

Supplement 5

Problems in the interpretation of the female genitalia of *Attaphila* and other Blaberoidea

(A) Elements of laterosternal shelf area

There are three problems in the interpretation of the sclerite herein called laterosternal-shelf sclerite **ls** (Figs 22, 23, with parts **ls-c**, **ls-a**, **ls-w**, and **ls-p**):

(1) The median U-shaped portion of **ls** (**ls-c** plus **ls-a**) might either represent the true middle part of a medially continuous laterosternal-shelf sclerite (**ls**, a 7th-segmental sclerotisation of the primary genital lobe = languette **LG7**, see Klass 1998: figs 5–10), or the vestibular sclerite (**vs**, a 7th-segmental sclerotisation on the dorsal side of the subgenital lobe = ventral fold **vf7**; **ls-c** and **ls-a** then being misnomers). One reason for the problem is that an important landmark is missing in *Attaphila*: the step that in cockroaches usually places the laterosternal shelf at a level above the vestibular sclerite (making the former a shelf; MK64 = McKittrick 1964: fig. 40B). The interpretation of **ls-c** plus **ls-a** as part of sclerite **ls** is supported by the presence in many other Blaberoidea of continuity across the midline of a sclerite that is quite clearly **ls**, as there is a separate vestibular sclerite further posteriorly (e.g. **vs** of *Loboptera* in Fig. 30A). Yet, the matter remains controversial. We note that we use the name “laterosternal shelf” for the area that in cockroaches is usually elevated by the abovementioned step, while in *Attaphila* this area does not have the character of a shelf due to the lack of the step.

(2) The lateral wing parts of **ls** (**ls-w**) might either represent only the lateral parts of the laterosternal-shelf sclerite (**ls**, 7th-segmental, see in (1)), or include (or – less likely – entirely represent) the 8th-segmental basivalvulae (**bv**, lateral portions of coxae 8 **CX8** = valvifers 8, see Klass 1998: fig. 17). In Blaberoidea having both basivalvular and laterosternal-shelf sclerotisations, these extend side by side in the lateral to ventral walls of the genital chamber and anterior vestibulum (vaguely seen in MK64: figs 61, 63, 67A of *Pseudomops*, *Blattella*, and *Symploce*). The inclusion of laterosternal-shelf sclerotisations in **ls-w** of *Attaphila* is supported by comparison with MK64’s illustration of *Blattella* and *Symploce*, where a spermathecal plate is additionally present (‘sp.pl.’ in her figs 63, 67A, medially divided in *Blattella* but not in *Symploce*); the basivalvulae approach each other dorsad (i.e. morphologically posteriad) of this plate, whereas the left and right laterosternal-shelf sclerites approach each other ventrad (i.e. morphologically anteriad) of it; and the latter also applies to sclerite **ls** of *Attaphila* (Fig. 23A). Thus, the *anterior* lateral parts of sclerite **ls** of *Attaphila* are unlikely to include basivalvular sclerotisations; yet, a basivalvular component cannot be excluded by this for the *posterior* lateral parts of sclerite **ls**.

(3) The posterolateral extremities of **ls** (**ls-p**) might just be the terminal parts of the 7th-segmental laterosternal-shelf sclerite (**ls**, 7th-segmental, see in (1)), or they represent, as in many other Blattodea, the 8th-segmental lateral parts of laterocoxae 8 (**LC8**, called “posterolateral extensions” **pe**). The latter are either connected with or detached from the true **ls** sclerotisations (Klass 1998: figs 5–10); connection would apply to *Attaphila* in case of this interpretation. The matter could potentially be decided based on muscle attachments (**pe** bearing **tls8**: Klass 1998: figs 5, 7–10, 24; MK64: ‘tls VIII’). However, this criterion is

probably not applicable to Blaberoidea, which according to MK64 (p. 59) consistently have these attachments on membrane.

(B) Valvifers, basivalvulae, spermathecal plate

Regarding both their homologies and terminologies, there is much confusion with regard to these elements – between Blaberoidea and other Dictyoptera, and even within Blaberoidea. Generally in Blattodea, the sclerotisations that MK64 calls valvifer (vlf.I, including its anterior arm vlf.Ia) and basivalvula (bsv.) together represent the coxa of abdominal segment 8 (**CX8** in Brannoch et al. 2017: fig. 14; “gonocoxa VIII s.lat.” in Klass 1998). This, however, does not include the putative parts of the “valvifer” that MK64 allocated in her “crosspiece” – these belong to the gonangulum (see Klass 1998: figs 11–18).

The division of **CX8** into a small posterolateral sclerite, the valvifer (“gonocoxa VIII s.str.” in Klass 1998, **vlf** herein), and a larger anterior sclerite, the basivalvula (also “basivalvula” in Klass 1998), appears to be an autapomorphy of Blattodea or an inclusive subgroup thereof; in Mantodea **CX8** is undivided (Klass 1998: figs 11–16, 18). Blaberoidea usually also have **CX8** divided in two sclerites, but these are both elongate and run in parallel along the lateral walls of the genital chamber; the homologies between these two and the valvifer and basivalvula of other Blattodea are interpreted differently in Klass (1998) and MK64 (compare pictures a and b in Klass 1998: fig. 17). In Blaberoidea the contact between the posterior tip of the mesal sclerite with the paratergal extension (**pt8,9**) and the lateral extremity of the gonapophyseal sclerotisation, called **A5** in Klass (1998: fig. 17), is an important landmark identifying the valvifer part of the sclerotisations, and the two interpretations agree for this part. The conflict refers to the assignment of the larger anterior portion of the mesal sclerite to the valvifer or basivalvula. Another problem arises in blaberoidea with only one elongate sclerite in this area. This usually forms the contact **A5** and thus includes the homologue of the mesal sclerite, but it is unclear whether the homologue of the lateral sclerite is absent or is included in the lateral part of the single sclerite. The lack of a subdivision of **CX8** inherent in the latter possibility could be a secondary fusion, but considering that some of the recent molecular analyses (Legendre et al. 2015; Evangelista et al. 2019, 2021) found a sistergroup relationship between Blaberoidea and the remaining Blattodea, it could alternatively be a plesiomorphic connection (homologous with that in Mantodea, see above).

An associated problem is the identification of the spermathecal plate/sclerite (**sp**). In the plesiomorphic dictyopteran condition this plate lies between the posterior portions of the **CX8** sclerites (**Spp** in Brannoch et al. 2017: fig. 14; ‘ss’ in Klass 1998: figs 2–4). The sclerite is likely 9th-segmental, and the 8th-segmental opening of the plesiomorphic unpaired spermatheca is placed immediately anterior to it. In Anaplectidae and Blaberoidea, according to MK64, the homologous sclerite is located between the anterior tips of the mesal **CX8** sclerites, having undergone a shift to the anterior. This is supported by the opening of the plesiomorphic unpaired spermatheca on this sclerite in those *Anaplecta* that have retained this spermatheca, and possibly by the course of a muscle (see MK64: sp., sp.pl., and ISVIII-IXa in figs 38, 39). For Blaberoidea only the muscle argument may count (if the homologisation of the muscle is correct), as the unpaired spermathecae are absent throughout. On the other hand, MK64’s homologisation of the sclerites she calls ‘sp.pl.’ in Blaberoidea, Anaplectidae, and other Dictyoptera leads to two problems: **(1)** The blaberoidea (and anaplectid) ‘sp.pl.’ has the same position as other median sclerites in other dictyopterans: those called interbasivalvula in Klass (1998: ‘ib’ in figs 2–4; **CG8** in Brannoch et al. 2017: fig. 14), which are present in addition to the spermathecal plate located further posteriorly. **(2)** In at least some *Anaplecta* left and right coxal sclerites of segment 8 (basivalvulae ‘bsv.’ in MK64: figs 33, 35, 39) are united across the midline posterior to the ‘sp.pl.’. The same is also seen in many Blaberoidea (see above in this supplement). This would essentially mean that 8th-segmental sclerites cross

the midline behind a 9th-segmental sclerite, which renders this interpretation highly implausible.

Things are even further complicated by the very different size of the putative spermathecal sclerites, by their occasional median division, by their variously close association with the anterior ends of the valvifers (which can be medially fused or not), and by the presence of additional sclerotisations in the roof of the genital chamber in some Blaberoidea (e.g. unnamed sclerite of *Lophoblatta* in MK64: figs 44, 59; interpreted by MK64: figs 92, 93 as part of the valvifer in blaberids).

These interwoven problems in the interpretation of the blaberoid sclerites cannot be resolved herein, as they require a careful study of the exoskeleton and musculature in a decent sample of Blattodea. As a preliminary solution one can follow MK64: the mesal **CX8** sclerite is the valvifer (**vlf**), the lateral **CX8** sclerite is the basalvalvula (**bv**), and the anterior sclerite is the spermathecal plate (**sp**). However, it should be kept in mind that the homologies with sclerites bearing the same name in other Blattodea are unclear, and there are also many problems of homology within Blaberoidea. This also means that the possibilities of a phylogenetic evaluation of the sclerites and other elements of this area are limited.