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The male reproductive organs of Bruchidae and Chrysomelidae (Coleoptera)

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Summary

The male reproductive organs of 6 Bruchidae and 41 Chrysomelidae species were investigated. The testes, vasa efferentia, vasa deferentia, vesiculae seminales, accessory glands and ejeculatory duct were examined and illustrated. Their structural details were compared among related species and among other taxa. It was found that the differences in the structure and number of testicular lobes and of accessory glands are of systematic importance at generic level while the differences of other structures are systematically significant at various taxonomic levels.

Introduction

Three particular structures of the male reproductive organs of Bruchidae and Chrysomelidae were differently interpreted by previous authors. One of these structures was the testis e.g. a structure accepted as a testis by one author is considered as a lobe of the testis by another. In this work, the interpretation was made on the principle that a structure

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connected directly to the vas deferens was taken as testis and a structure connected to the vas deferens via a vas efferens was taken as a lobe of the testis. Secondly on a histological basis Bordas (1899 and 1900) distinguished two types of accessory glands in beetles; mesadenes having an internal epidermal lining, which is mesodermal in origin, and ectadanes having an internal chitinous lining, which is ectodermal in origin. This terminology was also followed in Bruchinae by Zacher (1930) and Mukerji and Bhuya (1937) but avoided in this work as no histological study was made to determine the origin of these organs. Thirdly, in Bruchidae, distension of the vas deferens, where it is attached to the testis, was called vesicula seminalis by Zacher (1930) and Mukerji and Bhuya (1937) whereas another structure closely resembling the vesicula seminalis of other Chrysomeloidea was called prostate. In this work, the most customary terminology was adopted by analogy throughout the families studied.

The male reproductive organs consist of a pair of testes, vasa efferentia a pair of vasa deferentia, one or two vesiculae seminales, a varying number of accessory glands and an ejeculatory duct. The testes usually lie on either side of the gut; they are white or creamy in most species but yellow in most Galerucinae and Halticinae. Each testis may be single-lobed, bilobed or multilobed and each lobe comprises one or more follicles. The lobes of each testis are usually enclosed in a membranous sheath separately or unitedly. Vasa efferentia and vasa deferentia are variable in size; vasa efferentia may be partially or completely enclosed in the testicular sheath. The vesiculae seminales are usually small, ovoid, one on each side and are usually placed in the middle of vasa deferentia but in some groups they are partially or completely united into one lobe and displaced to the apex of the ejaculatory duct. The accessory glands vary in size and number; they may be tubular, bifurcate or ramified and in one, two, three even five pairs. The ejaculatory duct may be divided into three regions usually with the middle region being the largest or it may be simple, short or long, straight, looped or coiled.

Material and Methods

The specimens examined were collected in various localities of Great Britain by the authors and of Turkey by H. Kasap. The exotic specimens were taken from the collection of R.A. Crowson. Most of the specimens were examined in living state, i.e. each specimen was narcotised with ethyl-ether and dissected in Ringer's solution or distilled water under a binocular stereo microscope. Alcohol preserved specimens were also dissected after softening.

The figures were drawn by free hand to show the fine details of the reproductive organs.

Results and Discussion

Family: Bruchidae

The male reproductive organs of **Zabrotes subfasciatus** Boh. were figured by Zacher (1930) and those of **Acanthoscelides obtectus** Say were briefly described by Daviault (1928) and studied in more detail by Huignard (1975). Mukerji and Bhuya (1937) investigated the male reproductive systems of **Bruchus quadrimaculatus** F. and **Callosobruchus chinensis** (L.) in detail; the reproductive organs of **Acanthoscelides obtectus** (fig. 3), **Zabrotes subfasciatus** (fig. 5), **Euspermophagus sericeus** (Geoffr.) (fig. 4), **Caryedon serratus** (Ol.) (fig. 6) were studied in this investigation.

Our studies reveal a great diversity of structures in the male reproductive organs, making generalisation very difficult, so each species is briefly and separately described below. The pictures of Mukerji and Bhuya (1937) were also reproduced and were reinterpreted the structures of reproductive organs of **Callosobruchus chinensis** (fig. 1) and **Bruchus quadrimaculatus** (fig. 2), using the terminology here adopted for other Chrysomeloidea as the terminology of these authors was very different from that of other authors.

Subfamily 1. **Bruchinae**

In **C. chinensis** and **B. quadrimaculata,** the reproductive organs of the each side (figs. 1,2) consist of a bilobed testis, at least 4 accessory glands, a small vesicula seminalis in both species, the testis opens to the largest, baloon-like accessory gland. According to Mukerji and Bhuya (1937) in **B. quadrimaculata** one of the accessory glands may occasionally divide into branches and the number of the accessory glands of each side may increase to 5; in this case the accessory glands of the genus much resemble those of **A. obtectus.**

In **A. obtectus** (fig. 3), each testis is one-lobed and connected with a large, baloon-like accessory gland (as in above species) which basally, at the apex of vas deferens, unites with another gland consisting of a large reservoir receiving six ramified multitubular structures. Three more accessory glands open to the vas deferens about in the middle. The vesicula

seminalis is short and thick, connecting the testis to the large, baloon-like accessory gland. The ejaculatory duct is rather short and posteriorly distended to form a bulbous reservoir. Our observations on this species confirm those of Huignard (1975).

Subfamily 2. **Amblycerinae**

Eu. sericeus (fig. 4): Each testis bilobed; each lobe elongate with distinct follicles; two short and thick vasa eferentia joining to form a thinner, long a narrow vas deferens; a long tubular accessory gland opening at the middle of the vas deferens and 2 more tubular ones joining together in a common opening just before the apical dilation of the vas deferens to form the vesicula seminalis; the two vesiculae seminales joining to form a short simple ejaculatory duct.

Z. subfasciatus (fig. 5): Each testis bilobed; each lobe pyriform, non-follicular and joined to vas deferens via a narrow and relatively long vas efferens; the accessory glands three on each side, two small, round opening together near the base of the vas deferens and one larger, elongate gland opening to the vesicula seminalis; the vasa deferentia rather short, posteriorly dilated to vesiculae seminales which unite together at the apex of the ejaculatory duct as in **Eu. sericeus**; the ejaculatory duct rather short and simple. Our observations on this species agree with those of Zacher (1930).

Subfamily 3. **Pachymerinae**

C. serratus (fig. 6): Each testis bilobed; each lobe opening into a very large vas efferens and separately enclosed in a membranous sheath; the vas deferens of each side enlarged near the junction of vasa efferentia, gradually narrowing posteriorly; the accessory glands three pairs, in relation to their positions being analogous to those of Amblycerinae, one of them on each side rather large, round and near the base of the vas deferens, two of them small, elongated and opening on opposite sides of the vas deferens at the junction with the vesicula seminalis; the vesiculae seminales as in Amblycerinae; the ejaculatory duct short and simple.

Family: Chrysomelidae

Subfamily 1. **Sagrinae**

In the absence of fresh material, few dry specimens of **Sagra congoana** Clav. were softened and dissected. The fragmentary remains of the male

reproductive organs of one specimen revealed following structures: the testis bilobed; each with numerous distinct follicles and separately enclosed in a membranous sheath; the vasa deferentia rather larger in the proximity of the testes; the number of the accessory glands branching into numerous long tubules forming a large mass, similar to the structures described in **Acanthoscelides obtectus** by Huignard (1975) and here (fig. 3). There was only one multilobular vesicula seminalis at the apex of the ejaculatory duct where the vasa deferentia unite.

Subfamily 2. **Donaciinae**

In **Donacia vulgaris** Zscach. (fig. 7), the testes are bilobed; the vas efferens is short and distended at its origin; each testicular lobe consists of 12 follicles; the vasa deferentia are distended in the middle to form a small, pyriform vesicula seminalis, into which open the accessory glands. There are 2 pairs of long, tubular and sac-shaped accessory glands on each side. The ejaculatory duct is a long, simple, musculated tube. Dufour (1825) figured the male reproductive organs of **Donacia simplex** F., which shows similar features to **D. vulgaris.** Donia (1958) studied **Donacia clavipes** F. which however differs with the two lobes of each testis enclosed in a common membranous sheath and its non-follicular structure and also with the ejaculatory duct divided into three regions with the middle part dilated.

In **Plateumaris discolor** Panz. (fig. 8), the each testis consists of 3 lobules, each corresponding to the follicles as they are enclosed together in a common testicular sheath. There are 2 pairs of accessory glands.

Subfamily 3. **Criocerinae**

According to Donia (1958) **Crioceris asparagi** (L.) has male reproductive organs similar to those of **D. clavipes** figured by him.

Subfamily 4. **Cryptocephalinae**

The reproductive organs of **Cryptocephalus aureolus** Suff. were studied by Donia (1958) and those of **C. rugicollis** Ol. (fig. 9), **C. labiatus** L. and **Brachycaulus ferrugineus** Fairm. were studied here. Between **C. aureolus** and **C.rugicollis** or **C.labitus** there are considerable differences. In **C.aureolus** the testes bilobed; the vasa deferentia short and uniformly narrow; vesiculae seminales small and round, placed at about the end of the vasa deferentia; the accessory glands are one pair, small, ovoid, each opening into

a vesicula seminalis; the ejaculatory duct long and divided into three regions, the middle part being dilated.

In **C. rugicollis** (fig. 9) and **C. labiatus** the testes bilobed; the vasa deferentia rather long and uniformly narrow; vesiculae seminales small, round and placed much nearer the testes; the accessory glands one pair but as compared with the testes they are only a little smaller than the testes; the ejaculatory duct very long, divided into two regions, the proximal region (on the testis side) is short and wide whereas the posterior part is uniformly narrow, long and coiled helically in **C. rugicollis** and irregularly in **C. labiatus.**

B. ferrugineus has the testes and vesiculae seminales resembling those of **C. rugicollis** and **C. labiatus** and one pair of accessory glands are bilobed and surrounding the vasa deferentia. Its ejaculatory duct is convoluted and shorter than that of **Cryptocephalus;** it is only a little distended in the middle.

Subfamily 5. **Clytrinae**

The male reproductive organs of **Clytra novempunctata** Ol. (fig. 11) and **Labidostomis taxicornis** F. (fig. 10) were dissected. In **L. taxicornis,** testes one lobed; the vasa deferentia short and narrow; the accessory glands are two pairs, long and tubular and directly opened to the testes besides the vasa deferentia where there may be vesiculae seminales within the testicular sheath as in **C. novempunctata** (fig. 11B); the ejaculatory duct rather short and a little distended posteriorly.

In **C. novempunctata** (fig. 11), testes round and one-lobed; the vasa deferentia short; the ejaculatory duct moderately long, anteriorly more dilated. Its testes are interesting in showing a rather complicated internal structure as shown in fig. 11B: the follicles are in two groups discharging into a central globular structure which may correspond to the vesicula seminalis and at the base of which there is a sausage-shaped structure opening to the vas deferens which may as well be considered to be the modified accessory gland.

Subfamily 6. **Chrysomelinae**

The male reproductive organs of a number of Chrysomelinae species were studied by Bordas (1899, 1900), Harnisch (1915), Hamnett (1944), Williams (1945), Pavlovskiy and Teravskiy (1958), Donia (1958) and those

of **Phyllocaris cyanicornis** F. (fig. 13), **Chrysolina americana** L. (fig. 14), **Ch. polita** L., **Gastroidea viridula** (DeG.) (fig. 16), **Phaedon tumidulus** Germ., **Phyllodecta vulgatissima** (L.) (fig. 17), **Hydrothassa marginella** (L.) (fig. 18), **Prasocuris phellandrii** (L.) (fig. 19), **Phytodecta pallidus** (L.) (fig. 15), **Plagiodera versicolora** (Laich.) and of **Timarcha tenebricosa** (F.) (fig. 12), were studied here.

In this subfamily there is a considerable variation in the structure of different parts among different species studied. According to the structure of the testes, four groups of species can be distinguished: (i) **Leptinotarsa decemlineata** Say, **Ph. cyanicornis, Chrysolina, Phytodecta** whose testis on each side is bilobed and the lobes are widely separated from each other and each lobe is separately enclosed in a membranous sheath, consisting of a number of follicles e.g. 20 in **Ph. cyanicornis,** 9-14 in **Chrysolina americana** and **Ch. menthastri** Suffr. and only one in **Ch. polita,** 10 in **Chrysomela populi** (L.), 4 **Phytodecta olivacea,** Forst., 22 in **Phyt. pallidus,** (ii) **Pl. versicolora, H. marginella, G. viridula, Phyll. vitellinae** Gyll. with the testis on each side bilobed, both lobes enclosed in a common membranous sheath; in **Pl. versicolora** and **H. marginella** each testis consists of a number of radially arranged follicles, 8 in **Pl. versicolora** and 5 in **H. marginella.** On the other hand in **Gastroidea polygoni** L. each lobe consists of 4-5 irregularly arranged, round follicles (Donia, 1958) while in **G. viridula** each lobe consists of only one follicle (fig. 16). (iii) **Chrysochloa cacaliae** (Schrank) (Bordas, 1900) and **Pr. phellandrii, Phaedon tumidulus, Phyll. vulgatissima,** whose testes are one-lobed comprising a number of round follicles, regularly arranged and about 5 in **Pr. phellandrii** and irregularly arranged and variably numbered in others. (iv) **T. tenebricosa,** whose testis are multilobular, each lobe having a separate vas efferens opening into a central vas deferens. In **T. tenebricosa** (fig. 12A,C), there are 10 lobes per testis, each lobe with many follicles and separately enclosed in membranous sheaths, and the whole testis is enclosed in a second common sheath. In. **T. goettingensis** L., Bordas (1899, 1900) removing both sheaths figured 8 groups (lobes) of follicles, each group with a separate vas efferens and Donia (1958) apparently detaching both sheaths figured 4 big lobes per testis without distinct vasa efferentia and follicles; from the figures of both authors it may be concluded that in **T.goettingensis** each testis has 8 groups of follicles enclosed in a common follicular sheath two by two forming 4 big lobes in each testis.

In the species with bilobed and multilobed testis, the vasa efferentia of each testis may join together at one point forming a kind of reservoir at the apex of vasa deferentia as in **Ch. menthastri, Phyt. pallidus** (fig. 15), **H. marginella** (fig. 18), **Phyllocharis cyanicornis** (fig. 13) and **G. viridula** (fig. 16) or they join the thickened apical part of the vasa deferentia as in **Ch. polita** and **Timarcha** (fig. 12).

In **Ch. americana** (fig. 14), **Gastroidea polygoni** and **Chrysomela populi** the apeces of vasa efferentia are dilated where they connect with the testes and the vasa efferentia of the more anterior lobes are longer. The vasa deferentia are generally long and narrow.

The vesiculae seminales are usually small, pyriform and placed in the middle of vasa deferentia, proximally (on the testis side) receiving one accessory gland besides the proximal part of the vas deferens.

In all the species mentioned above, except in **T. tenebricosa,** there is a pair of accessory glands one on each side opening to the vesicula seminalis anterior to the opening of the proximal part of the vas deferens. They are usually narrow, long and convoluted. In **T. tenebricosa** (fig. 12 A,B), there are 4 pairs of accessory glands. Donia (1958) figured the accessory glands of **T. goettingensis,** taking the short and thick pair as vesiculae seminales. In the same species Bordas (1899, 1900) figured one pair of thick and round structures as accessory glands and no vesiculae seminales. The differences in the structure of testes and of the accessory glands of these two species of **Timarcha** may well be systematically important specific characters.

The ejaculatory duct is short and narrow in **Chrysomela, Phyllodecta Phyt. pallidus;** long and narrow in **Phyt. olivacea** and long and divided into three regions with the middle region dilated in other species studied.

Subfamily 7. **Halticinae**

The male reproductive organs of **Epithrix sp.** were studied by Williams (1945), those of **Longitarsus jacobaeae** (Waterh.), **Haltica palustris** Ws. and **Podogrica menetriesi** (Fald.) by Donia (1958) and those of **Derocrepis rufipes** (L.) (fig. 20), **Crepidodera transversa** (Marsh.), **Chalcoides fulvicornis** (F.), **Longitarsus melanocephalus** (Marsh.), **Psylloides cuprea** (fig. 21), **Aphtona coerulea** (Geoffr.), **Apteropeda orbiculata** (Marsh.) (fig. 23), **Podogrica menetriesi** (Fald.), **Chaetocnema concinna** (Marsh.) and **Sphaeroderma testaceum** (F.) (fig. 22) were investigated in this work.

In all the species studied, the originally paired testes, each consisting of two lobes, are united into a large median testis and enclosed in a common sheath; it is situated dorsal to the gut in the middle of the abdomen. The testes are usually bright yellow, sometimes greyish. The vasa deferentia are short and thin, originating from the united testes to open to the anterior margin of the vesicula seminalis, thus forming a ring around the hind gut. There is a pair of long and narrow accessory glands, each opening to the vesicula seminalis outside the vas deferens (figs. 20-23). The distal end of each gland is highly dilated, increasingly to its proximal end especially in reproductively active stages, as observed in **Apteropeda orbiculata.** There is only one small and oval vesicula seminalis, placed at the apex of the ejaculatory duct, which is a simple and short tube and about as long as the vasa deferentia.

Subfamily 8. **Galerucinae**

The male reproductive organs of **Galeruca tanaceti** L. and **Exosoma lucitanica** (L.) were figured by Dufour (1825), those of **Agelastica alni** (L.) by Bordas (1899), those of **Galerucella birmanica** (Jac.) by Khatib (1946) and those of **Sermylassa halensis** (L.), **Luperus longicornis** (F.) (fig. 24), **Phyllobrotica quadrimaculata** (L.), **Galerucella nymphaeae** (L.) (fig. 25) were studied here.

The male reproductive organs of this subfamily very much resemble those of Halticinae reported above; the only difference may be that the accessory glands of Galerucinae are nearly twice as long and more convoluted.

Subfamily 9. **Eumolpinae**

The male reproductive organs of **Abirus rubripes** Lefev. (fig. 27), **Tricliona** sp. (fig. 29), **Spilopyra sumptuosa** Baly (fig. 26), **Geloptera jugularis** (Er.) (fig. 30), **Pseudopiomera andrewesi** Jac. (fig. 28) and of **Nodina aeneicollis** Jac. (fig. 31) were studied here.

According to the structures of testes, two groups may distinguishable among these species: (i) **A. rubripes, Tricliona** sp. and **S. sumptuosa** whose each testis is bilobed. In **A. rubripes,** the lobes are widely separated and each lobe is composed of 8 radial and elongate follicles and enclosed in a membranous sheath. In **Tricliona sp., S. sumptuosa,** both lobes of each testis are enclosed in a common sheath, each lobe comprising 10 follicles. (ii) in **G. jugularis, Ps. andrewesi** and **N. aeneicollis** each testis is one-

lobed; there are 3 follicles in **G. jugularis**, 4 in **Ps. andrewesi**, 12 in **N. aeneicollis** for the details of other structural differences regarding the testes cf. figs. 28,30 and 31.

The vasa deferentia are moderately long and thick except for **A. rubripes** and **S. sumptuosa** whose vasa deferentia are rather specialised and complicated in structure see figs. 26 and 27.

The vesiculae seminales are round and small in **A. rubripes, Tricliona sp., G. jugularis** and **N. aeneicollis;** in **A. rubripes** they locate in the middle of vasa deferentia whereas in others they are located immediately after the testes. In **S. sumptuosa** and **Ps. andrewesi** there are no distinct vesiculae seminales.

They all have one accessory gland on each side; those of **S. sumptuosa** and **N. aeneicollis** are somewhat short and thick whereas those of other genera are thin very long and convoluted. The position of their attachments vary between the genera see figs. 26-31.

The ejaculatory duct in **N. aeneicollis** is a short and simple musculated tube and in all the other species studied it is divided into 3 regions, the middle part always being dilated; in **A. rubripes** this part forms even a more elaborated structure as seen in fig. 27 with a very long, narrow and helically convoluted distal part.

Subfamily 10. **Cassidinae**

The male reproductive organs of **Cassida viridis** L. were studied by Dufour (1825) and Donia (1958) and those of **C. rubiginosa** Müell., (fig. 32) were studied here.

In these species the testes are bilobed, each testis consisting of distinct follicles. The two lobes of each testis are closely packed together in a membranous sheath. Each lobe has a short and thick vas efferens. The vasa deferentia are relatively thin and long, receiving the accessory glands and the vesiculae seminales in about the middle. The vesiculae seminales are rather unusual with small and oval diverticula attached to the vasa deferentia in the middle so that in appearance these diverticula rather resemble the accessory glands.

There is a rather moderately long and tubular accessory gland on each side; in **C. viridis** they are bell-shaped with three lobes whereas in **C. rubiginosa** they are U-shaped (figs. 32A,B). The ejaculatory duct is long and divided into three regions; the anterior region is narrow and

short, the middle region is moderately long and dilated, the posterior region is extremely long and strongly coiled up.

Subfamily 11. **Hispinae**

The male reproductive organs of **Promecotheca reichei** Baly were studied by Taylor (1937) and of **Hispa testacea** L. (fig. 33) were previously studied by Donia (1958) and in this work. The reproductive organs of this subfamily resemble those of **Cassida.** Each testis is bilobed in **Promecotheca** and one-lobed in **Hispa.** Each lobe contains 7 or sometimes 8 or 9 distinct follicles in **Promecotheca** and 4 follicles in **Hispa.** The lobes of each testis are enclosed together in a common membranous sheath. The vasa efferentia and vasa deferentia are short and thick. There is one accessory gland on each side opening to the vesicula seminalis in **Promecotheca** and close by the vesicula seminalis but to the vas deferens in **Hispa.** The accessory glands are small and balloon-like, resembling those of Camptosomatan groups studied. The ejaculatory duct is as described in **Cassida.**

Systematic conclusions

(a) In the groups studied, the testis may be one-lobed, bilobed or multilobed and the lobes of each testis may be either separately or collectively enclosed in a sheath; each lobe may have many follicles or only one follicle. The testis is one-lobed in **Acanthoscelides obtectus** (Bruchidae), **Plateumaris discolor** (Donaciinae), some Cryptocephalinae, Clytrinae, some Eumalpinae, **Hispa** (Hispinae) bilobed in most of the groups studied and multilobed in **Timarcha** (Chrysomelidae). The differences in the structure of the testis are usually important at generic level, for examples see (g), (j), (l), and (m).

(b) The accessory glands are variable in structure and at least 4 pairs in Bruchinae, 3 pairs in Pachymerinae, Amblycerinae, 2 pairs or more in **Timarcha** (Chrysomelidae), 2 pairs in Donaciinae, Criocerinae, **Labidostomis** (Clytrinae), no accessory glands in **Clytra** (Clytrinae) and only one pair in all the remaining groups studied. The detailed structure of these glands are of systematic importance at generic level, for examples see (e), (g) and (i).

(c) The vesiculae seminalis are not visible only in Clyrinae (enclosed in the testicular sheath), **Spilopyra,** and **Pseudopiomera** (Eumalpinae). In Amblycerinae, Pachymerinae and Sagrinae the two vesiculae seminales are united posteriorly at the apex of the ejaculatory duct, but anteriorly

still separate, in Halticinae and Galerucinae they are completely fused forming one small, ovoid vesicula seminalis placed at the apex of the ejaculatory duct. In the other groups studied the two vesiculae seminalis are well separated and usually situated in the middle of the vasa deferentia.

(d) The ejaculatory duct is long and simple in some Bruchidae, Galerucinae, short and simple in some Bruchidae, Criocerinae, Clytrinae, Halticinae, long and divided into two or three regions (if three, the middle part usually being distended), in Cryptocephalinae, Cassidinae, Hispinae and very variable in others.

(e) Bruchidae can be characterized by a usually short and simple ejaculatory duct at the apex of which the vesiculae seminales united (except for Bruchinae whose vesiculae seminales are separate) and at least three pairs of accessory glands. In Amblycerinae and Pachymerinae can be distinguished from Bruchinae in having three pairs of accessory glands, which are at least four pairs in Bruchinae.

(f) The structure of the basally fused vesiculae seminales and the presence of ramified accessory glands in Bruchidae and **Sagra** (Sagrinae) provide evidences for a possible interrelationship.

(g) **Donacia** can be distinguished from **Plateumaris** in having the testis bilobed, one-lobed in **Plateumaris.**

(h) The general structure of the male reproductive organs are basically similar in Donacilinae and Criocerinae.

(i) Cryptocephalinae can be distinguishable from Clytrinae in having the ejaculatory duct much longer and only one pair of accessory glands, which are either absent or two pairs in Clytrinae. In Clytrinae, **Clytra** can be distinguishable from **Labidostomis** in having no accessory glands, while there are two pairs in **Labidostomis.**

(j) In Chrysomelinae the general structure of the male reproductive organs are very variable and the structural differences are of systematic importance usually at generic and specific levels. According to the structure of the testis 4 groups of genera were distinguished, see in the text.

(k) Halticinae and Galerucinae resemble each other and differ from all the other Chrysomelidae, in having both testes above the gut where they are collectively enclosed in a common testicular sheath with the vasa deferentia encircling the hind gut. On the other hand, Galerucinae may be distinguished from Halticinae in having the accessory glands more convoluted and nearly twice as long as those of Halticinae.

(l) In Eumolpinae the general structure of the male reproductive organs are very variable and the structural differences are of systematic importance at generic level e.g. **Geloptera, Pseudopiomera** and **Nodina** can be separated from the other genera studied in having one-lobed testis and they are distinguishable from each other, **Geloptera** in having three characteristic lobules in each testis corresponding to follicles (fig. 30), **Pseudopiomera** in having four conical radially arranged follicles in each testis (fig. 28) and **Nodina** in having 12 elongate and radially arranged follicles in each testis (fig.31).

(m) The closely related subfamilies Cassidinae and Hispinae can be distinguished from each other, the vesicula seminalis being rather large, saclike and each attached to the vas deferens via a short neck in Cassidinae, but small, ovoid and formed by the symmetrical distension of the vas deferens in the middle, in Hispinae. In Hispinae, **Promecotheca** can be distinguished from **Hispa** in having bilobed testes which are one-lobed in **Hispa.**

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Özet

Bruchidae ve Chrysomelidae (Coleoptera) familyalarının erkek üreme organları

Bruchidae familyasından 6, Chrysomelidae familyasından 41 türün erkek üreme organları çalışıldı.

Testisler, vasa efferentia, vasa deferentia, vesiculae seminales, yardımcı salgı bezleri ve boşaltım kanalı ayrıntılı olarak incelenerek çoğu türlerinki şekillendirildi.

Akraba türler ve diğer taxonlar arasındaki yapısal farklılıklar karşılaştırıldı. Testis loblarının ve yardımcı salgı bezlerinin sayı ve yapılarındaki farklılıkların cins aşamasında, diğer yapısal farklılıkların da değişik taksonomik aşamalarda sistematik öneme sahip olduğu saptandı.

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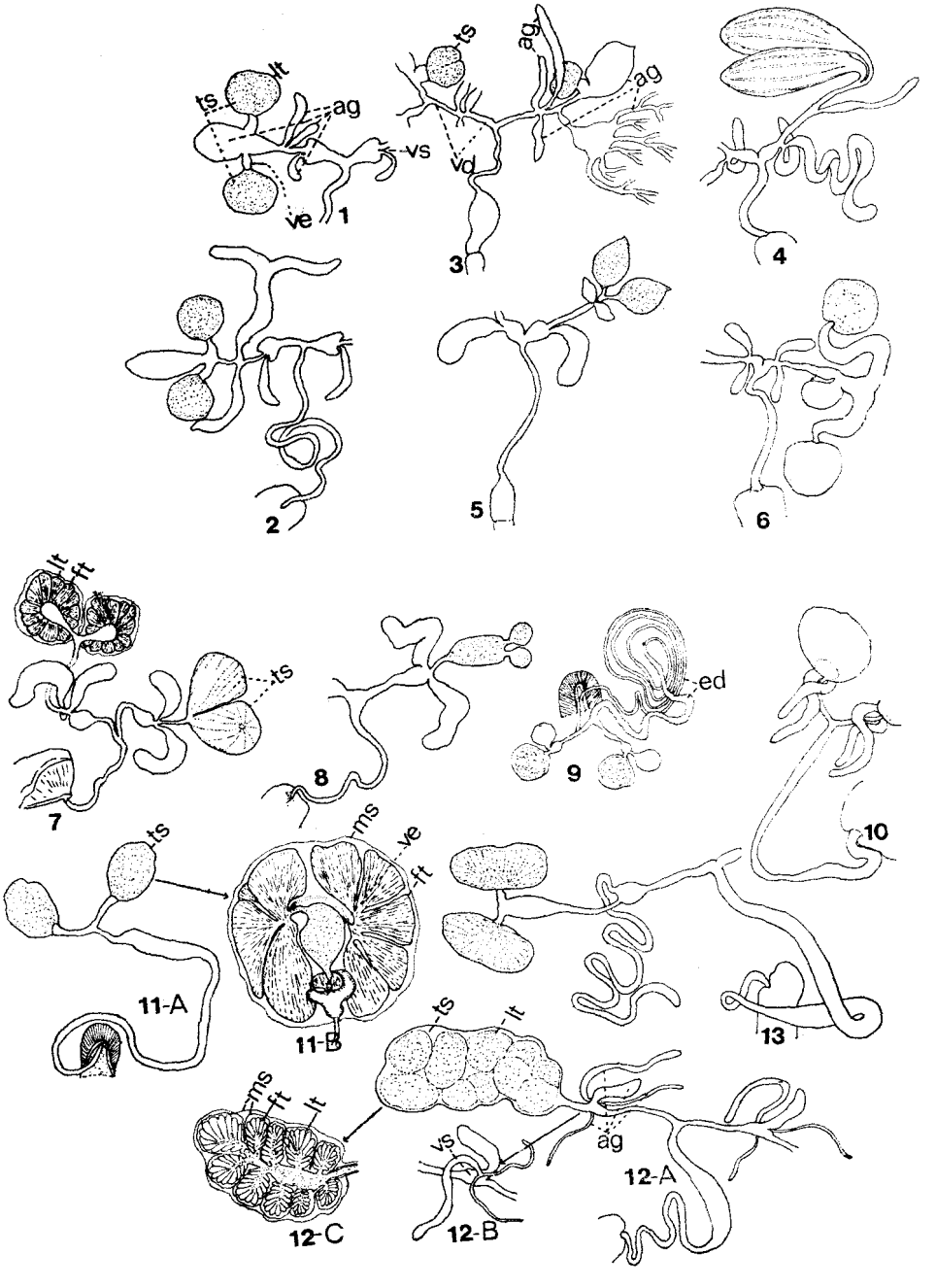
Figs. 1-13; (1) and (2) reproduced from Mukerji and Bhuya (1937); (1) **C. chinensis**, (2) **B. quadrimaculatus**; (3) **A. obtectus**; (4) **Eu. sericeus**; (5) **Z. subfasciatus**; (6) **C. serratus**; (7) **D. vulgaris**; (8) **P. discolor**; (9) **Cryp. rugicollis**; (10) L. **taxicornis**; (11) **Clytra novempunctata**, A- general structure, B- internal structures of one testis dissected; (12) **T. tenebricosa**, A- general structure, B- vesicula seminalis and accessory glands magnified, C- internal structures of the testis dissected; (13) **Ph. cyanicornis**.

Abbreviations for all figures: ag, accessory gland; aed, aedeagus; ed, ejeculatory duct; ft, follicles of testis; lt, lobe of testis; ms, membranous sheath; ts, testis; vd, vas deferens; ve, vas efferens.

Figs. 14-27: (14) **Ch. americana**, A- general structure, B- testis magnified; (15) **Phyt. pallidus**; (16) **G. viridula**; (17) **Phyll. vulgatissima**; (18) **H. marginella**, A- general structure, B- ventral view of a testis and its *vasa efferentia*; (19) **Pr. phellandrii** (20) **D. rufipes**; (21) **Psy. cuprea**, A- general structure, B- testes dissected; (22) **S. testaceum**; (23) **A. orbiculata**; (24) **L. longicornis**; (25) **G. nymphaeae**; (26) **S. sumptuosa**; A- general structure, B- testis and accessory gland magnified; (27) **Ab. rubripes**. Lettering of figures as in figs. 1-13.

Figs. 28-33: (28) **Ps. andrewesi**; (29) **Tricliona sp.**; (30) **G. jugularis**; (31) **N. aeneicollis**; (32) **C. rubiginosa**; A- general structure, B- vesicula seminalis and accessory gland magnified; (33) **H. testacea**; A- general structure, B- testis dissected and magnified. Lettering of figures as in figs. 1-13.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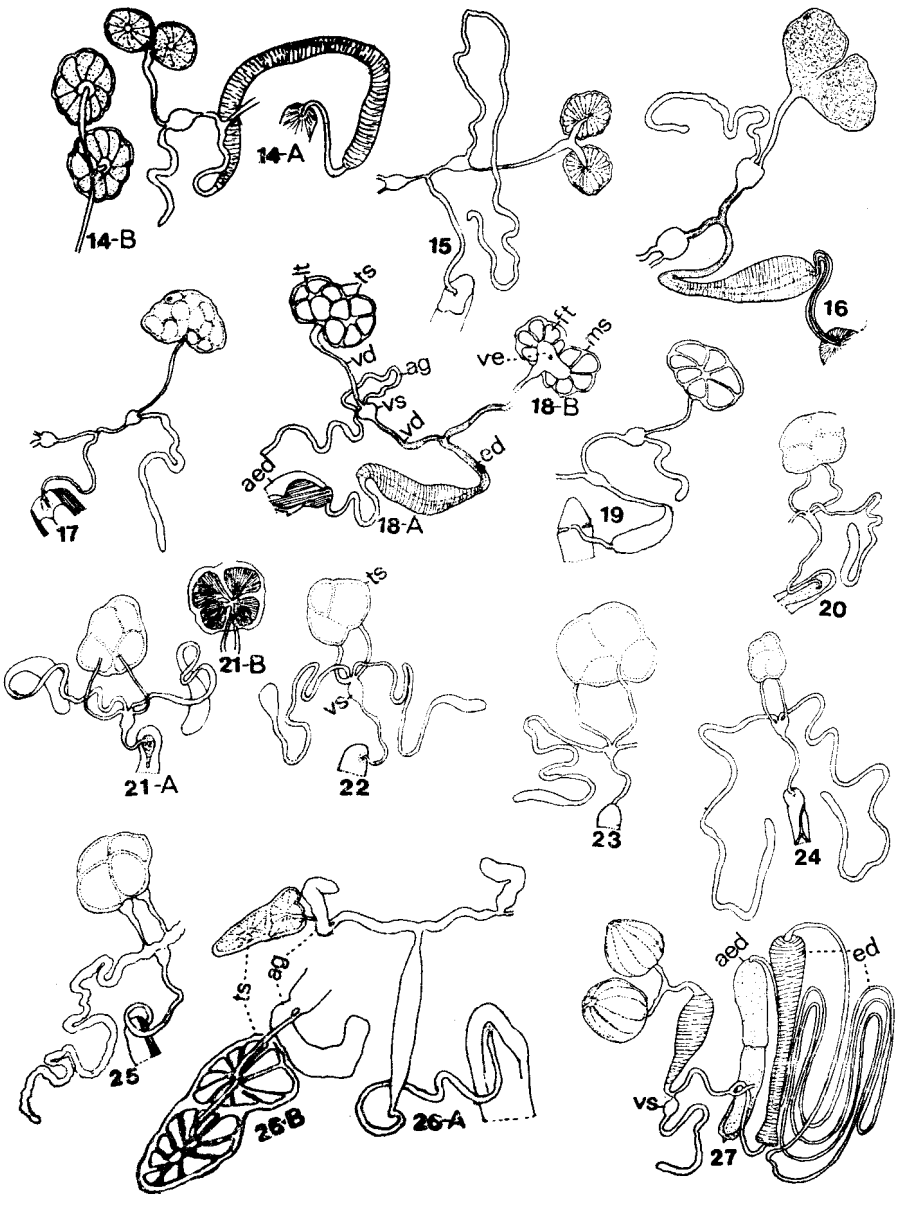
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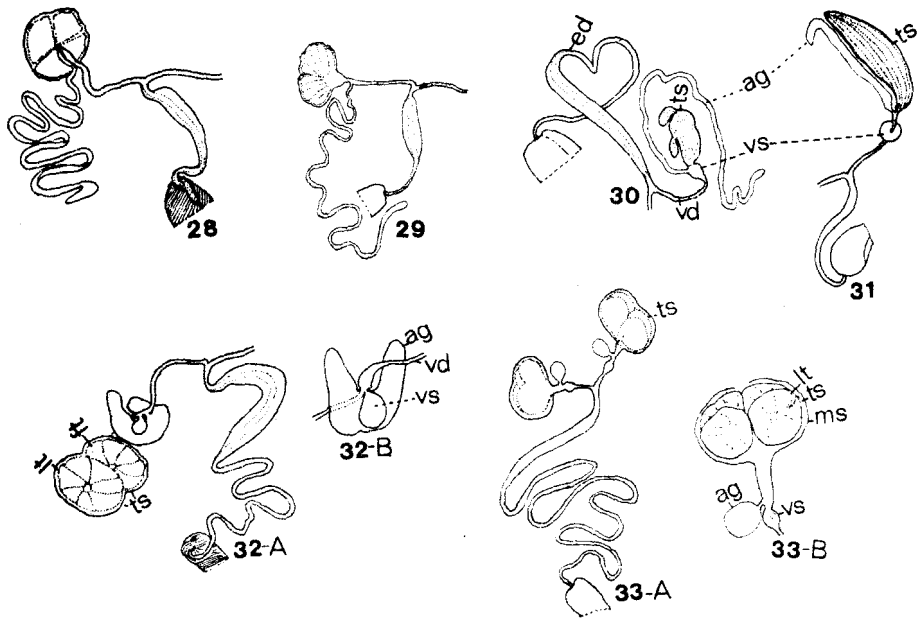
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