

Report on the Ph.D. Thesis presented by Mgr Petr Kment
to obtain the degree of Doctor of the Charles University in Prague

**« Comparative morphology of structures
associated with metathoracic scent glands in Heteroptera »**

This morphological work analyses, in an extensive comparative way, the external cuticular structures which are associated with the openings of the metathoracic glands of Hemiptera Heteroptera. These glands – often complex –, are usually considered as “defensive”. They characterize the suborder Heteroptera; they are absent in other Hemiptera. All new information concerning those glands is important for the comprehension of the heteropteran suborder.

P. Kment takes into consideration the whole Heteroptera, but only representatives of the Pentatomoidea – considered as the most advanced lineage of the suborder – are thoroughly analyzed: 1000 species belonging to 500 genera representing all the families and subfamilies of Pentatomoidea (except Strotarsinae) were examined. Then, one of the pentatomoid families, the Tessaratomidae, forms the subject of a detailed study.

Besides the descriptive aspect which highlights the great variation of the studied cuticular structures, the dissertation mainly deals with the evolutionary problems using cladistic methodology: analyse and polarization of the characters, homology and anagenesis of the structures, relationships between the families (or genera), classification and phylogeny. Some functional aspects are also taken into account.

The thesis submitted by Mgr P. Kment consists of five separate texts, forming a whole of 400 pages.

1. – A main text (178 p., 244 Figs) entitled “**Comparative morphology of structures associated with metathoracic scent glands in Heteroptera**” including an important bibliography (289 references) and two Appendix (32 p.) giving: (i) the list of the studied material, (ii) the main morphological terms used and the numerous synonyms found in the literature.
2. – A paper (104 p., 138 Figs, 3 Tabl.) submitted to *Zootaxa*, jointly with J. Vilimova (Kment & Vilimova), entitled “**Thoracic scent efferent system of the Tessaratomidae sensu lato (Hemiptera: Heteroptera: Pentatomoidea) with reference to the phylogeny of the family**”.
3. – A paper (30 p., 51 Figs) published in *Acta Ent. Mus. Nat. Pragae* (Kment 2005), entitled: “**Revision of *Mahea* Distant, 1909, with a review of the Acanthosomatidae of Madagascar and Seychelles**”
4. – A paper (40 p., 86 Figs) published in *Acta Mus. Nat. Pragae* (Kment 2008), entitled: “**Revision of the endemic Madagascan genus *Triplatyx* (Pentatomidae)**”.
5. – A paper (47 p., 147 Figs) published in *Zootaxa*, jointly with Z. Jindra (Kment & Jindra 2009), entitled: “**A revision of *Tripanda* and *Tenerva* (Pentatomidae)**”.

The dissertation is very well presented. The text is clear, concise with an abundant illustration, mainly line drawings and SEM micrographies. The drawings illustrating the morphological structures studied, realized according to uniform models, are strictly

comparable from a taxon to another. The analyses (morphological, taxonomic, phylogenetic) are rigorous.

The main text. In the introduction (4 p.), the candidate reminds all the data known on the heteropteran metathoracic glands, the internal as well as the external elements, since the pioneer work of Dufour (1833) until the now days. He shows that if the external elements are often used as specific or generic characters useful in taxonomy, they were not very often used until now in phylogeny to evaluate the relationships of the various heteropteran groups, in particular the 16 pentatomoid families whose relations are still unclear.

A section "Material & Method" and Appendix 1, gives the list of the studied species. Those constitute a representative sample of the 16 pentatomoid families and their respective subfamilies.

In the first part of the work, entitled "Terminology" (15 p.), P. Kment describes and clearly defines the principal elements, internal and external, forming the metathoracic glands. He selects the morphological terms which he intends to use and confronts them with those found in the literature (cf Annexe 2). This work is extremely useful and important because the morphological terms found in the literature are varied and not clearly defined. Personally, I don't agree with the term "macrosculpture" because the so-called "macrosculptures" are in fact true cuticular structures, and not sculptures.

The second part, "Description" (36 p.), abundantly illustrated, describes in detail and with great precision the external structures of metathoracic glands in each family and subfamily.

In the third and last part, "Discussion" (17 p.), the candidate analyzes and discusses with good arguments and conviction the previously described characters. In support of his demonstration, he uses particularly the Grazia's et al (2008) recent phylogenetic data combining morphological and molecular characters. He tries to deduce the conditions plesio- and apomorphic of the structures, and the homologies. As a result, he shows that the phenomena of homoplasy (by convergence and reversion) are numerous in Pentatomoidea; and consequently, that the external structures of metathoracic glands are not very useful for the phylogenetic reconstruction. However existence of synapomorphies allow to define two families: Plataspidae and Tessaratomidae. P. Kment shows also evidence of evolutionary tendencies within Pentatomoidea, for example, the reduction of the glandular system observed in some families. The correlations that he tries to establish between this reduction and the aposematism, or the habitat, of the species, are very interesting.

Article Kment & Vilimova submitted to *Zootaxa*. In this work, the candidate explores in details the family of Tessaratomidae which has just been defined by a synapomorphy (development of peritremal lobes). Its aim is : (i) to evaluate the characters of the metathoracic glands in the phylogenetic reconstruction, (ii) to clear up the relationships of the tessaratomid family with the other families of Pentatomoidea and (iii) to clear up the still very confused relationships between the three tessaratomid subfamilies (Tessaratominae, Natalicolinae, Oncomerinae) and between the tribes.

The morphological study is based on 40 species belonging to 33 genera representing the three subfamilies and all the tribes of Tessaratomidae. The external glandular characters are described and illustrated in all the species, and then analysed. P. Kment discerns three different morphological types within the family. The type 1 (specific to the Oncomerinae) is regarded as plesiomorphic; the type 2 (specific to Tessaratominae + Natalicolinae) is unique and regarded as autapomorphic; type 3 (specific to *Platyatus*) is homologized with the type 1.

The cladistic analysis is based on 22 species of Pentatomoidea previously studied by Grazia et al. (except for the metathoracic glands) representing 10 families of Pentatomoidea.

To the 27 characters used by these authors, the candidate adds 10 new characters, previously polarized, he obtained from the metathoracic glands. The results of the analysis support the monophyly of the Tessaratomidae + Natalicolinae + Oncomerinae (Tessaratomidae sensu lato), and that of Tessaratominae + Natalicolinae (Tessaratomidae sensu stricto), but do not clear up the relations within these taxa. It confirms also the Dinidoridae as the sister-group of the Tessaratomidae.

Articles Kment (2005, 2008), Kment & Jindra (2009). In these three papers, the external structures of metathoracic glands are studied, as well as other external morphological characters, within the context of generic revisions. The studied genera (*Mahea* [10 species], *Triplatyx* [5 species], *Tripanda-Tenerva* [7 species]), afrotropical or endemic of Madagascar or Seychelles, belong to two families of Pentatomoidea (Acanthosomatidae and Pentatomidae). In addition to the classic work of taxonomy rigorously carried out within the four genera, the candidate analyses meticulously each character and brings very useful complementary data on the related genera.

These revisions show the undeniable qualities of the candidate in systematic, as well as the excellent knowledge he has of the studied groups and of the rules of nomenclature. P. Kment does not examine only the external morphological characters in order to describe new species (7 new species are described there); when it is possible, he adds, reliable internal characters, as well as biological, ecological and phylogenetic data.

To conclude, I express a positive judgement on the submitted text. Certainly, the form of the dissertation in five distinct texts is not without inconvenient. There are repetitions and the five texts are not really connected between them. More important: there is no "General Conclusion" (this one could have been built in the main text); and there is no section "Futur prospects" (and yet those do not miss most likely). I regret the absence of those two sections.

Nevertheless, these critical comments do not decrease the quality of the the work realized, the quality and quantity of the results obtained by Mgr P. Kment. This study is indeed a fundamental contribution to the knowledge of metathoracic glands of Heteroptera. It analyzes in minute detail the cuticular structures still badly known at the evolutionary level. It brings extremely useful information to a better interpretation of these structures within Heteroptera; it brings also the first hypotheses concerning their evolution – apparently very rapid – within Pentatomoidea and Tessaratomidae. Moreover, in this dissertation, the candidate shows that he is a very qualified specialist and an experienced systematist.

For all these reasons, the undersigned referee agrees for the presentation of the dissertation and its defence in order to obtain the Doctor's degree from the University Charles in Prague.

MUSEUM NATIONAL
D'HISTOIRE NATURELLE
ENTOMOLOGIE
15, rue Buffon - PARIS 75005
Tél. : 40 79 34 00

Paris (MNHN), le 30 juillet 2009
Dominique Pluot-Sigwalt