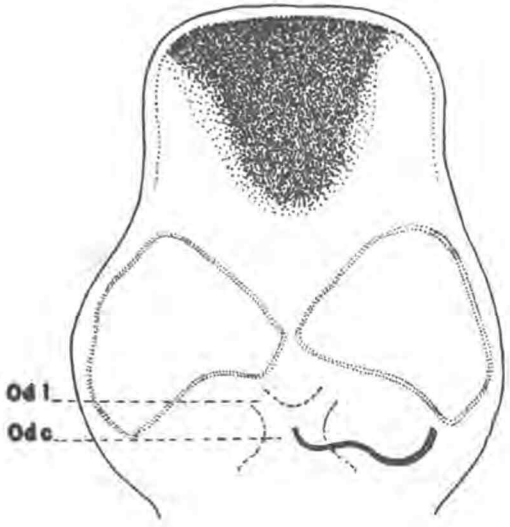
Fig. 11. Nabis subcoleoptratus (Kirby). Dorsal view of the seminal depository. x80

Fig. 12. Nabis subcoleoptratus (Kirby). Ventral view of the seminal depository. x80

Fig. 13. Nabis flavomarginatus Scholtz. Dorsal view of the seminal depository. x80

Fig. 14. Nabis flavomarginatus Scholtz. Ventral view of the seminal depository. x80

PLATE 4



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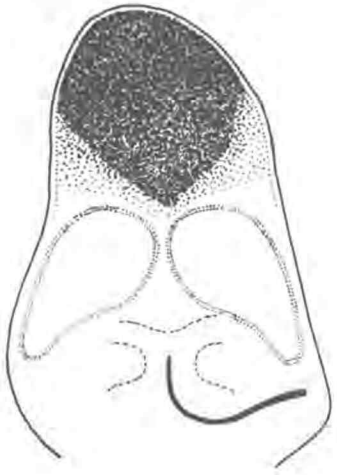

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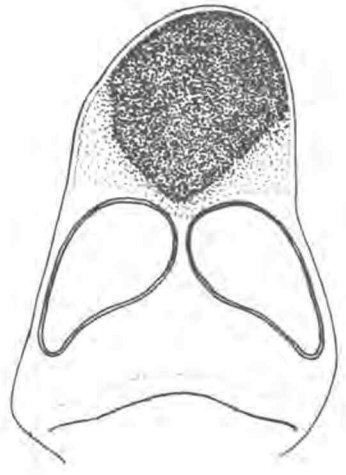

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PLATE 5

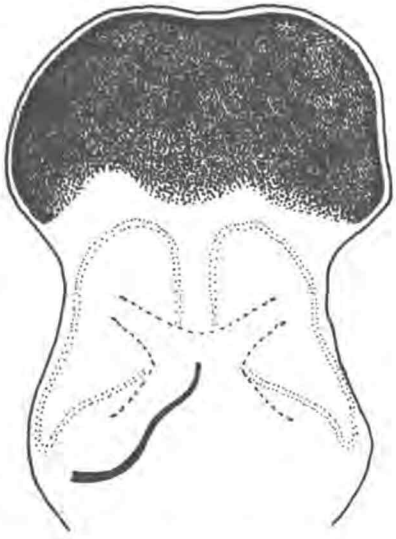
Fig. 15. Nabis vanduzeei (Kirkaldy). Dorsal view of the seminal depository. x80

Fig. 16. Nabis vanduzeei (Kirkaldy). Ventral view of the seminal depository. x80

Fig. 17. Nabis heidemanni (Reuter). Dorsal view of the seminal depository. x80

Fig. 18. Nabis heidemanni (Reuter). Ventral view of the seminal depository. x80

PLATE 5



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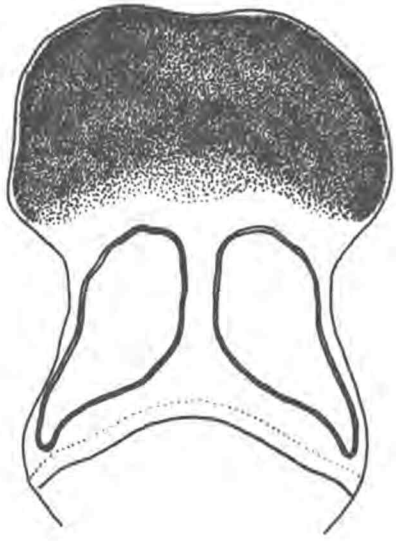

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PLATE 6

Fig. 19. Nabis deceptivus Harris. Dorsal view of the seminal depository. x80

Fig. 20. Nabis deceptivus Harris. Ventral view of the seminal depository. x80

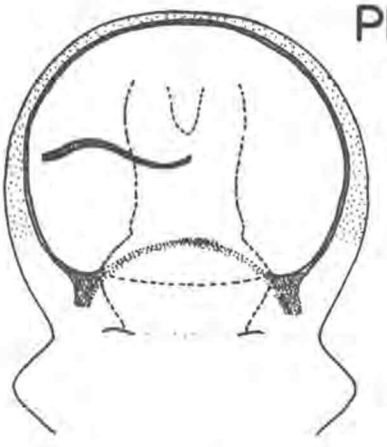
Fig. 21. Nabis dentipes Harris. Dorsal view of the seminal depository. x80

Fig. 22. Nabis dentipes Harris. Ventral view of the seminal depository. x80

Fig. 23. Nabis sordidus Reuter. Dorsal view of the seminal depository. x80

Fig. 24. Nabis sordidus Reuter. Ventral view of the seminal depository. x80

PLATE 6



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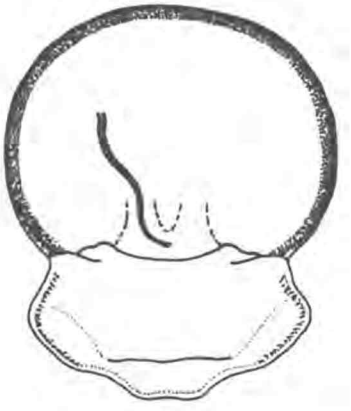

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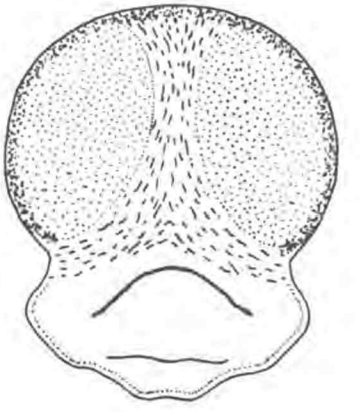

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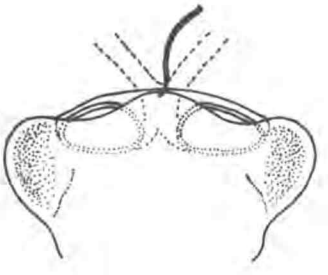

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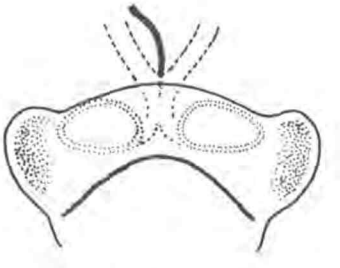

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PLATE 7

Fig. 25. Nabis annulatus Reuter. Dorsal view of the seminal depository. x80

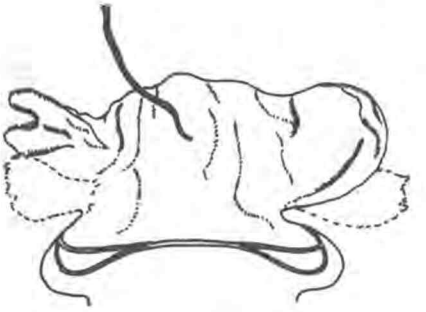
Fig. 26. Nabis annulatus Reuter. Ventral view of the seminal depository. x80

Fig. 27. Nabis propinquus Reuter. Ventral view of the seminal depository. x80 (From England)

Fig. 28. Nabis propinquus Reuter. Dorsal view of the seminal depository. x80

Fig. 29. Nabis propinquus Reuter. Ventral view of the seminal depository. x80

PLATE 7



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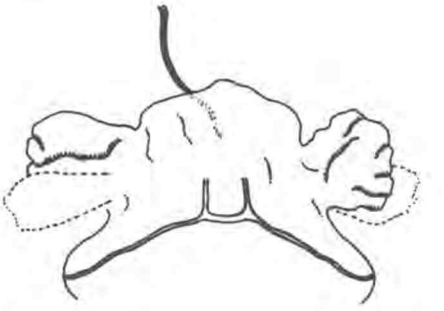

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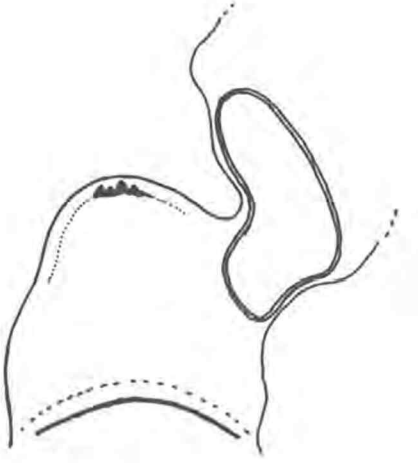

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PLATE 8

Fig. 30. Nabis limbatus Dahlbom. Dorsal view of the seminal depository. x80

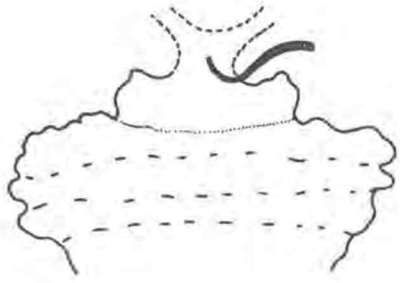
Fig. 31. Nabis limbatus Dahlbom. Ventral view of the seminal depository. x80

Fig. 32. Nabis limbatus Dahlbom. Ventral view of the sclerotized rings. x80

Fig. 33. Nabis nigrovittatus Sahlberg. Dorsal view of the seminal depository. x80

Fig. 34. Nabis nigrovittatus Sahlberg. Ventral view of the seminal depository. x80

PLATE 8



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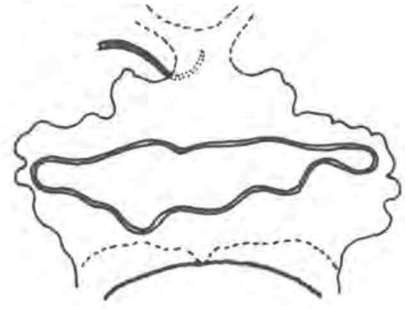

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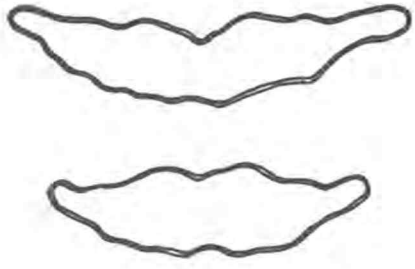

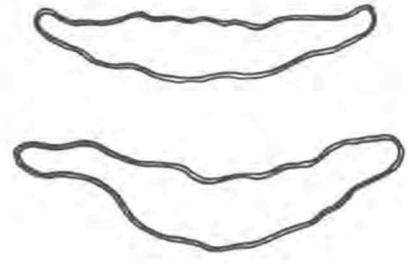

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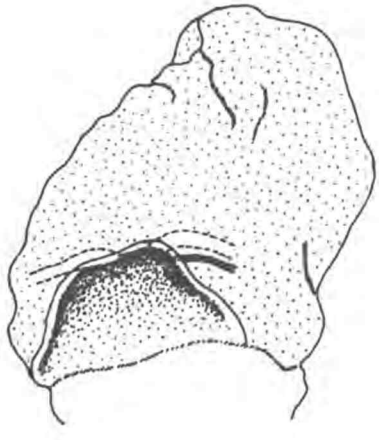

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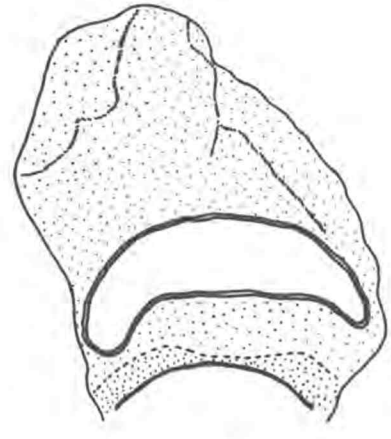

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PLATE 9

Fig. 35. Nabis lovetti Harris. Dorsal view of the seminal depository. x80

Fig. 36. Nabis lovetti Harris. Ventral view of the seminal depository. x80

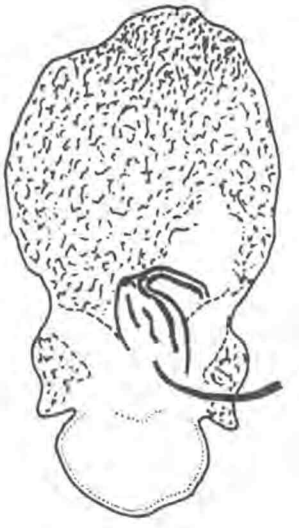
Fig. 37. Nabis roseipennis Reuter. Dorsal view of the seminal depository of the macropterous form. x80

Fig. 38. Nabis roseipennis Reuter. Ventral view of the seminal depository of the macropterous form. x80

Fig. 39. Nabis roseipennis Reuter. Dorsal view of the seminal depository of the brachypterous form. x80

Fig. 40. Nabis roseipennis Reuter. Ventral view of the seminal depository of the brachypterous form. x80

PLATE 9



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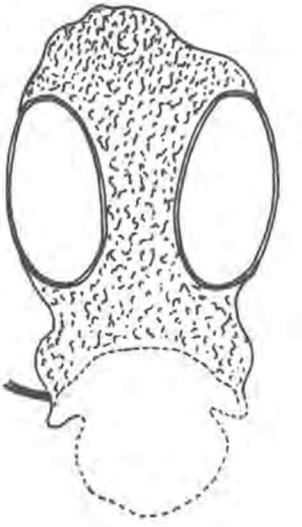

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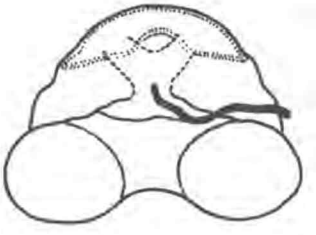

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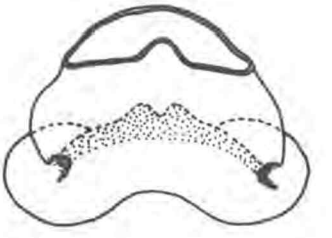

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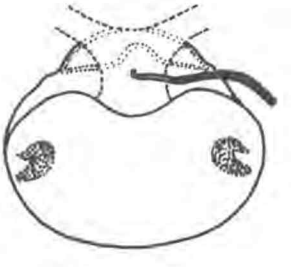

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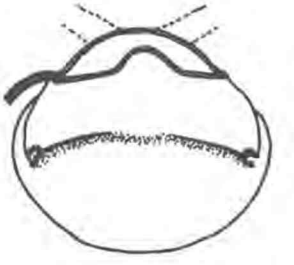

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PLATE 10

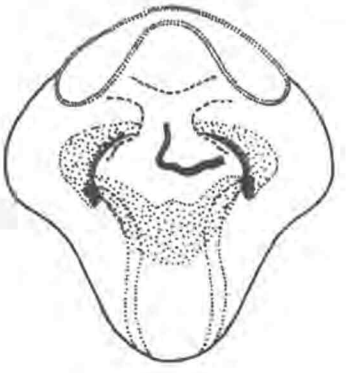
Fig. 41. Nabis rufusculus Reuter. Dorsal view of the seminal depository. x80

Fig. 42. Nabis rufusculus Reuter. Ventral view of the seminal depository. x80

Fig. 43. Nabis kalmii Reuter. Dorsal view of the seminal depository. x80

Fig. 44. Nabis kalmii Reuter. Ventral view of the seminal depository. x80

PLATE 10



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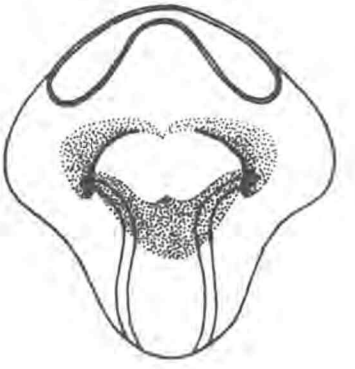

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PLATE 11

Fig. 45. Nabis capsiformis Germar. Dorsal view of the seminal depository. x80

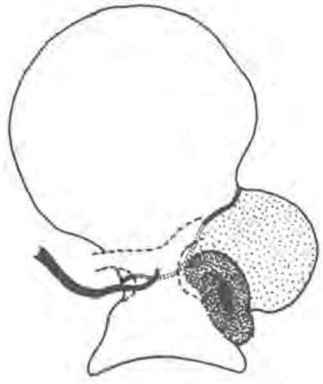
Fig. 46. Nabis capsiformis Germar. Ventral view of the seminal depository. x80

Fig. 47. Nabis ferus (Linnaeus). Dorsal view of the seminal depository. x80 (From England)

Fig. 48. Nabis ferus (Linnaeus). Ventral view of the seminal depository. x80 (From England)

Fig. 49. Nabis ferus (Linnaeus). Ventral view of the sclerotized rings. x80 (From England)

PLATE II



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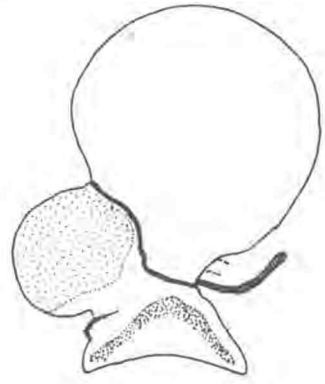

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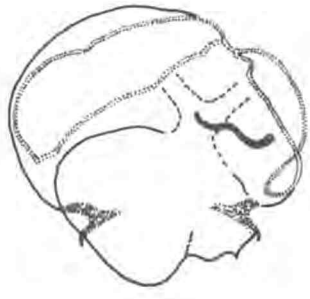

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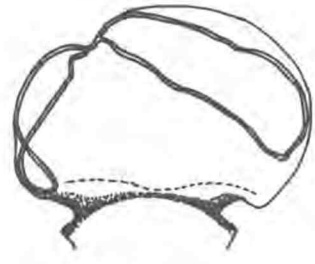

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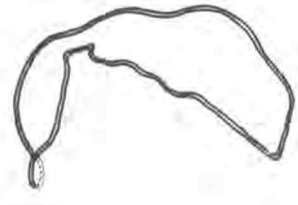

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PLATE 12

Fig. 50. Nabis ferus (Linnaeus). Dorsal view of the seminal depository of the brachypterous form. x80 (From United States)

Fig. 51. Nabis ferus (Linnaeus). Ventral view of the seminal depository of the brachypterous form. x80 (From United States)

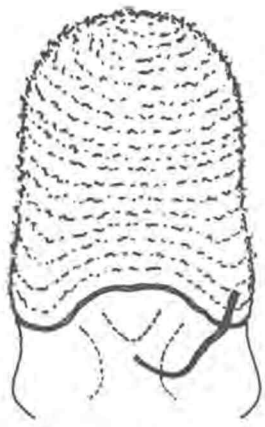
Fig. 52. Nabis ferus (Linnaeus). Dorsal view of the seminal depository of the macropterous form. x80 (From United States)

Fig. 53. Nabis ferus (Linnaeus). Ventral view of the seminal depository of the macropterous form. x80 (From United States)

Fig. 54. Nabis inscriptus (Kirby). Dorsal view of the seminal depository. x80

Fig. 55. Nabis inscriptus (Kirby). Ventral view of the seminal depository. x80

PLATE 12



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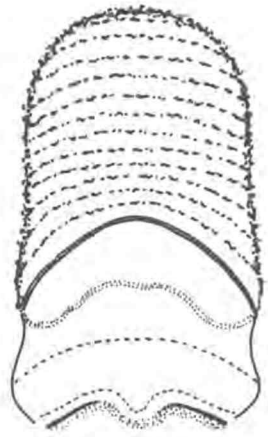

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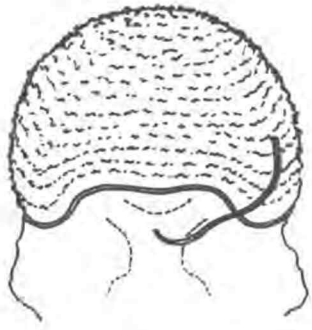

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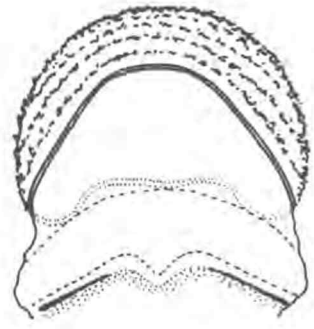

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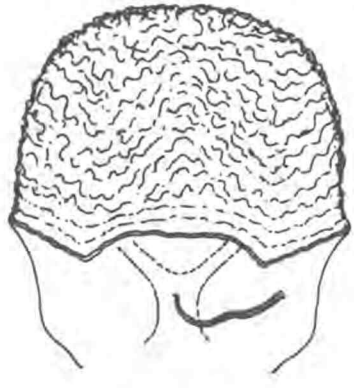

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PLATE 13

Fig. 56. Nabis alternatus Parshley. Dorsal view of the seminal depository. x80

Fig. 57. Nabis alternatus Parshley. Ventral view of the seminal depository. x80

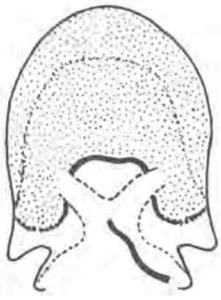
Fig. 58. Nabis alternatus, color form uniformis Harris. Dorsal view of the seminal depository. x80

Fig. 59. Nabis alternatus, color form uniformis Harris. Ventral view of the seminal depository. x80

Fig. 60. Nabis ferus var. pallidipennis Harris. Dorsal view of the seminal depository. x80

Fig. 61. Nabis ferus var. pallidipennis Harris. Ventral view of the seminal depository. x80

PLATE 13



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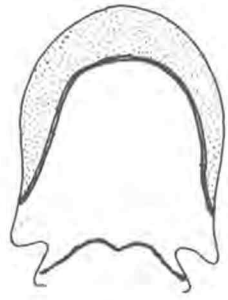

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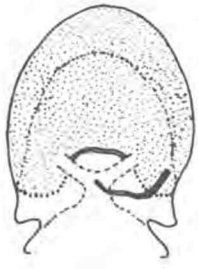

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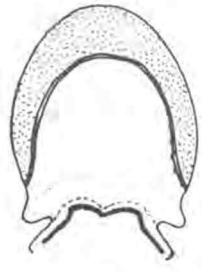

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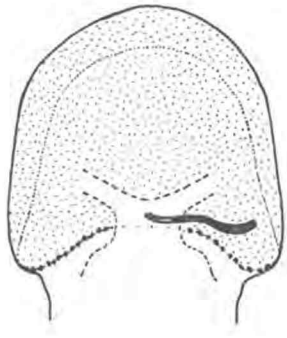

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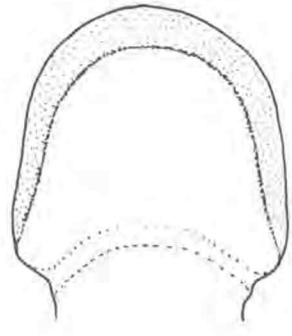

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PLATE 14

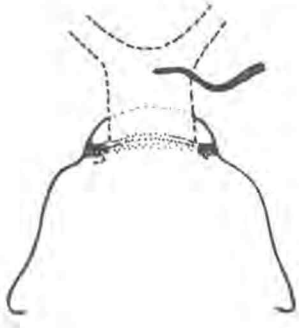
Fig. 62. Nabis major Costa. Dorsal view of the seminal depository. x80

Fig. 63. Nabis major Costa. Ventral view of the seminal depository. x80

Fig. 64. Nabis boops Schiodte. Dorsal view of the seminal depository. x80

Fig. 65. Nabis boops Schiodte. Ventral view of the seminal depository. x80

PLATE 14



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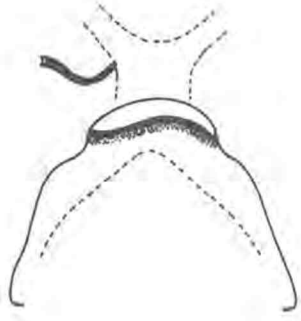

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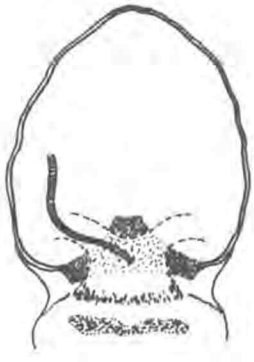

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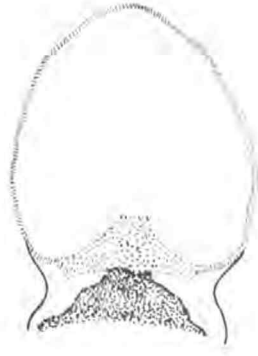

65

PLATE 15

Fig. 66. Nabis a. Dorsal view of the seminal depository. x80

Fig. 67. Nabis a. Ventral view of the seminal depository. x80

Fig. 68. Nabis b. Dorsal view of the seminal depository. x80

Fig. 69. Nabis b. Ventral view of the seminal depository. x80

PLATE 15

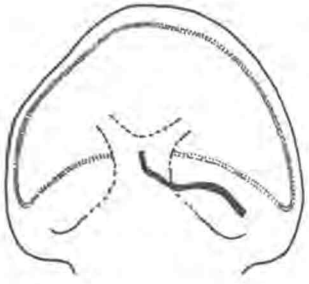

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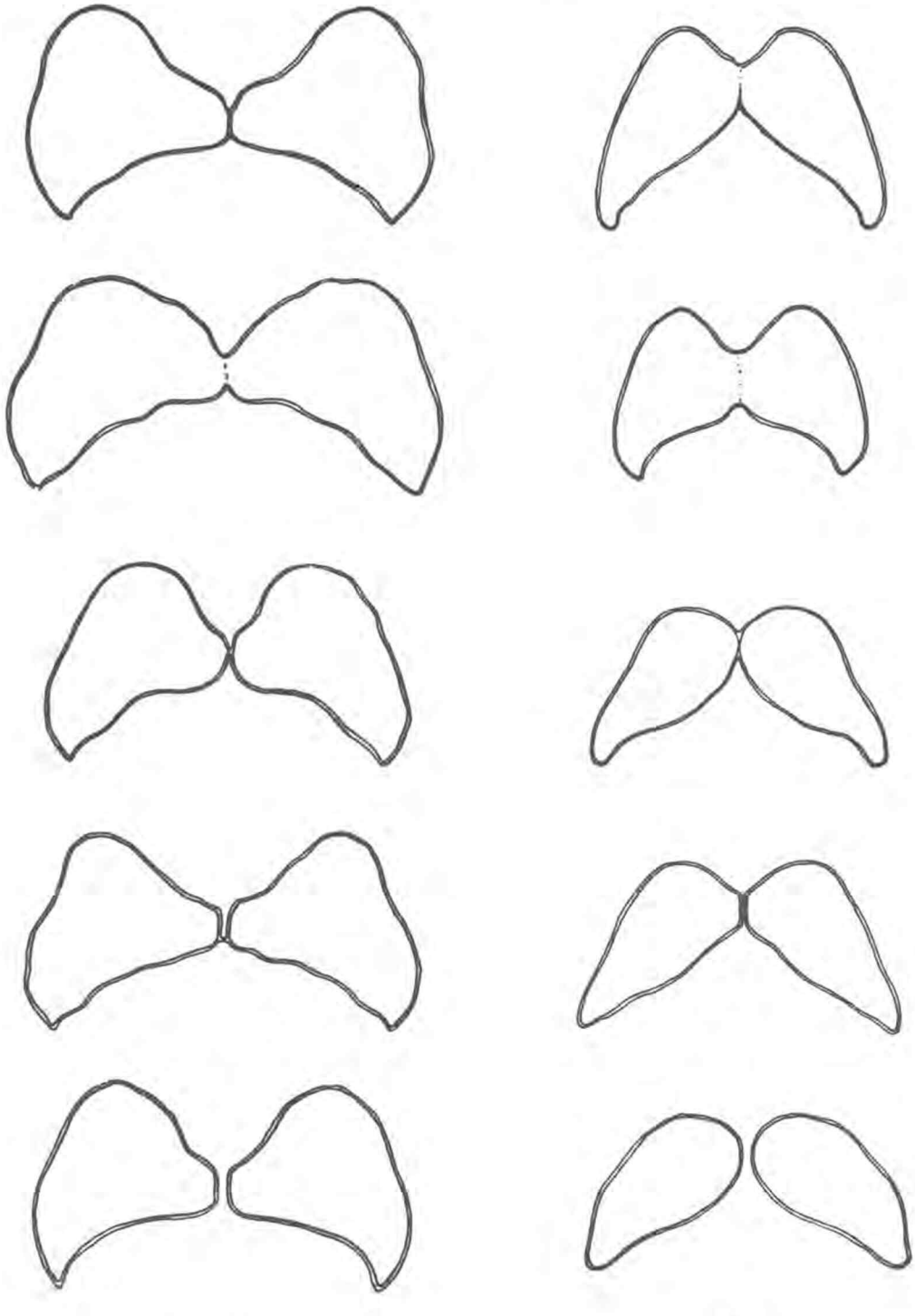
PLATE 16

Fig. 70. Nabis subcoleoptratus (Kirby). Ventral view of the sclerotized rings. x80

Fig. 71. Nabis flavomarginatus Scholtz. Ventral view of the sclerotized rings. x80

PLATE 16



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