The spermatheca of the Dipsocoridae with special reference to the strange "loculus capsulae" in *Harpago* species (Heteroptera, Dipsocoromorpha)

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Résumé – **La spermathèque des Dipsocoridae et l'étrange « loculus capsulae » des *Harpago* (Heteroptera, Dipsocoromorpha)**. – La spermathèque des Dipsocoridae est décrite et comparée dans les trois genres connus de la famille (*Cryptostemma*, *Harpago* **n. stat**., *Pachycoleus*) ; elle est formée de trois parties distinctes : – un long canal enroulé en spirale comprenant un court segment apical différencié (pars intermedialis) dont la fonction reste inconnue ; – une capsule séminale de forme sphérique ; – une petite glande apicale en forme de bulbe dont la région basale est pourvue d'une pompe musculaire. Cette structure reste très constante. La glande apicale en particulier, anatomiquement distincte de la capsule séminale, caractérise l'ensemble des Dipsocoromorpha et apparaît comme un organe unique si l'on considère l'ensemble des Hétéroptères. Une autre particularité, apparemment remarquable, est la position de la capsule séminale dans la cavité abdominale, très constante également, toujours à gauche sous le tergite 7 dans toutes les familles sauf une. La structure que nous nommons *loculus capsulae* semble propre aux deux seule espèces connues du genre *Harpago* ; il s'agit d'une différenciation cuticulaire interne de la partie gauche du 7e tergite formée par deux larges expansions issues respectivement du tergite et du latérotergite qui maintiennent la capsule séminale contre la paroi abdominale. Cette formation s'apparente ainsi à une sorte d'armature de soutien s'opposant à tout déplacement de l'organe dans la cavité abdominale. Certains faits susceptibles d'éclairer la fonction de cette étrange structure sont abordés dans la discussion.

Abstract – The spermatheca of Dipsocoridae is described and compared in the three known genera of the family (*Cryptostemma*, *Harpago* **n. stat**. and *Pachycoleus*); it consists of three distinct parts: a long coiled duct including a short apically differentiated segment (pars intermedialis) of unknown function, a spherical seminal capsule, and a small bulb-shaped apical gland with a muscular pump at its base. The structure of the spermatheca remains very uniform in the family, especially the apical gland that is anatomically distinct from the seminal capsule and which seems to be an apomorphy for the whole Dipsocoromorpha. A recently discovered structure, named here the loculus capsulae, appears to exist only in the two known species of the genus *Harpago*. This internal cuticular structure is situated on the left side of the seventh tergite. It consists of two broad expansions, extending from the tergite and laterotergite respectively, which maintain the seminal capsule near the abdominal wall. This structure appears as a kind of supporting armature impeding the spherical seminal capsule from free movement in the abdominal cavity. The form and function of this strange structure are discussed in this paper.

Within the "primitive" and unusual Dipsocoromorpha (Hemiptera, Heteroptera) (see Wheeler *et al*. 1993; Štys 1995), the Dipsocoridae – which includes some of the smallest true bugs (1.5-3.0 mm) – are known by several main studies: Wygodzinsky (1948), Josifov (1967), Linnavuori (1951, 1959, 1984), Štys (1970, 1990), among others. These authors have described, often in detail, the very differentiated male genitalia and pregenital segments, which exhibit both left asymmetry and curious appendage-like structures. In contrast, the females are poorly studied and less well known but are seemingly less remarkable (Wygodzinsky 1948, 1952, 1953, 1955; Scudder 1959; Štys 1970, 1977; Štys *et al*. 1998).

Recently, a very enigmatic cuticular differentiation has been discovered in females of the two known species

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of *Harpago* (*medium* and *maroccanum*) (1) (Péricart & Pluot-Sigwalt 2002). This structure is located on the left side of the abdomen, beneath tergite VII and appears associated with the spermatheca, namely with the seminal capsule which is housed inside. Accordingly we propose to name this structure the "loculus capsulae".

The Dipsocoridae contain three recognized natural groups (*Cryptostemma*, *Harpago* and *Pachycoleus*) that are regarded as genera or subgenera in the literature. For greater convenience we will consider them as genera in the present paper. In the first part we review the general structure of the spermatheca within the Dipsocoridae and include a detailed description of this structure in *Cryptostemma alienum*. In the second part, we describe the loculus capsulae in the females of the *Harpago* species. Finally, we add a critical review of the literature on dipsocoromorphan spermatheca.

Material and methods

Our goal is to compare females belonging to the three genera of Dipsocoridae. Despite the scarcity of the available material (particularly for *Harpago* species), we have been able to study alcohol preserved or dried specimens of representatives of each genus: *Cryptostemma alienum* (H.S.) (several specimens), *Harpago maroccanum* Wagner (1 specimen), *Harpago medium* Rey (1 specimen), *Pachycoleus pusillimus* (J. Sahlberg) (2 specimens), *P. waltli* (Fieber) (1 specimen). For a comparative purpose, we have also examined females of related groups, *Ceratocombus coleoptratus* (Zetterstedt) (Ceratocombidae) and a female of an unidentified species of Schizopteridae.

The entire individuals or only their abdomens were first observed under a stereomicroscope in glycerol or lactophenol after KOH treatment. Access to internal cuticular structures was performed after dissection, starting with microscopic examination without staining followed by progressive staining with chlorazol black.

We also examined microscopic preparations and histological serial sections made in the year 1950 by Gabrielle and Jacques Carayon. This precious material allowed us to investigate more precisely the structure of the spermatheca in *C. alienum*, and make an easier functional interpretation.

For the terminology of the different parts of the spermatheca, we follow Dupuis (1955, 1970) and the internal classification of the Dipsocoromorpha is that proposed by Štys (1995).

(1) The synonymy of *Cryptostemma* (*Harpago*) *castaneovitreum* Linnavuori, 1951 with *Cryptostemma medium* Rey, 1888 has been recently established (Péricart 2002).

RESULTS

1. The spermatheca in the Dipsocoridae

Preliminary observations of the spermatheca can be made by simply examining the entire cleared specimens. The seminal capsule may be easily observed in dorsal view through the lightly sclerotized integument of the abdomen (figs. 6, 9). In all species examined the capsule appears situated on the left side of the 7th tergite, a location already figured in *Cryptostemma uhleri* by Wygodzinky (1948). We point out this precise location because of its significance (see below and Discussion).

Until now, the spermatheca of the Dipsocoridae has only been figured (without morphological details or functional interpretation) in four species of *Cryptostemma* by Wygodzinsky (1948: *C. uhleri* McAtee & Malloch; – 1952: *C. haywardi* Wygodzinsky; – 1955: *C. usingeri* Wygodzinsky) and Hill (1987: *C. uriarra* Hill).

General structure in *Cryptostemma alienum* (fig. 1A)

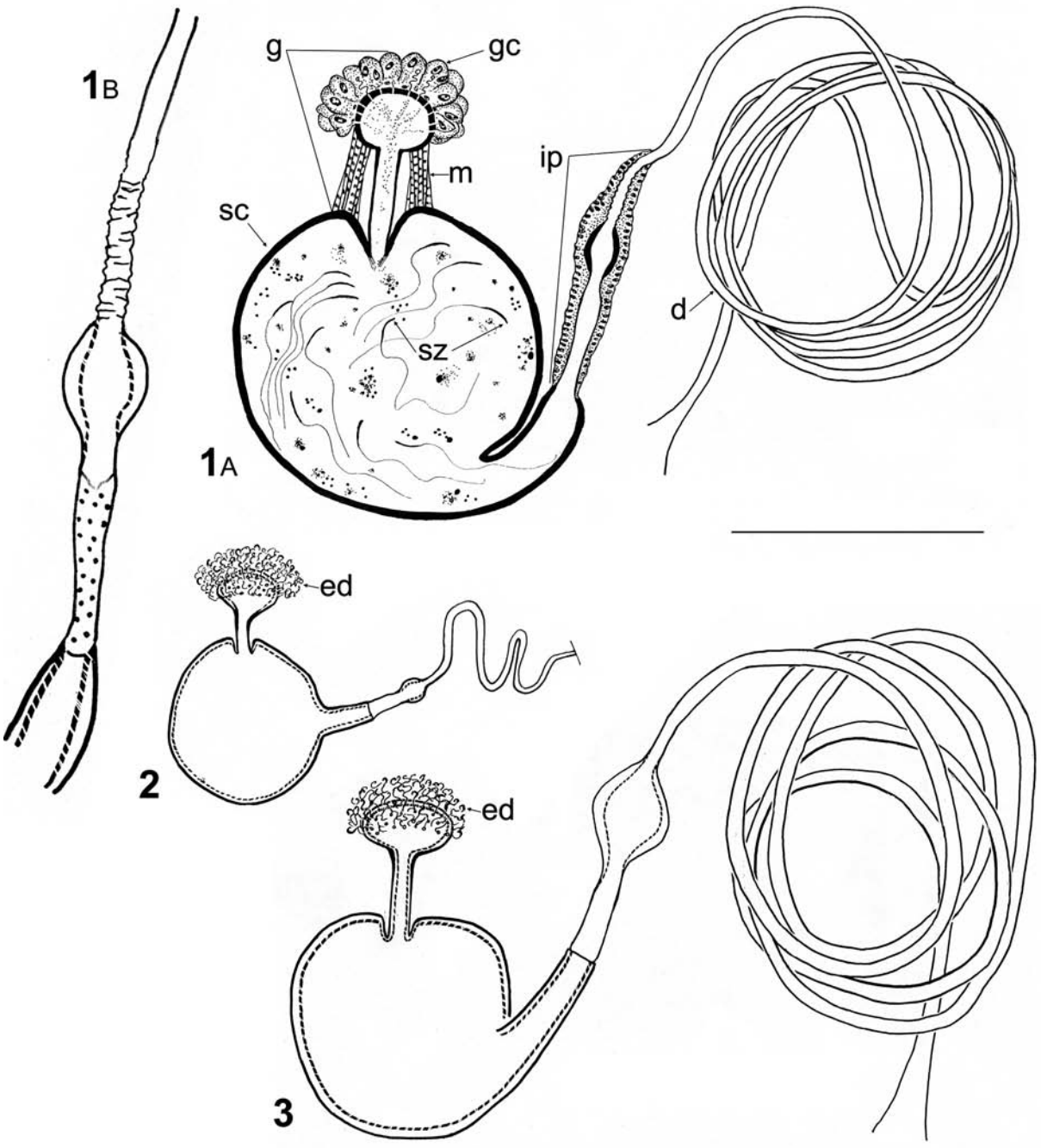
The spermatheca comprises three structurally different parts: a long coiled duct connected to the median vagina, a large seminal capsule and a small apical gland. The opening into the vagina is associated with a "fecundation groove" running in the dorsal vaginal wall.

1. The spermathecal ***duct*** is a long (4-5 mm) coiled canal with a narrow lumen. Based on the cuticular wall (intima) and surrounding epithelial cells, two different regions may be recognized: the *duct* itself (fig. 1, d), which represents the main portion, and the *pars intermedialis* (intermediate piece) (fig. 1, ip), a short distal section leading to the seminal capsule.

– The duct is a very long and narrow tube, regularly coiled in a spiral (at least 10 turns) nearby the seminal capsule as shown in figure 1. Its intima is moderately sclerotized and pigmented, smooth, overlaid with few scattered epithelial cells; it is apparently devoid of any muscle fibres. In the basal part, the lumen widens slightly before the opening into the dorsal wall of the vagina.

– We have named the short distal differentiated section (length of about 0.1 mm) the "intermediate piece" because of its situation between the seminal capsule and the duct, just like the *pars intermedialis* known in the Pentatomomorpha (the "spermathecal pump" of several authors). In fact, the two structures are not homologous (see below and Discussion). The segment is hardly broader than the duct and lined with a thin unpigmented intima; at mid-length it swells into a small vesicular dilatation having a thicker and slightly sclerotized intima. Along the whole length of the intermediate piece, the intima is covered by a prominent and

regular epithelium formed by large cells with basal nuclei. This thick epithelium contrasts with the extremely flattened epithelium of the main part of the duct. No muscle fibre could be observed. Although the role of this section remains obscure the porous aspect of the intima in *C. alienum* and in other species, indicates a possible glandular function (see the different aspect of the intima in fig. 1B).



Figures 1-3
Dipsocoromorphan spermatheca. – 1, *Cryptostemma alienum*. A, General structure drawn from fixed specimens and serial sections. B, cuticular intima of the intermediate part in a cleared specimen. – 2, *Pachycoleus waltli*, cuticular intima in cleared specimen. – 3, *Harpago medium*, idem. – d: duct; g: gland; ed: efferent ductules; gc: gland cell; ip: intermediate piece; m: muscle fibers; sc: seminal capsule; sz: spermatozoans. Scale bar = 0,1 mm (except for 1B)

2. The ***seminal capsule*** (fig. 1, sc), i.e. the true storage organ, is a relatively big sphere (diameter about 0.1 mm). In the basal part, on one side, the spherical capsule turns into a caudal appendage and forms a large and short curved canal leading to the intermediate section of the duct. The cuticular wall of the seminal capsule is thick, smooth, pigmented and sclerotized; it is covered by a virtually indistinct flattened epithelium. In inseminated females the lumen contains numerous spermatozoans (sz) and a small amount of secretion.

3. The ***gland*** (fig. 1, g) appears as a small bulbous-like diverticule on the top of the seminal capsule. The intima is more or less thick and unsclerotized, except where muscle fibres (m) attach, and it is coated by a simple epithelium. The dilated part of the bulb is covered by voluminous glandular cells (gc). The narrowed base opens into the capsule and is entirely surrounded by a stout bundle of muscle fibres (pumping region), the muscles being attached to the cuticular wall of the bulb (which is partly sclerotized at that place) and on the seminal capsule; there are no flanges. Just at the opening into the capsule, the lumen of the gland is more or less occluded by a kind of a soft cuticular valve (septum).

The ***fecundation groove*** is a narrow open canal running in the dorsal wall of the vagina from the opening of the spermathecal duct and forward to the median oviduct. This structure is not easy to observe without histological sections; its sclerotized intima thickens and forms a groove, probably more or less rigid, compared to the vaginal intima, similar to that figured in *Velia* by Pendergrast (1957).

Comparative data (figs. 2, 3)

In other dipsocorid species studied, only the cuticular wall of the spermatheca was examined, so we were unable to observe whether an associated fecundation groove was present or not in *Harpago* and *Pachycoleus*.

The structure of the spermatheca shows a remarkable uniformity in the three dipsocorid genera in the following characters: – seminal capsule of a rather perfect

Figures 4-6

Female abdomen (dorsal view) in cleared specimens of Dipsocoridae. – 4, *Harpago medium*, general view showing the loculus capsulae (lc) on the left. – 5, *idem*, detail of the loculus capsulae. – 6, *Pachycoleus pusillimus*, apex of the abdomen showing the seminal capsule (sc) visible on the left through the translucent integument of the 7th segment.

spherical shape (apart from its caudal appendage) – apical bulbous gland, small – spermathecal duct very long and spirally coiled with an apical region differentiated as an intermediate section. In each part of the spermatheca, the intima shows the same peculiarities as described in *C. alienum*. The bulbous gland appears to be covered by a meshwork of filamentous material, corresponding probably to the cuticular efferent ductules of the gland cells (figs. 2, 3, ed). These ductules are extremely fine compared to the homologous ductules in other groups.

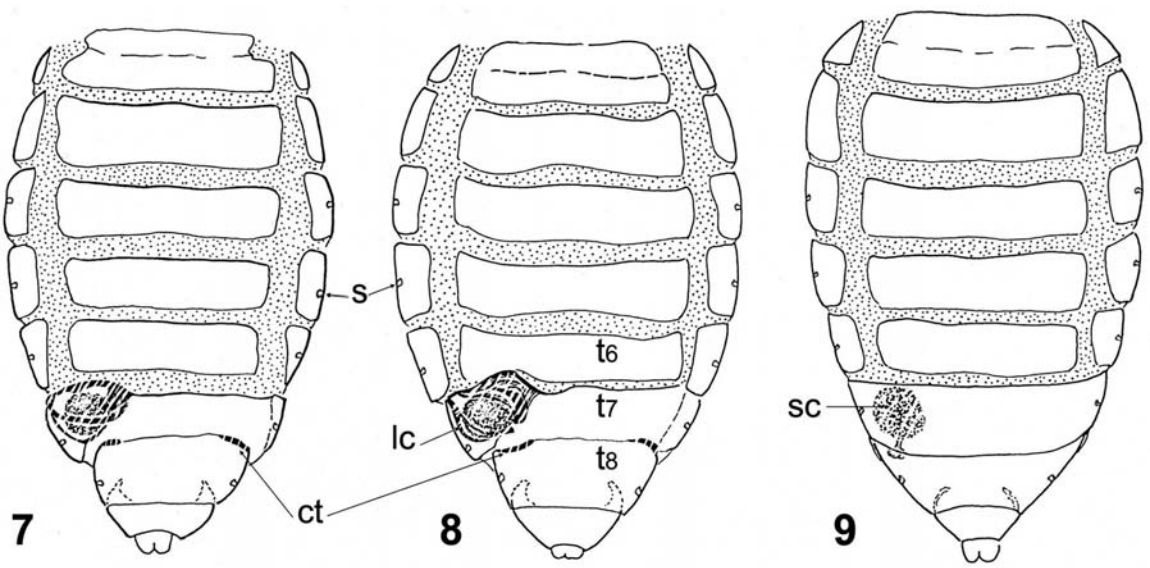
The dimensions of the spermatheca are not very different from one species to another, the only variable part being the intermediate section. This part, especially the median vesicle, is more developed in the two *Harpago* species than in *Pachycoleus* where it seems reduced.

The literature does not mention the presence of such an intermediate piece in the species of *Cryptostemma* studied. In fact this part is not obvious and may pass unnoticed. However, in *C. uhleri* and *C. usingeri*, Wygodzinsky (1948, 1955) depicts the duct with a slight bulge at this level. On the other hand, the length of the duct is never indicated in the literature and cannot therefore be discussed here.

2. The loculus capsulae in the *Harpago* species (figs. 4, 5, 7, 8, 10)

In the two *Harpago* species studied, the structure in which the spermathecal capule is housed is an internal cuticular differentiation of the left part of the 7th tergum. In the cleared specimens, after pushing out the wings, the structure appears very obvious through the thin dorsal integument. At first sight, it looks like a kind of large scar or a dark cuticular defect but a more careful examination reveals the spherical seminal capsule inside a regular formation (figs. 5, 6). The figures 7 and 8 give a general view of the abdomen in the two species.

The asymmetrical abdomen – Unlike the females of *Cryptostemma* and *Pachycoleus*, in which the whole abdomen is symmetrical and "normal" (Štys 1970), the female abdomen of the two *Harpago* species appears slightly asymmetrical posteriorly in dorsal view. Tergites I-VI are symmetrical and unmodified and one can notice between each tergite (except I-II, which are fused) a transverse band, where the membranous integument remains unsclerotised. Tergites VII and VIII are more or less fused and asymmetrical. On tergite VII we see (with difficulty) the right side of the mediotergite partly fused with the very small laterotergite. On the left side



Figures 7-9
Schematic representation of the female abdomen (dorsal view) in cleared specimens of Dipsocoridae. – 7, *Harpago medium*, the loculus capsulae appears obviously on the left of the 7th tergum (note the slight sinistral asymmetry). – 8, *Harpago maroccanum*, idem; the figure shows real but minor differences with the previous species. – 9, *Pachycoleus pusillimum*, showing the free seminal capsule visible on the left. – ct: cuticular thickening; lc: loculus capsulae; s: spiracle; sc: seminal capsule; t: tergite.

the whole part is transformed. On the internal face of tergite VIII, two cuticular thickenings (fig. 10A, ct) appear laterally along the anterior margin of the segment.

Spiracles IV to VIII are situated on laterotergites (figs. 7, 8, s), slightly ventral and very near the dorso-ventral fold.

The loculus capsulae – This consits of two strong lamellar expansions (fig. 10B, C, le1, le2) derived from the left laterotergite VII and the mediotergite VII respectively. These expansions curve themselves on entering the general cavity, each of them forming a half-wall and together confine the capsule in a kind of loose cage. The expansion of the laterotergite appears to be the "posterior wall" of the cage (fig. 10B) and that of the mediotergite plays the same function anteriad and mesad (fig. 10C). The thin spermathecal duct runs freely through the cage to the vagina. The intermediate part is apparently in the cage.

In *Harpago maroccanum*, the arrangement of the two lamellar expansions exhibits the same structure as in *H. medium* with only a little differences in shape and arrangement. However, the cleared specimen was not dissected and only examined by a classical light microscope.

We were unable to examine fresh or fixed material, so we do not know if some tissue, muscle fibers in particular, are combined with the cuticular walls of the loculus capsulae.

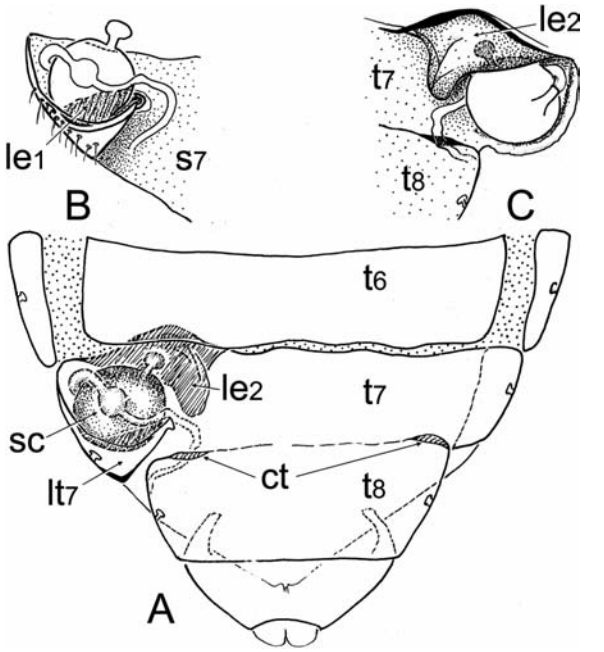


Figure 10
The loculus capsulae in *Harpago maroccanum*. A, dorsal external view. – B, detail of the structure in dorsal internal view after removal mediotergite 7; the laterotergite is still in place. – C, same, but in ventral and internal view after removal of the sternite. – ct: cuticular thickening; le1, 2: lamellar expansion 1 and 2; lt: laterotergite; s: sternum; sc: seminal capsule; t: tergite.

3. The dipsocoromorphan spermatheca: a critical review of the literature

In order to estimate whether the spermatheca of the Dipsocoridae presents some peculiarities within the Dipsocoromorpha or not, we have closely examined the literature. The data are various, fragmentary and disparate, and somewhat hard to compare because of the lack of uniformity in the terminology used and also to some extent because of a lack of precision. Nevertheless some conclusions can be drawn.

– The same ground plan is seen in other dipsocoromorphan families where the spermatheca has been described or figured: Ceratocombidae (Wygodzinsky 1951; Pendergrast 1957; Emsley 1969; Štys 1977), Hypsipterygidae (Emsley 1969; Štys 1970), Schizopteridae (Wygodzinsky 1950a; Miyamoto 1960; Emsley 1969; Štys 1974, 1985; Hill 1990), Stemmocryptidae (Štys 1983). In our opinion, all the examined species have fundamentally the same type of spermatheca, i.e. a seminal capsule (more or less elongated or spherical) provided with a small bulbous gland. In any case the apical bulbous gland is always present, with notable constant features as already observed by Pendergrast (1957), Emsley (1969), Štys (1970).

It is here necessary to emphasize that some mistakes have been made in the functional interpretation of the different parts of the spermatheca. Pendergrast (1957) alone indicates clearly that the seminal capsule (bulb) in *Ceratocombus* is the proper sperm storage region. Also, authors have referred to the different parts of the spermatheca by different names. For instance, the apical gland particularly is named either "bulb" or "spermathecal pump", but never « gland » in spite of the fact that the ductules (ducteols) of the gland cells were observed by Pendergrast. Furthermore, on the grounds of its bulbous shape and its muscular pump, this gland has often been misinterpreted as the seminal capsule. Likewise, the seminal capsule was often seen as an enlarged part of the duct.

– A functional spermatheca is present in all dipsocoromorphan genera already examined but there are some contradictions concerning the genus *Hypselosoma* (Schizopteridae). Accordingly, Wygodzinsky (1960), followed by Štys (1970), indicated that the spermatheca is absent ("non développée") in this genus. For his

part, Emsley (1969) indicates that the tribe Hypselosomatini, defined by Esaki & Miyamoto (1959), is characterized by a "nearly spherical spermatheca", however we were unable to find this statement in the paper of these authors.

– As indicated above, no author has mentioned the presence of a modified section of the spermathecal duct adjacent to the seminal capsule, as we have described in Dipsocoridae. In *Ceratocombus coleoptratus* and in an unidentified species of Schizopteridae we are able to confirm the absence of the intermediate part of the ductus. The length of the duct, when precised apart, appears as more or less elongated and coiled, depending on species, but never so much as in Dipsocoridae and *Trichonannus* (Ceratocombidae) (Wygodzinsky 1953).

– Another peculiarity is the location of the seminal capsule regularly situated at the extreme left side below the 7th tergum. We have observed this location (even after KOH treatment, as well as in dried and alcohol specimens) in all studied specimens and in other dipsocoromorphan families (see Ceratocombidae: Wygodzinky 1951; Štys 1977; Hypsipterygidae: Štys 1970; Schizopteridae: Emsley 1969; Štys 1985). Only in *Stemmocrypta* (Stemmocryptidae) is the spermatheca figured in the middle of the abdomen (Štys 1983).

In all species the seminal capsule appears free in the abdominal cavity, except in the two species of *Harpago* where a loculus capsulae is present.

DISCUSSION

It is now accepted that the Dipsocoridae and all other dipsocoromorphan families constitute one of the more mysterious groups of Heteroptera. All authors agree that this group is very ancient and difficult to classify, as much of its representatives show a remarkable mixture of plesiomorphies and autapomorphies (Cobben 1968, 1978; Štys 1970, 1990, 1995). Štys (2002) challenged the monophyly of the Dipsocoromorpha and suggested to subdivide it into Dipsocoromorpha s. str. (Stemmocryptidae and Dipsocoridae) and a new infraorder Ceratocombomorpha (Ceratocombidae, Hypsipterygidae and "Schizopteridae").

Both the spermatheca and the loculus capsulae described in this paper appear as two remarkable structures bringing useful additional information concerning the group. They also give rise to many questions about their function and their origin. In concluding this study, only some facts can be brought together and some ideas advanced, particularly for the loculus capsulae. We examine below whether this strange structure may be related to one or several male or female peculiarities.

The spermatheca of the Dipsocoromorpha: an unique structure among Heteroptera

As already said by Pendergrast (1957), the dipsocoromorphan spermatheca is unclassifiable and indeed, as we will now show, of a type found no where else in the Heteroptera. Dupuis (1963) pointed out that the dipsocorid spermatheca appears with « un net faciès Trichophorien; les figures disponibles ne permettant pas d'affirmer l'existence d'une pompe spermatique vraie ». True, the resemblance is real but misleading for at least the following reasons.

(1) No homology can exist between the muscular pump of the apical gland in dipsocorids and the one existing at the base of the seminal capsule of the Pentatomomorpha (*pars intermedialis*) which is a differentiation of a part of the spermathecal duct (Dupuis 1955).

(2) In the same way, as stated above, the apical differentiated section of the spermathecal duct (intermediate section) in Dipsocoridae cannot be homologous with the intermediate piece known in Pentatomomorpha. Both formations are similarly located but not of the same structure and certainly not with the same function. Contrary to the Pentatomomorpha, the intermediate section is not a pumping region (muscle fibers being apparently totally absent).

(3) To our knowledge, the occurrence of an apical gland, as an organ anatomically distinct of the seminal capsule, has never been recorded among Heteroptera. Such a gland is a distinctive feature of the Dipsocoromorpha. In all heteropteran species with spermathecal gland functionnally present, the secretory cells cover directly the seminal capsule and do not form a distinct unit. Nevertheless, in Corixoidea (Corixidae, Naucoridae, Ochteridae) the spermathecal glands may be a tubular outgrowth more or less distinct of the seminal capsule (see Larsén 1938; Pendergrast 1957). However these data need confirmation because some of our unpublished observations in Corixidae are contradictory.

The fecundation groove: a non-unique structure for Dipsocoromorpha

The presence of a fecundation groove in the dorsal wall of the vagina, associated with the spermatheca, is relatively widespread in some other heteropteran groups. This structure is apparently involved with the migration of spermatozoa towards the median oviduct where fecundation takes place. In fact, the condition of the groove represents a rudimentary form of the well known and widespread fecundation canal in Gerromorpha (see

Pendergrast 1957; Andersen 1982). Note however, that the development of such a structure (as groove or canal) has evolved independently several times in unrelated groups e.g. in Gerromorpha (as seen above), Leptopodomorpha (Cobben 1968: Omaniidae and Leptopodidae), and Pentatomomorpha (Scudder 1959 and Gaffour-Bensebbane 1990 in Scutelleridae; Pluot 1970 in Pyrrhocoridae).

Peculiarities of the spermatheca in Dipsocoridae and *Harpago* species

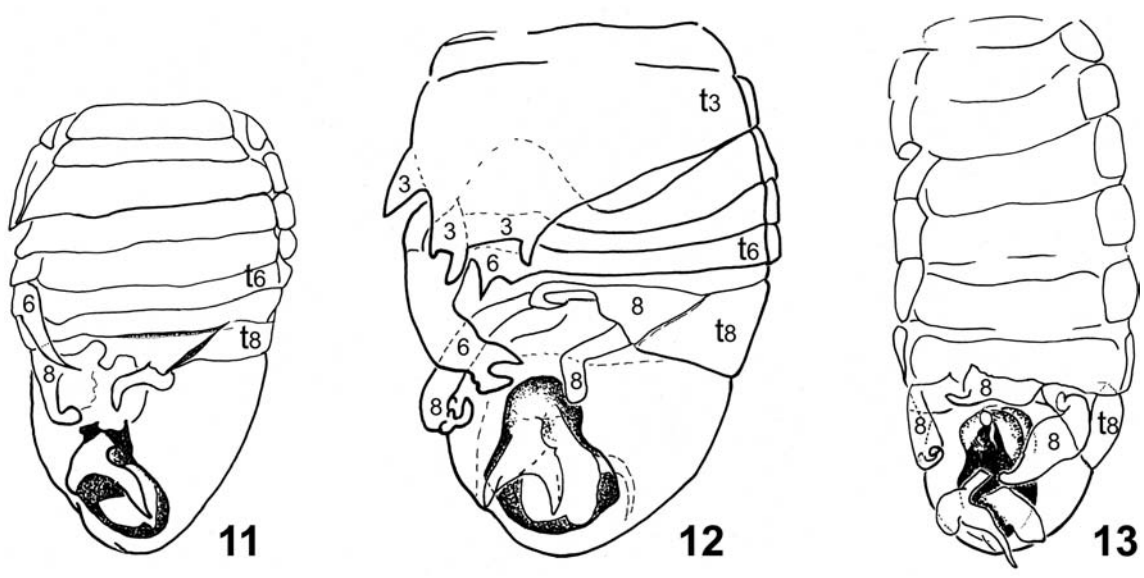
Our results and analysis of the literature data suggest that among Dipsocoromorpha, the dipsocorid spermatheca does not present any notable peculiarities, except for the presence of an intermediate piece; this differentiated part in the ductus should be an exclusive feature of the Dipsocoridae, but this needs confirmation. As already mentioned, the function of this intermediate section remains unknown. In the same way, we cannot find any peculiarities of the spermatheca in the *Harpago* species linked to the loculus capsulae. Nevertheless, we can place emphasis on the relatively large size of the seminal capsule, the long spermathecal duct and the development of the intermediate piece. All such characters show a greater specialiazation within *Harpago*, but this does not provide any significant information about the function of this structure, in which the seminal capsule is housed and kept, and why it has appeared in only the two *Harpago* species.

The loculus capsulae: an adaptive structure for the *Harpago* species?

So, the loculus capsulae is a very enigmatic differentiation in the abdomen of the female of *Harpago*. Without equivalent within Heteroptera, it cannot be compared with any other structure and must be added to the long list of peculiarities already known in Dipsocoromorpha.

We attempt to examine here all the features we suspect to be more or less linked to the loculus capsulae.

– *Sinistral location*. The first consideration concerns the sinistral (left) location of the loculus capsulae, which is exactly the same as the seminal capsule in all dipsocorids. This is certainly not a coincidence. Several authors have specified this location for the spermatheca in Dipsocoromorpha. In the Heteroptera literature in general, it is not usual to find precise details on the position of the spermatheca within the abdominal cavity. However, Larsén (1938) specifies that the organ is always turned to the left in the Corixidae and in other families it probably goes without saying that the spermatheca lies in median position or near the median vagina.



Figures 11-13
Dorsal view of the male abdomen in the three dipsocorid genera, showing differences in the pregenital appendages (numbers refer to concerned tergites). – 11, *Cryptostemma alienum* (redrawn after Wygodzinsky 1948; Linnavuori 1951; Josifov 1967). – 12, *Harpago medium* (redrawn after Linnavuori 1951; Josifov 1967). – 13, *Pachycoleus waltli*. – t: tergite.

So, the situation in the dipsocoromorphan species could be exceptional if not unique.

– *Correlations with male abdominal features*. The males of all Dipsocoromorpha show various abdominal peculiarities. Restricting our observations to the cases of the three genera of Dipsocoridae, we recall some already well-known features (figs. 11-13).

(1) Sinistral asymmetry of most urites, not only genital (Štys 2002); (2) presence of appendage-like structures, mainly formed by left laterotergites; (3) among the diverse cases, the two representatives of genus *Harpago* show the most complicated and strangely shaped, forceps-like appendages on the left laterotergites and mediotergites III, VI and VIII (fig. 13). From an evolutionary perspective, it is tempting to think that there is some correlation between this fact and the presence of a loculus capsulae in the females of the same genus. We could postulate that males and females express some genetic trait and trend concerning the cuticular development of appendages in males and internal expansions in females.

– *Mating*. It is also possible that the local thickenings in females function as protection for their dorsum, at the level of the spermatheca, against injury by the male copulatory forceps. Nothing is known concerning the mating of Dipsocoridae, but Melber & Köhler (1992) succeeded in observing the mating of *Ceratocombus coleoptratus*, a species which belongs to the family Ceratocombidae. In this species, during mating, the male takes its place *under* the female, and very probably uses its appendages for obtaining and stabilizing the copulatory position.

– *Copulation, insemination and vesica*. In Dipsocoromorpha, a correlation may exist between the length of the spermathecal duct and the length of the flagellar vesica, both being sclerified and spirally coiled in those cases where they are long, as in Dipsocoridae et Ceratocombidae (Wygodzinsky 1948a; Cobben 1978; Hill 1987); Hill (1987) gave a coiling of 20 to 30 turns for some *Cryptostemma* species. If the flagellar vesica extends along the whole length of the spermathecal duct and deposits sperm directly into seminal capsule, it probably produces mechanical stress. Due to its relatively large size (compared to the small size of the species) and to its near spherical shape, the seminal capsule may require a supporting armature or anchorage in order to withstand this mechanical stress and prevent uncontrolled movements, during all processes of copulation and insemination.

Finally, it may be said that even if this study raises more questions than answers, the loculus capsulae could be a useful structure for the female, acting as a protective structure for the seminal capsule, securing its position, preventing inadequate movements and making copulation and insemination easier.

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