Bionomina **1**: 15–55 (2010)
www.mapress.com/bionomina/

Article

ISSN 1179-7649 (print edition)
BIONOMINA
ISSN 1179-7657 (online edition)

Circumscriptional names of higher taxa in Hexapoda

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Abstract

Testing non-typified names by applying rules of circumscriptional nomenclature shows that in most cases the traditional usage can be supported. However, the original circumscription of several widely used non-typified names does not fit the taxa they are applied to. Here I discuss names historically applied to the taxa whose correct circumscriptional names should be Hexapoda, Amyocerata, Triplura, Dermatoptera, Saltatoria, Spectra, Pandictyoptera, Palaeoblattariae, Neoblattariae, Parametabola, Parasita, Arthroidignatha, Plantisuga, Metabola, Birostrata, Rhaphidioptera, Meganeuroptera, Eleuterata, Panzygothoraca, Lepidoptera and Glossolepidoptera. The new names Holopandictyoptera **taxon nov.**, Cryptovipositoria **taxon nov.**, Oothecophora **taxon nov.**, Enteracantha **taxon nov.**, and Pleuroptera **taxon nov.** are proposed for recognized but yet unnamed taxa.

Key words: dual nomenclature system, circumscriptional nomenclature, circumscriptional names, typified names, Hexapoda, Insecta, new taxa, Holopandictyoptera, Cryptovipositoria, Oothecophora, Enteracantha, Pleuroptera

General nomenclatural principles

Typified vs. circumscriptional names

Since pre-Linnaean times, two alternative approaches to naming taxa have been in general use—the type-based and the circumscription-based. The two are mutually exclusive, and a name can be used according to one of them only. A classification may either stick to one of these approaches, or use both concurrently by applying different approaches either to names of different taxa or to different names of the same taxon. Numerous examples of how this worked on various arthropod classifications since 1758 are given in my online catalogue *Nomina Circumscribentia Insectorum* (Kluge 2004–2010), where typified (i.e., type-based) and circumscriptional (i.e., circumscription-based) names are marked "T" or "C" in colored squares, respectively. What makes the two alternative approaches coexist is the general language-related challenge: to communicate meaning unequivocally, a name must be uniquely associated with an object, but the number of objects to be named is unlimited, whereas the human memory can only handle a limited number. Circumscriptional nomenclature gives each taxon a unique name but cannot provide enough names to cover all the taxa. Typified nomenclature is capable to name any number of taxa, but the names are not unique: depending on classification, the same typified name can be applied to different taxa; this allows to minimize the number of names. The situation may dictate what kind of name (circumscriptional or typified) to chose for a given taxon. Low-rank taxa (numerous and often known to a small number of specialists) usually get typified names, whereas high-rank taxa (which are fewer and often widely known) get circumscriptional names. Each approach has its advantages, and attempts to impose a single type of nomenclature have been unsuccessful.

A solution I suggested is my versatile *Dual Nomenclature System (Dual-Nom)* that takes advantage of both type-based and circumscription-based names (Kluge 1999*a–b*, 2000, 2004*a*, 2009*a*). The basic principle of Dual-Nom is applying two sets of rules to different sets of names, with no name subject to both. Dual-Nom includes *circumscriptional nomenclature (Circ-Nom)* and *hierarchical nomenclature (Hier-Nom)*, treating any non-typified name as circumscriptional (see "The circumscriptional nomenclature" below) and any typified name as hierarchical (see "The type-based hierarchical nomenclature" below). The typified names can also be treated as rank-based; thus, Dual-Nom is compatible with the *International Code of Zoological Nomenclature* (the *Code*) and the Rohdendorf-Rasnitsyn nomenclature for higher taxa (see "Type-based rank-based nomenclatures" below). Under Dual-Nom, a taxon may have two valid names: a typified hierarchical name (available for every taxon) and a non-typified circumscriptional name.

Hemihomonyms (term coined by Starobogatov 1991) are identical names given to obviously different taxa under different nomenclatures—unlike true homonyms, i.e., identical names applied to different taxa within a single nomenclatural system. Thus, a given nomenclature can get rid of homonyms by applying its

rules, but hemihomonyms cannot be totally eliminated, since no rules operate across nomenclatural lines. In cases where hemihomonyms cause confusion we have to come up with a solution.

Type-based nomenclatures

All the type-based zoological nomenclatures deal with the same set of typified names whose availability is determined under the *Code*. Spelling and usage of typified names may differ between rank-based nomenclatures (see "Type-based rank-based nomenclatures" below), the hierarchical nomenclature (see "The type-based hierarchical nomenclature" below) and other type-based nomenclatures (see "Another type-based nomenclature" below). The typified names can also be used in a basic format (Kluge 2009*a*).

The *basic format* (or "universal form") is a non-italicized genus-group name (as defined by the *Code*) followed by slash and the letter(s) "f" (where a family-group name derived from that generic name is available) and "g" (to indicate availability as a genus-group name). The authorship can be added in brackets as necessary. Examples of basic format are: "Ephemera/fg"; "Ephemera/fg [f: 1810; g: 1758]"; "Ephemera/fg [f: Ephemerinae Latreille, 1810: 273; g: *Ephemera* Linnaeus, 1758: 546, typus *E. vulgata* Linnaeus, 1758 (design. Latreille 1810)]". This format covers the entire set of typified names for any supra-specific taxa that include *Ephemera vulgata* but no type species of any genus- or family-group names older that *Ephemera* and Ephemerinae, respectively—i.e., the genus *Ephemera*, the subfamily Ephemerinae, the family Ephemeridae, the order Ephemerida, the infraclass Ephemerones, etc.

For names introduced in the same publication, page priority shall apply. Thus, the name *Ephemera* Linnaeus, 1758 (genus 208, p. 546) is younger than *Libellula* Linnaeus, 1758 (genus 207, p. 543) but older than *Phryganea* Linnaeus, 1758 (genus 209, p. 547).

The oldest typified names in zoology are *Araneus* and Araneidae (for genus- and family-groups, respectively), both arbitrarily deemed to have been published by Clerck on 1 January 1758, prior to the 10th edition of the *Systema Naturae* (Anonymous 1999, 2009; Kluge 2007*c*). Accordingly, the basic format for a typified name of any zoological taxon that includes the type species of *Araneus* (e.g., Metazoa, Arthropoda, Chelicerata) would be Araneus/fg. Any taxa that do not include the type species of *Araneus* but include the type species of *Scarabaeus* (e.g., Mandibulata, Hexapoda, Pterygota, Metabola) have the basic-format typified name Scarabaeus/fg (Table 1), because *Scarabaeus* Linnaeus, 1758 (genus 170, p. 345) is the first arthropod genus described in the 10th edition of the *Systema Naturae*, and the ordinal name Scaraboides Laicharting, 1781 (p. ii) is the first typified name proposed for arthropods.

Type-based rank-based nomenclatures

Typified botanical names of any rank are regulated by the *International Code of Botanical Nomenclature*. The *International Code of Zoological Nomenclature* regulates type-based zoological names from subspecies to superfamily level, whereas the names of higher-rank taxa are not subject to any generally accepted rules. Various sets of universal rules for typified high-rank names have been suggested by several authors.

The most rational set of such rules (Rohdendorf 1977; Rasnitsyn 1982) treats the names of taxa above superfamily as family-group names. This approach was applied to a good number of insect taxa (Rohdendorf & Rasnitsyn 1980; Rasnitsyn & Quicke 2002). Other suggested rules for typified names (Starobogatov 1991; Alonso-Zarazaga 2005) recognize several nomenclatural groups above the family group; they are less convenient and have not been tested.

All the type-based nomenclatures mentioned above are also *rank-based* (following *ranking*).

Suggestions have been made to use some non-typified names as rank-based ones (e.g., Bey-Bienko 1962; Boudreaux 1979). Using non-typified names as rank-based is hardly reasonable, since the pool of typified names can fully satisfy any demand for rank-based names (Kluge 1999*a–b*, 2000).

Most taxonomists consider the concept of rank above species level to be purely artificial. Because of this, some workers would prefer to get rid of supraspecific ranks altogether. A solution is offered by hierarchical nomenclature.

The type-based hierarchical nomenclature

The *Code*-based hierarchical nomenclature is the only rank-free system of typified names (Kluge 1999*a–b*); this nomenclature is a part of Dual-Nom, which is totally rank-free.

Hierarchical name (nom.hier.) is derived from the basic-format typified name (see "Type-based nomenclatures" above) by adding a number to indicate the place of the taxon within a hierarchical classification, with "1" assigned to the highest taxon to which the typified name can be applied, "2" to its immediate subordinate, and so on. The numbers are not associated with any formal ranks and can be used in classifications where no such ranks exist. For example, the taxon that includes all mayflies and their extinct relatives is named "Ephemera/fg1" whether it is an infraclass, a superorder, an order, or has no formally assigned rank.

To make the typified names easier to understand, the oldest genus-group names of the nearest excluded and included groups can be added in parentheses behind the numbers or instead them. For example, the name "Scarabaeus/fg4 (sine *Podura*; incl. *Lepisma*)," or simply "Scarabaeus/fg (sine *Podura*; incl. *Lepisma*)", refers to the Amyocerata, the insect taxon that does not include the Entognatha (whose oldest genus-group name is *Podura*) but does include the Triplura (whose oldest genus-group name is *Lepisma*).

Unlike the *Code*-regulated rank-based names, the hierarchical names are not bound by any formal (i.e., artificial) ranks. Any supra-specific taxa in any classification can be given hierarchical names, flexible and unique as they are (whereas in rank-based nomenclatures only taxa with formal ranks can be named). In addition, some taxa can also bear circumscriptional names (see "The circumscriptional nomenclature" below).

The rank-free hierarchical nomenclature has proven practical. It allowed me to thoroughly describe and compare 372 supra-specific mayfly taxa, most of which could not be named within the traditional rank-based nomenclature (Kluge 2004*a*, Kluge 2007*a–b*, 2008, 2009*b–c*, 2010*a–b*).

Another type-based nomenclature

Papavero *et al.* (2001), unaware of the hierarchical nomenclature, suggested another type-based nomenclature, similar but not completely rank-free: names are numbered starting from the lowest taxon of each formal rank rather than from the highest taxon. The highest taxon is defined objectively within a classification, while the lowest one is not (it can be only defined artificially, i.e., using artificial absolute ranks). Papavero's nomenclature was developed as a concept and was not tested; it is clearly less practical than the hierarchical one.

Circumscription-based nomenclatures

Besides typified names (see "Type-based nomenclatures" above), zoologists use today a lot of non-typified ones: most agree that we can't do without names like Metazoa, Arthropoda, Hymenoptera or Apocrita. Non-typified names can be used in two different ways: (1) merely following tradition and/or authority, with no general rules, or (2) applying the rules of circumscriptional nomenclature. The first way is practical where one has to deal with a very limited number of taxa anybody can easily memorize. It works well for high-rank taxa in studies of low-rank taxonomy and for non-taxonomic publications—but becomes all but impossible to use as scores of names begin to overwhelm the memory. This often happens when one is facing the task to name

all the lineages that a reconstructed phylogeny reveals or suggests. In such cases it is advisable to use non-typified names following special rules of circumscriptional nomenclature.

The circumscriptional nomenclature

Rules regulating non-typified zoological names have been proposed earlier (Kluge 1996*a*, 1999*a–b*, 2000). This *circumscriptional nomenclature (Circ-Nom)* constitutes a part of the Dual-Nom (see "Typified vs. circumscriptional names" above). As well as the whole Dual-Nom, the Circ-Nom is theory-free: the same circumscriptional name can be used in multiple mutually contradicting classifications no matter what the taxon's nature is perceived to be (holophylum, plesiomorphon, collective group or anything else). The taxon with a circumscriptional name can be variously ranked (unlike in rank-based nomenclatures), variously placed within classifications (unlike in hierarchical nomenclature), or variously defined in morphological terms. However, a circumscriptional name can never be applied to a taxon of a different circumscription.

The circumscriptional nomenclature had been successfully tested on taxa above Arthropoda, on higher arthropod taxa, on higher insect taxa, and at all levels within the Ephemeroptera (Kluge 2000, 2004*a–b*, 2005*a–b*; 2008, 2010*a*, 2004–2010). Its application to higher insect taxa is illustrated and discussed below.

The basic principles of circumscriptional nomenclature are as follows:

Availability of circumscriptional names

A name available as circumscriptional is any zoological name that is not part of the species group, genus group or family group defined by or subject to the *Code*, and is not obtained by adding suffix and ending to an available genus-group name. The "-morph-" and "-form-" elements are often used to produce typified names and therefore should be treated as suffixes, so the names produced by adding "morph-" or "-form-" to generic names are not available as circumscriptional. Names of species-, genus- and family-groups are regulated by the *Code* on principles of typified nomenclature, incompatible with circumscriptional principles, so the two sets of names should never be confused. Any names produced using the family-group model should also be subject to the rules of typified nomenclature, but not circumscriptional nomenclature.

Circumscriptional zoological names shall have the same starting point (1758) as *Code*-regulated typified ones: it is the availability of the typified names that allows to distinguish the two sets. In a circumscriptional name, any emendation (including those that affect suffixes and endings only[1]) gives rise to a new circumscriptional name with its own author, date and original circumscription.

Under the *Code*, a name is not available unless originally proposed in latinized form. In circumscriptional nomenclature, though, an exception should be made—at least for the names introduced by early French authors, since great many circumscriptional names currently in extensive use were originally proposed in French only, including HEXAPODA Blainville, 1816 (originally "Hexapodes"), ISOPTERA Brullé, 1832 ("Isoptères"), HETEROMERA Duméril, 1806 ("Hétéromères"), RHOPALOCERA Duméril, 1806 ("Ropalocères"), DIPLOPODA Gervais, 1844 ("Diplopodes"), etc. Attributing those to the workers who were the first to latinize such names would cause confusion, as those workers did not see themselves as the authors and thus mentioned no such authorship in their papers. So these names should be considered available in the latinized form but with the authorship and date of the original French spelling.

1. Unlike circumscriptional names, typified names have changeable suffixes and endings.

Assigning circumscriptional names to taxa

In circumscriptional nomenclature, the name-bearing type is the whole set of taxa listed in the original publication.

The attributes that define a circumscriptional name are (Kluge 1996*a*):

Original included membership: the set of species explicitly or implicitly quoted in the original publication of the name as members of that taxon.

Original net included membership: original included membership less (1) the species whose position is considered uncertain in the original publication, and (2) the species erroneously listed as members of the taxon contrary to the diagnosis provided for that taxon in the original publication (see the Lepidoptera example below).

Original excluded membership: a set of species explicitly or implicitly quoted in the original publication of the name as non-members of that taxon.

Original net excluded membership: original excluded membership less (1) the species whose position is considered uncertain in the original publication, and (2) the species erroneously listed as members of another taxa contrary to the diagnoses provided in the original publication.

Original circumscription (or *original admissible membership*): any set containing all species of original net included membership and no species of original net excluded membership.

The main principle of circumscriptional nomenclature is that each name should be applied only to a taxon whose circumscription fits the original circumscription of that name, i.e., which includes all species of original net included membership and no species of original net excluded membership. For this purpose, only the original publication is relevant; later publications that redefine the taxon are not.

Newly discovered species may complicate the classification, so the original circumscription would fit more than one subordinate taxon within the classification. This means that the name *non-monosemantically (non-univocally)* fits each of these taxa in circumscription. In such cases, each of these taxa can be given an additional younger valid name of appropriate unique circumscription, i.e. a *monosemantically (univocally)* fitting name. Thus, in certain situations a taxon may have more than one valid circumscriptional name (see the Dermatoptera and Pandictyoptera examples below).

Different names whose original circumscriptions fit the same taxon, are termed *circumscriptional synonyms (syn.circ.)*. Circumscriptional synonyms can be *monosemantic (univocal)* if the original circumscriptions fit the same taxon in all classifications, or, otherwise, *non-monosemantic (non-univocal)*. Circumscriptional synonymy is quite different from ranking synonymy that may exist in rank-based nomenclatures only[2] (Kluge 2000).

Validity of circumscriptional names

If a taxon has more than one monosemantically fitting circumscriptional name, one of them should be chosen. This can be done basing on priority. Unlike the absolute requirement to fit the original circumscription, priority is optional (but desirable). There are cases where choosing a junior name over the oldest one allows to keep tradition or avoid homonymy, hemihomonymy or other inconvenience. In some cases, choosing a single valid circumscriptional name may not be necessary and more than one circumscriptional synonym may be allowed to circulate.

Homonymy of circumscriptional names should be avoided wherever possible, but there is no strict rules about homonyms. Homonymy rules could be introduced if a general catalogue of circumscriptional names was available, but the existing catalogue covers the arthropods only (Kluge 2004–2010).

2. In hierarchical nomenclatures, no subjective synonyms exist.

Other rules for circumscription-based names

Dubois (2005, 2006, 2007) has suggested different rules for using non-typified names according to their circumscription ("bidirectional ostension") without, however, pointing any advantages his system may have over Circ-Nom. Unlike the rank-free Circ-Nom, Dubois's nomenclature is partly rank-dependent, being restricted to the "class-series", i.e., taxa whose ranks are higher than superfamily. Unlike Dual-Nom, where names of any supra-species ranks can be either typified, or circumscriptional, Dubois suggests to separate typified and circumscriptional names along formal rank lines, so that names up to superfamily are typified and above that level, circumscriptional. This requires a formal line drawn between the family-group ("family-series") and the higher group ("class-series"). As long as the starting point for all names is 1758, and the family group as we understand it did not emerge before 1802, such line may prove hard to draw; the current *Code* does not make such distinction. Since Dubois also suggests that all the high-rank names (including those derived from available generic names) be subject to the circumscriptional principle, he defies any rules for typified names of high-rank taxa (see "Type-based rank-based nomenclatures" above). Plans to have circumscriptional principles eventually apply to all names (Kluge 1996*a*; Dubois 2007) should be abandoned as unrealistic (Kluge 1999*a*).

The "Rule of Taxonomic Consistency" (Dubois 2006: 228) disqualifies names originally proposed for families from being valid circumscriptional names, which would make unavailable many generally accepted non-typified names traditionally used as circumscriptional: e.g., PEDIPALPI Latreille, 1806, CHILOPODA Latreille, 1817, SALTATORIA Latreille, 1817, SIPHUNCULATA Latreille, 1825 and MEGALOPTERA Latreille, 1802 were originally proposed for families and are now treated as suborders, orders or classes.

Dubois's availability rule states that a name "*must have been published* (...) *for a taxon (not an informal group)*". This means that a taxon being originally proposed with no formal rank would render its name unavailable. Applying this rule would make automatically unavailable any names introduced by Hennig and his followers, as well as many other widely used names, such as BILATERIA Haeckel, 1874, PTERYGOTA Gegenbaur, 1878, METABOLA Burmeister, 1832 or HOLOMETABOLA Burmeister, 1835.

Dubois (2006: 228) suggests that "*Unavailable nomina* (...) *are not to be considered as originally included or excluded*"—thus missing an important point: it is taxa, not names, that should be included or excluded. He suggests detailed formal rules defining what should be considered originally included and originally excluded taxa. However, the variety of real-life situations and ways whereby the existent non-typified names may have been originally defined is such that no set of formal rules, however elaborate, could possibly cover all. Therefore, in each case we have to use any means available to find out which animals the author of the name meant to include or exclude while drafting the original paper.

Dubois (2006: 190) oddly defines homonymy as applying the same name to taxa once considered identical but now considered different under the new circumscriptional rules. This means that every time someone keeps an old name for a taxon but changes its circumscription, the name becomes a new name with its own authorship, date and original circumscription, and a junior homonym of the old name. Applying such concept would result in an exorbitant number of names and make cataloguing impossible; workers who used names inconsistently with the rules introduced later, would be unaware of their authorship of the "new" names. Under Circ-Nom, on the other hand, applying the same name to taxa of different circumscription is regarded to be wrong, but does not create new "homonyms".

The "Rule of Preoccupation" (Dubois 2006: 229), whereby any names "*derived from the same root*" are considered homonyms, would severely restrict the pool of possible names and eliminate such widely used names as Eumetazoa (derived from Metazoa) or Mecopteroidea (from Mecoptera). Under Circ-Nom, circumscriptional homonyms have the exact same spelling, just like genus-group names under the *Code*: it is important for both groups to keep as many non-homonymous names as possible.

To perpetuate traditional usage of non-typified names, Dubois (2006: 230) suggests special rules for ten name categories. Criteria of these categories include usage of names in both Latin and vernacular form in all languages in all systematic, non-systematic and non-scientific publications since 31 December 1899, an

arbitrarily chosen date. Not only reviewing all that literature is unfeasible, but at least some criteria are hopelessly impracticable. Particularly, no "symphonym" (a name used as valid by everybody in all publications since 1899) is viable: a single paper applying standardized formats and making the nomenclature typified top to bottom[3] would invalidate all the non-typified names at once. Besides, in non-systematic and non-scientific literature there are things no rule can cover. Under Dubois's rules, name validity strongly depends upon current usage, which is a recipe for perpetual name change. On the other hand, under the *Code*, the Dual-Nom, and other nomenclatural systems, the name validity, once established, stays until the classification changes.

Dubois's elaborate code is designed primarily to conserve widely used names, although all it takes to successfully use those is common sense: they simply don't need to be regulated, just as vernacular names. On the other hand, the Circ-Nom (and the Dual-Nom in general) aims to ensure consistent usage of scientific names, which are too numerous and at most having too small number of users to be managed based on common sense alone.

Dubois (2006: 233) says that the transition to his nomenclature would involve every name being validated, i.e., require nomenclatural acts. On the other hand, Dual-Nom requires no extra nomenclatural action to become fully operative.

Nomenclatures other than type- or circumscription-based

Nomenclatures have been suggested on principles other than type-based or circumscriptional-based. Among them we can mention character-based and phylogeny-based principles.

There are names originally proposed as *character-based*. For example, the names COLLEMBOLA Lubbock, 1873, OLIGOMERENTOMA Krausse & Wolff, 1919, PROTOMORPHA Handshin, 1952 and PODURA Bey-Bienko, 1962 have all been proposed for obviously the same taxon to reflect its various characters—ventral tube, reduced segmentation, assumed primitive condition and furca, respectively. Such a way of naming has no perspectives, since every taxon has any number of features, none more important than others. Under Circ-Nom, all these names are circumscriptional synonyms (see "The circumscriptional nomenclature" above).

The *phylogeny-based* principle is used in the *PhyloCode* (Queiroz & Gauthier 1990; Cantino & Queiroz 2010). At least three aspects make it unacceptable:

It provides no general availability (or "establishment") rules for its names, which could separate available *PhyloCode* names from others. So, to have a *PhyloCode* name established it has to be registered into the special database managed by the special committee and to get a registration number. If numbers could be really unique and distinct, names could be substituted by these numbers, and any nomenclature would become unnecessary, but this is not so.

The *PhyloCode* is inconsistent with the *International Code of Zoological Nomenclature* and the *International Code of Botanical Nomenclature*—a major reason why most biologists who are aware of the *PhyloCode* reject it.

Unlike other nomenclatures, the *PhyloCode* is not theory-free—which is, in my opinion, the main reason why it should be rejected, even if there were no other reasons.

Should any names be established under the *PhyloCode*, they should be treated as either circumscriptional (see "The circumscriptional nomenclature" above) or typified (see "Type-based nomenclatures" above), depending on their format.

3. Examples include papers by advocates of typified nomenclature like Rasnitsyn (1982), Starobogatov (1991) or Alonso-Zarazaga (2005).

Application of circumscriptional nomenclature to high-level insect taxa

Application of the circumscriptional principle often coincides with the traditional usage of these names, but no set of general rules could support a pre-existing tradition in its entirety.

To illustrate this point, let us take a look at the classification of insect orders that traditionally uses non-typified names. Table 1 shows a situation where circumscriptional rules support the tradition in two thirds of instances. Among the listed names that comply with circumscriptional principles: (1) as many as 42 names are generally accepted (Entognatha, Diplura, Ellipura, Collembola, Protura, Zygentoma, Microcoryphia, Pterygota, Ephemeroptera, Panephemeroptera, Metapterygota, Odonata, Odonatoptera, Neoptera, Polyneoptera, Embioptera, Plecoptera, Notoptera, Isoptera, Eumetabola, Zoraptera, Acercaria, Panpsocoptera, Copeognatha, Condylognatha, Thysanoptera, Hemelytrata, Auchenorrhyncha, Heteropteroidea, Coleorrhyncha, Heteroptera, Neuropteroidea, Rhaphidioptera = Raphidioptera, Elytrophora, Strepsiptera, Hymenoptera, Amphiesmenoptera, Trichoptera, Lepidoptera, Diptera, Mecaptera = Mecoptera and Aphaniptera = Siphonaptera); (2) three names (Hexapoda, Dermatoptera and Saltatoria) are widely used along with names inconsistent with circumscriptional principles; (3) fifteen names (Amyocerata, Triplura, Pandictyoptera, Palaeoblattariae, Oothecophora, Neoblattariae, Parametabola, Parasita, Arthroidignatha, Plantisuga, Metabola, Birostrata, Meganeuroptera, Eleuterata and Panzygothoraca) are not in use, whereas the names inconsistent with circumscriptional principles are mostly used instead; and (4) twelve names (Spectra, Raptoriae, Saltipedes, Scytinelytra, Gynaptera, Gallinsecta, Nothomegaloptera, Eumegaloptera, Scorpiomusci, Nannomecoptera, Metamecoptera and Raphioptera) are hardly ever used, as typified names are used instead to refer to these taxa.

This list includes a number of questionable entities. Some groups will be dismantled in the future, e.g., Polyneoptera (a group with no known autapomorphies), Neoblattariae and Copeognatha (plesiomorphons ancestral to Isoptera and Parasita, respectively). Zygentoma, Zoraptera, Strepsiptera and some other taxa are sometimes placed quite differently from Table 1. This paper deals with nomenclature rather than taxonomy or phylogeny. The status of some taxa was discussed elsewhere (Kluge 1996*b*, 2000, 2002, 2003, 2004*b*, 2005*a*–*b*); all of these will be fully defined in a forthcoming treatment of insect systematics. Detailed information on these circumscriptional names, with all the circumscriptional synonyms listed, is available on my website (Kluge 2004–2010).

TABLE 1. Tentative placement of the taxa of Hexapoda discussed in text.
Circumscriptional names are in **boldface**; names discussed in the text are marked by an asterisk.

1. **Hexapoda** Blainville, 1816 (nom. hier.: Scarabaeus/fg3) *
1.1. **Entognatha** Stummer-Traunfels, 1891 (nom. hier.: Podura/fg1)
1.1.1. **Diplura** Börner, 1904 (nom. hier.: Iapyx/f1=Campodea/g1)
1.1.2. **Ellipura** Börner, 1910 (nom. hier.: Podura/fg2)
1.1.2.1. **Collembola** Lubbock, 1873 (nom. hier.: Podura/fg3)
1.1.2.2. **Protura** Silvestri, 1907 (nom. hier.: Acerentomon/fg1)
1.2. **Amyocerata** Remington, 1955 (nom. hier.: Scarabaeus/fg4) *
1.2.1. **Triplura** Ewing, 1942 (nom. hier.: Lepisma/fg1) *
1.2.1.1. **Zygentoma** Börner, 1904 (nom. hier.: Lepisma/fg2)
1.2.1.2. **Microcoryphia** Verhoeff, 1904 (nom. hier.: Machilis/fg1)
1.2.2. **Pterygota** Gegenbaur, 1878 (nom. hier.: Scarabaeus/fg5)
1.2.2.1. **Ephemeroptera** Hyatt & Arms, 1890 **s.l.** (nom. hier.: Ephemera/fg1) = **Panephemeroptera** Crampton, 1928
1.2.2.2. **Metapterygota** Börner, 1909 (nom. hier.: Scarabaeus/fg6)
1.2.2.2.1. **Odonata** Fabricius, 1793 **s.l.** (nom. hier.: Libellula/fg1) = **Odonatoptera** Lameere, 1900
1.2.2.2.2. **Neoptera** Martynov, 1923 (nom. hier.: Scarabaeus/fg7)
1.2.2.2.2.1. Plesiomorphon **Polyneoptera** Martynov, 1923 (nom. hier.: Gryllus/f1=Forficula/g1)
1.2.2.2.2.1.1. **Embioptera** Lameere, 1900 (nom. hier.: Embia/fg1)
1.2.2.2.2.1.2. **Plecoptera** Burmeister, 1839 (nom. hier.: Perla/fg1)
1.2.2.2.2.1.3. **Notoptera** Crampton, 1915 (nom. hier.: Grylloblatta/fg1)

1.2.2.2.2.1.4. **Dermatoptera** Burmeister, 1838 **s.l.** (nom. hier.: Forficula/f1=g2) = **Dermapteroidea** Jeannel, 1949 *
1.2.2.2.2.1.5. **Saltatoria** Latreille, 1817 (nom. hier.: Gryllus/f3=g2) *
1.2.2.2.2.1.6. **Spectra** Latreille, 1802 (nom. hier.: Phasma/fg1) *
1.2.2.2.2.1.7. **Holopandictyoptera** taxon nov. (nom. hier.: Blatta/fg1) = **Pandictyoptera** Crampton, 1917 **s.l.** *
1.2.2.2.2.1.7.1. †Plesiomorphon **Palaeoblattariae** Scudder, 1879 (nom. hier.: Mylacris/fg1) *
1.2.2.2.2.1.7.2. **Cryptovipositoria** taxon nov. (nom. hier.: Blatta/fg2) = **Pandictyoptera** Crampton, 1917 **s.str.** *
1.2.2.2.2.1.7.2.1. **Raptoriae** Latreille, 1802 (nom. hier.: Mantis/fg1)
1.2.2.2.2.1.7.2.2. **Oothecophora** taxon nov. (nom. hier.: Blatta/fg3) *
1.2.2.2.2.1.7.1.2.1. Plesiomorphon **Neoblattariae** Scudder, 1895 (nom. hier.: Blatta/fg4) *
1.2.2.2.2.1.7.1.2.2. **Isoptera** Brullé, 1832 (nom. hier.: Termes/fg1)
1.2.2.2.2.2. **Eumetabola** Hennig, 1953 (nom. hier.: Scarabaeus/fg8)
1.2.2.2.2.2.1. **Parametabola** Crampton, 1938 (nom. hier.: Cimex/f1=Cicada/g1) *
1.2.2.2.2.2.1.1. **Zoraptera** Silvestri, 1913 (nom. hier.: Zorotypus/fg1)
1.2.2.2.2.2.1.2. **Acercaria** Börner, 1904 (nom. hier.: Cimex/f2=Cicada/g2)
1.2.2.2.2.2.1.2.1. **Panpsocoptera** Crampton, 1938 (nom. hier.: Psocus/f1=Pediculus/g1)
1.2.2.2.2.2.1.2.1.1. Plesiomorphon **Copeognatha** Enderlein, 1903 (nom. hier.: Psocus/f2=g1)
1.2.2.2.2.2.1.2.1.2. **Parasita** Latreille, 1796 (nom. hier.: Pediculus/f1=g2) *
1.2.2.2.2.2.1.2.2. **Condylognatha** Börner, 1904 (nom. hier.: Cimex/f3=Cicada/g3)
1.2.2.2.2.2.1.2.2.1. **Thysanoptera** Haliday, 1836 (nom. hier.: Thrips/fg1)
1.2.2.2.2.2.1.2.2.2. **Arthroidignatha** Spinola, 1850 (nom. hier.: Cimex/f4=Cicada/g4) *
1.2.2.2.2.2.1.2.2.2.1. **Hemelytrata** Fallén 1829 (nom. hier.: Cimex/f5=Cicada/g5)
1.2.2.2.2.2.1.2.2.2.1.1. **Auchenorrhyncha** Duméril, 1806 (nom. hier.: Cicada/f1=g6)
1.2.2.2.2.2.1.2.2.2.1.2. **Heteropteroidea** Schlee, 1969 (nom. hier.: Cimex/f6=Notonecta/g1)
1.2.2.2.2.2.1.2.2.2.1.2.1. **Coleorrhyncha** Myers & China, 1929 (nom. hier.: Peloridium/fg1)
1.2.2.2.2.2.1.2.2.2.1.2.2. **Heteroptera** Latreille, 1810 (nom. hier.: Cimex/f7=Notonecta/g2)
1.2.2.2.2.2.1.2.2.2.2. **Plantisuga** Duméril, 1806 (nom. hier.: Aphis/fg1) *
1.2.2.2.2.2.1.2.2.2.2.1. **Saltipedes** Amyot & Serville, 1843 (nom. hier.: Psylla/fg1)
1.2.2.2.2.2.1.2.2.2.2.2. **Scytinelytra** Amyot & Serville, 1843 (nom. hier.: Aleyrodes/fg1)
1.2.2.2.2.2.1.2.2.2.2.3. **Gynaptera** Laporte, 1834 (nom. hier.: Aphis/fg2)
1.2.2.2.2.2.1.2.2.2.2.4. **Gallinsecta** De Geer, 1776 (nom. hier.: Coccus/fg1)
1.2.2.2.2.2.2. **Metabola** Burmeister, 1832 (nom. hier.: Scarabaeus/fg8) *
1.2.2.2.2.2.2.1. **Neuropteroidea** Handlirsch, 1903 (nom. hier.: Myrmeleon/f1=Hemerobius/g1)
1.2.2.2.2.2.2.1.1. **Birostrata** Kluge, 2005 (nom. hier.: Myrmeleon/f2=Hemerobius/g2) *
1.2.2.2.2.2.2.1.2. **Rhaphidioptera** Navás, 1916 (nom. hier.: Raphidia/fg1) *
1.2.2.2.2.2.2.1.3. **Meganeuroptera** Crampton, 1916*a* (nom. hier.: Corydalus/f1=Chauliodes/g1) *
1.2.2.2.2.2.2.1.3.1. **Nothomegaloptera** Engel, 2004 (nom. hier.: Sialis/fg1**)**
1.2.2.2.2.2.2.1.3.2. **Eumegaloptera** Riek, 1974 (nom. hier.: Corydalus/f2=Chauliodes/g2)
1.2.2.2.2.2.2.2. **Elytrophora** Packard, 1883 (nom. hier.: Scarabaeus/fg9)
1.2.2.2.2.2.2.2.1. **Eleuterata** Fabricius, 1775 (nom. hier.: Scarabaeus/fg10) *
1.2.2.2.2.2.2.2.2. **Strepsiptera** Kirby, 1813 (nom. hier.: Stylops/f1=Xenos/g1)
1.2.2.2.2.2.2.3. **Panzygothoraca** Kluge, 2004*b* (nom. hier.: Papilio/fg1) *
1.2.2.2.2.2.2.3.1. **Hymenoptera** Linnaeus, 1758 (nom. hier.: Vespa/f1=Cynips/g1)
1.2.2.2.2.2.2.3.2. **Amphiesmenoptera** Kiriakoff, 1948 (nom. hier.: Papilio/fg2)
1.2.2.2.2.2.2.3.2.1. **Trichoptera** Kirby, 1813 (nom. hier.: Phryganea/fg1)
1.2.2.2.2.2.2.3.2.2. **Lepidoptera** Linnaeus, 1758 (nom. hier.: Papilio/fg3) *
1.2.2.2.2.2.2.3.3. **Diptera** Linnaeus, 1758 (nom. hier.: Musca/f1=Oestrus/g1)
1.2.2.2.2.2.2.3.4. **Enteracantha** taxon nov. (nom. hier.: Panorpa/fg1) *
1.2.2.2.2.2.2.3.4.1. **Scorpiomusci** Kluge, 2004*b* (nom. hier.: Panorpa/fg2)
1.2.2.2.2.2.2.3.4.2. **Nannomecoptera** Hinton, 1981 (nom. hier.: Nannochorista/fg1)
1.2.2.2.2.2.2.3.4.3. **Metamecoptera** Crampton, 1930 (nom. hier.: Bittacus/fg1)
1.2.2.2.2.2.2.3.4.4. **Pleuroptera** taxon nov. (nom. hier.: Pulex/fg1) *
1.2.2.2.2.2.2.3.4.4.1. **Raphioptera** MacLeay, 1821 (nom. hier.: Boreus/fg1)
1.2.2.2.2.2.2.3.4.4.2. **Aphaniptera** Kirby & Spence, 1815 (nom. hier.: Pulex/fg2)

This paper discusses selected high-level insect taxa whose traditional names are inconsistent with the circumscriptional principles. In what follows, *italics* are used only for species- and genus-group names, as required by the *Code*; genus-group names that are part of hierarchical names or basic-format typified names are not italicized (see "The type-based hierarchical nomenclature" above); wherever a circumscriptional name appears for the first time and/or with authorship reference, it is set in SMALL CAPITALS, and usually in regular face thereafter.

HEXAPODA Blainville, 1816

Typified name: Scarabaeus/fg (sine *Cancer*, *Scolopendra*; incl. *Podura*)

The name Insecta, often used for Hexapoda, has a long history of inconsistent use. "Insecta" is the Latin translation of Aristotle's εντομον (Entomon)—a name applied for terrestrial arthropods other than crabs, which Aristotle placed in μαλακόστρακα (Malacostraca). Initially the name Insecta was used for the same taxon, which is not currently recognized. Priority rules attribute its formal authorship to Linnaeus (INSECTA Linnaeus, 1758) who, however, defied the tradition and included crabs within the order Aptera of his class Insecta (Linnaeus 1735, 1758). So the Linnaean class Insecta approximately corresponded to the taxon now known as ARTHROPODA Siebold, 1848, but included also a polychaete, *Scolopendra marina*, whereas some eucrustaceans[4] were placed in the class Vermes instead.

Later (e.g., Fabricius 1792–1798; Latreille 1796), the name Insecta was sometimes accepted in the Linnaean circumscription. The same name was used also in its traditional meaning, i.e., for a taxon which excludes crabs (e.g., Latreille 1802–1805). Lamarck (1801) applied the name Insecta to winged insects; other authors applied the name Insecta to taxa of various circumscriptions intermerdiate between the Linnaean and the Lamarckian. Table 2 shows how the name Insecta, as used by different authors since Linnaeus, refers to various taxa.

There was never a consensus usage for the name Insecta: at every single point different workers used it to refer to different things.

TABLE 2. Various taxa designated by the name Insecta as used by different authors since Linnaeus.

Reference to the use of the name INSECTA	Taxon corresponding to this use
INSECTA Linnaeus, 1758	CONDYLOPA Latreille, 1825
INSECTA: Lamarck 1801	PTERODICERA Latreille, 1802
INSECTA: Latreille 1802	TRACHEATA Haeckel, 1866
INSECTA: Leach 1815	HEXAPODA Blainville, 1816
INSECTA: Cuvier 1817	ATELOCERATA Heymons, 1901
INSECTA: Packard 1883	DIMALATA Sharov, 1966
INSECTA: Kingsley 1894	OPISTHOGONEATA Pocock, 1893*a–b*
INSECTA: Handschin 1958	AMYOCERATA Remington, 1955
INSECTA: Chen 1962	PLEOMERENTOMA Krausse & Wolff, 1919

Applied mostly to a class-rank taxon, this non-typified name was thus misused as rank-based (see "Type-based rank-based nomenclatures" above), which caused a great deal of confusion and even made some people believe in the polyphyly of the Hexapoda for no other reason than nomenclatural change (Kluge 1996*a*, 1999*b*, 2000).

There is, though, a widely accepted name, HEXAPODA Blainville, 1816, whose original circumscription fits the taxon to which it is applied. Introduced originally in French only ("Hexapodes"), the name should be

4. Genera *Lepas* sensu Linnaeus 1758 (now Cirripedia) and *Lernaea* sensu Linnaeus 1758 (parasitic copepodoids).

available with original authorship in subsequent Latin spelling (see "The circumscriptional nomenclature" above).

The name HEXAPODA Blainville, 1816 should be valid, in spite of the fact that it is preoccupied: its senior homonym, HEXAPODA Latreille, 1796, was proposed for an artificial taxon that combined wingless flies (*Nycteribia*) with six-legged mite larvae and has not been used since the beginning of the 19th century.

The name HEXAPODA Blainville, 1816 has no circumscriptional synonyms and is the only circumscriptional name applicable to this taxon.

AMYOCERATA Remington, 1955

Circumscriptional synonym:
— ECTOGNATHATA Boudreaux, 1979
Typified name: Scarabaeus/fg (sine *Podura*; incl. *Lepisma*)

Today the taxon consisting of Triplura and Pterygota is often called "Ectognatha". At some point, the authorship of the name Ectognatha was misattributed to Hennig (see, e.g., Kristensen 1995), but Hennig could pick it up from textbooks. Originally, the name ECTOGNATHA Stummer-Traunfels, 1891 was proposed for the taxon of wingless insects, later named TRIPLURA Ewing, 1942 (see below).

Hennig (1953) used the name "Ectognatha" to refer to a taxon combining the original Ectognatha (i.e., Triplura) with the Pterygota, and thus changed the circumscription to include all winged insects. Some workers apply circumscriptional principles loosely and consider that a non-typified name can be shared by taxa of nearly the same circumscription. In this case, though, the difference was enormous. Originally, the name Ectognatha was applied to triplurans to emphasize their difference from wingless insects with recessed mouthparts, i.e., Collembola and Diplura. This name sounds odd, though, being applied to insects with all kinds of mouthparts, including completely hidden ones, like in sucking lice.

For the taxon consisting of Triplura + Pterygota, some authors (e.g., Handschin 1958) used the name "Insecta", whose original circumscription also does not fit this taxon (see above).

In circumscriptional nomenclature, the correct name for Triplura + Pterygota is AMYOCERATA Remington, 1955. ECTOGNATHATA Boudreaux, 1979 is its junior circumscriptional synonym.

Using the names Ectognatha and Insecta instead of Amyocerata causes great confusion, when a statement about polyphyly of Hexapoda appeared from nothing (Kluge 1996*a*, 1999*b*, 2000).

TRIPLURA Ewing, 1942

Senior circumscriptional synonyms:
— ECTOTROPHA Grassi, 1888
— ECTOGNATHA Stummer-Traunfels, 1891
— EUTHYSANURA Schepotieff, 1909
— THYSANURADELPHIA Crampton, 1916*b*
— PHANEROGNATHA Krausse & Wolff, 1919
— ECTOTROPHICA Tillyard, 1926
Junior circumscriptional synonyms:
— APTERENTOMA Chen, 1958
— THYSANURATA Bey-Bienko, 1962
— ZYGOENTOMATA Brusca & Brusca, 1990
Typified name: Lepisma/fg (incl. *Machilis*)

The familiar current name of the taxon consisting of three-tailed wingless insects is "Thysanura". Initially, the names THYSANOURA Latreille, 1796 (as French "Thysanoures"), THYSANOURA sensu Latreille 1802 (the first Latin spelling) and THYSANURA Leach, 1815 each referred to an order that consisted of all primarily wingless hexapods—i.e., to the taxon subsequently named APTERYGOTA Lang, 1888. Later, the springtails were placed

into a separate order, COLLEMBOLA Lubbock, 1873, and the name "Thysanura" sensu Lubbock 1873 was applied to the order where *Iapyx*, *Campodea*, *Nicoletia*, *Lepisma*, *Lepismena* and *Machilis* were placed—i.e., to what was subsequently named CINURA Packard, 1883. Then the two-tailed members were moved into an order of their own, DIPLURA Börner, 1904, and the name "Thysanura" sensu Lameere 1895 and sensu Börner 1904 was applied to the order of three-tailed thysanurans, i.e., Archaeognatha + Zygentoma—the group subsequently named TRIPLURA Ewing, 1942. Sometimes the name "Thysanura" is applied even more narrowly, in lieu of either ZYGENTOMA Börner, 1904 or MICROCORYPHIA Verhoeff, 1904 (= ARCHAEOGNATHA Börner, 1904) (e.g., Börner 1910, 1920) (Table 3).

TABLE 3. Various meanings of the name Thysanura.
Names used in their original circumscription are in boldface. Estimated species numbers (right column) show that at every split the name Thysanura was consistently applied to the smaller taxon of the two.

Thysanura Leach, 1815 = **Apterygota**	**Cinura** = "Thysanura": Lubbock 1873	**Triplura** = "Thysanura": Börner 1904	**Microcoryphia** = "Thysanura": Börner 1920	450
			Zygentoma = "Thysanura": Börner 1910	600
		Diplura Börner, 1904		1000
	Collembola Lubbock, 1873			4000

The prevalent usage associates the name Thysanura with order-rank taxa, misusing a non-typified name as rank-based (see "Type-based rank-based nomenclatures" above). The names whose original circumscription fits the taxon consisting of all the three-tailed wingless insects are ECTOTROPHA Grassi, 1888, ECTOGNATHA Stummer-Traunfels, 1891, EUTHYSANURA Schepotieff, 1909, THYSANURADELPHIA Crampton, 1916*b*, PHANEROGNATHA Krausse & Wolff, 1919, TRIPLURA Ewing, 1942, APTERENTOMA Chen, 1958, THYSANURATA Bey-Bienko, 1962 and ZYGOENTOMATA Brusca & Brusca, 1990. Among these, TRIPLURA Ewing, 1942, by far not the oldest one, would be the name of choice, because using any other name from the list would lead to confusion: the name Ectognatha is often applied to Amyocerata (see above); the names Ectotropha and Phanerognatha are semantically close to Ectognatha; the names Euthysanura, Thysanuradelphia and Thysanurata can be confused with other names derived from Thysanura (e.g., with Thysanuroidea, which Escherich 1914 used for Cinura).

DERMATOPTERA Burmeister, 1838

Senior circumscriptional synonyms:
— LABIDOURA Duméril, 1806 (non genus *Labidura* Leach, 1815)
— PLACODA Billberg, 1820
— TRIMERA Zetterstedt, 1821 (non Duméril, 1806)
— EUPLEKOPTERA Westwood, 1831
Junior circumscriptional synonyms:
— EUPLEXOPTERA Westwood, 1839
— DERMOPTERA Agassiz, 1848
— HARMOPTERA Fieber, 1852
— EUPLECTOPTERA Fischer, 1853 (non Tillyard, 1932)
Typified name: Forficula/fg

The earwig taxon is usually called "Dermaptera". However, the original circumscription of the name DERMAPTERA De Geer, 1773 does not fit this taxon and encompassed the genera *Mantis*, *Locusta*, *Acrydium*, *Gryllus*, *Blatta* and *Forficula* with combined circumscription of Raptoriae + Spectra + Saltatoria + Neoblattariae + Dermatoptera. A junior circumscriptional synonym of Dermaptera is ULONATA Fabricius, 1775. Later, Retzius (1783), who followed De Geer's classification, renamed the Dermaptera into Hemiptera[5], and applied the name Dermaptera to true bugs (currently HETEROPTERA Latreille, 1810). Kirby (1813)

5. Various meanings of the name Hemiptera are discussed under Arthroidignatha below.

suggested to apply the name Dermaptera to the order consisting of *Forficula* only, and it has been used mostly that way ever since, which is inconsistent with the original circumscription, so Dermaptera cannot be used in that sense as a circumscriptional name.

The name DERMATOPTERA Burmeister, 1838, on the other hand, in its original circumscription fits the taxon to which it is applied, and thus can be used as its valid name. The name was first introduced as an emendation of the name Dermaptera, which Burmeister adopted sensu Kirby (i.e., for earwigs), not in its original meaning. Under the circumscriptional rules, an emendated name is considered as a new name with its own authorship, date and original circumscription. The name Dermatoptera Burmeister, 1838, proposed as an emendation of Dermaptera De Geer, 1773, is not a circumscriptional synonym of the latter.

The name Dermatoptera is not the oldest one among its circumscriptional synonyms, but should be preferred for the following reasons. The name LABIDOURA Duméril, 1806 and its subsequent emendation LABIDURA (Duméril 1806*a–b*; Burmeister 1838; Haeckel 1866) should be avoided as hemihomonyms of the valid earwig generic name *Labidura* Leach, 1815. The name PLACODA Billberg, 1820 was never used outside the original publication. TRIMERA was applied to two different taxa by Zetterstedt (1821). It was applied by other authors to various taxa with trimerous tarsi—to Auchenorrhyncha (Westwood 1840), to certain taxa among Coleoptera (Duméril 1806), Copeognatha (Enderlein 1903), etc. The name EUPLEKOPTERA Westwood, 1831 and its later emendations EUPLEXOPTERA and EUPLECTOPTERA (Westwood 1831, 1839; Fischer 1853) have long fallen into disuse, whereas its junior homonym EUPLECTOPTERA Tillyard, 1932 is used for true mayflies (Ephemeroptera s.str.).

All the names listed above as circumscriptional synonyms of Dermatoptera have identical original circumscriptions and would all apply to the same taxon, if only earwig species known at the time had been taken into account. However, the aberrant wingless *Hemimerus* Walker, 1871, the Paleozoic taxon Protelytroptera Tillyard, 1931, the Mesozoic family Protodiplatyidae Martynov, 1925 and other taxa described thereafter, all clearly related to the true earwigs, did not fit into Dermatoptera as defined based on morphology of previously known members. All these insects, including Protelytroptera, together with the true earwigs, make up a holophyletic taxon, DERMATOPTERA s.1. or DERMAPTEROIDEA Jeannel, 1949. Jeannel (1949) cited the Dermapteroidea authorship as "Martynov, 1925". However, the name introduced by Martynov (1925) was Dermatopteroidea, not Dermapteroidea; at that time Protelytroptera had not been discovered yet, so the original circumscription of the name DERMATOPTEROIDEA Martynov, 1925 non-monosemantically fits both Dermapteroidea Jeannel, 1949 (which includes Protelytroptera) and Brachydermaptera (which excludes Protelytroptera).

As shown in Table 4, the taxon Dermapteroidea includes the subordinated taxon DERMATOPTERA s.2, or BRACHYDERMAPTERA Kluge, 2003; the Brachydermaptera includes a subordinated taxon DERMATOPTERA s.3, or NEODERMAPTERA Engel, 2003, that, in turn, includes the Diploglossata and the true earwigs, i.e. DERMATOPTERA s.4, or HOLODERMAPTERA Verhoeff, 1904.

Thus, the name Dermatoptera and its monosemantic circumscriptional synonyms Labidoura, Placoda, Euplekoptera, Euplexoptera, Dermoptera, Harmoptera and Euplectoptera are non-monosemantic circumscriptional synonyms of the names Dermapteroidea, Brachydermaptera, Neodermaptera and Holodermaptera. On the other hand, the names Dermapteroidea, Brachydermaptera, Neodermaptera and Holodermaptera are not circumscriptional synonyms and refer to an array of successively subordinated taxa.

TABLE 4. Classification of the taxa of Dermatoptera discussed in text.

1. DERMAPTEROIDEA, or DERMATOPTERA sensu 1

Monosemantic circumscriptional names:

— DERMAPTEROIDEA Jeannel, 1949

— DERMAPTEROIDA Kevan & Knipper, 1961

— DERMAPTERIDA Boudreaux, 1979

Non-monosemantic circumscriptional name (fitting also Brachydermaptera):

— DERMATOPTEROIDEA Martynov, 1925, s.l.

Non-monosemantic circumscriptional names (fitting also Brachydermaptera, Neodermaptera, Holodermaptera):
— LABIDOURA Duméril, 1806 (non genus *Labidura* Leach, 1815)
— PLACODA Billberg, 1820
— TRIMERA Zetterstedt, 1821 (non Duméril, 1806)
— EUPLEKOPTERA Westwood, 1831
— DERMATOPTERA Burmeister, 1838
— EUPLEXOPTERA Westwood, 1839
— DERMOPTERA Agassiz, 1848
— HARMOPTERA Fieber, 1852
— EUPLECTOPTERA Fischer, 1853 (non Tillyard, 1932)
Typified name: Forficula/fg (incl. *Protelytron*)

1.1. †Plesiomorphon PROTELYTROPTERA

Circumscriptional names:
— ELYTROPTERA Tillyard, 1931 (non Clairville, 1798)
— PROTELYTROPTERA Tillyard, 1931
Typified name: Protelytron/fg

1.2. BRACHYDERMAPTERA, or DERMATOPTERA sensu 2

Monosemantic circumscriptional name:
— BRACHYDERMAPTERA Kluge, 2003
Non-monosemantic circumscriptional name (fitting also Dermapteroidea):
— DERMATOPTEROIDEA Martynov, 1925, s.str.
Non-monosemantic circumscriptional names (fitting also Dermapteroidea, Neodermaptera, Holodermaptera):
— LABIDOURA Duméril, 1806 (non genus *Labidura* Leach, 1815)
— PLACODA Billberg, 1820
— TRIMERA Zetterstedt, 1821 (non Duméril, 1806)
— EUPLEKOPTERA Westwood, 1831
— DERMATOPTERA Burmeister, 1838
— EUPLEXOPTERA Westwood, 1839
— DERMOPTERA Agassiz, 1848
— HARMOPTERA Fieber, 1852
— EUPLECTOPTERA Fischer, 1853 (non Tillyard, 1932)
Typified name: Forficula/fg (sine *Protelytron*; incl. *Protodiplatys*)

1.2.1. †Plesiomorphon ARCHIDERMAPTERA

Circumscriptional name:
— ARCHIDERMAPTERA Bey-Bienko, 1936
Typified name: Protodiplatys/fg

1.2.2. NEODERMAPTERA, or DERMATOPTERA sensu 3

Monosemantic circumscriptional name:
— NEODERMAPTERA Engel, 2003
Non-monosemantic circumscriptional names (fitting also Dermapteroidea, Brachydermaptera, Holodermaptera):
— LABIDOURA Duméril, 1806 (non genus *Labidura* Leach, 1815)
— PLACODA Billberg, 1820
— TRIMERA Zetterstedt, 1821 (non Duméril, 1806)
— EUPLEKOPTERA Westwood, 1831
— DERMATOPTERA Burmeister, 1838
— EUPLEXOPTERA Westwood, 1839
— DERMOPTERA Agassiz, 1848
— HARMOPTERA Fieber, 1852
— EUPLECTOPTERA Fischer, 1853 (non Tillyard, 1932)
Typified name: Forficula/fg (sine *Protodiplatys*; incl. *Hemimerus*)

1.2.2.1. DIPLOGLOSSATA

Circumscriptional names:
— DIPLOGLOSSATA Saussure, 1879
— DERMODERMAPTERA Verhoeff, 1902
Typified name: Hemimerus/fg

1.2.2.2. HOLODERMAPTERA, or DERMATOPTERA sensu 4

Monosemantic circumscriptional name:
— HOLODERMAPTERA Verhoeff, 1904
Non-monosemantic circumscriptional names (fitting also Dermapteroidea, Brachydermaptera, Neodermaptera):
— LABIDOURA Duméril, 1806 (non genus *Labidura* Leach, 1815)
— PLACODA Billberg, 1820
— TRIMERA Zetterstedt, 1821 (non Duméril, 1806)
— EUPLEKOPTERA Westwood, 1831
— DERMATOPTERA Burmeister, 1838
— EUPLEXOPTERA Westwood, 1839
— DERMOPTERA Agassiz, 1848
— HARMOPTERA Fieber, 1852
— EUPLECTOPTERA Fischer, 1853 (non Tillyard, 1932)
Typified name: Forficula/fg (sine *Hemimerus*)

SALTATORIA Latreille, 1817

Circumscriptional synonyms:
— SALIENTIA Claus, 1868 (non Laurenti, 1768)
— ORTHOPTEROIDA Kevan & Knipper, 1961
Typified name: Gryllus/fg (incl. *Acrida*)

This group is usually called "Orthoptera". However, the original circumscription of the name ORTHOPTERA Olivier, 1789 does not fit this taxon. Originally, the order Orthoptera consisted of the genera *Blatta*, *Mantis*, *Gryllus*, *Truxalis*, *Acrydium* and *Tridactylus* with the combined circumscription of Neoblattariae + Raptoriae + Spectra + Saltatoria. Over time, different authors applied the name Orthoptera to taxa of various circumscriptions, the least inclusive of which corresponds to Caelifera (Orthoptera sensu Vickery & Kevan 1983), whereas the most inclusive encompasses all the Hexapoda except for the Metabola and Arthroidignatha (Orthoptera sensu Gerstaecker 1863). The prevalent usage associates the name Orthoptera with order-rank taxa, i.e., misuses a non-typified name as rank-based (see "Type-based rank-based nomenclatures" above).

The name SALTATORIA Latreille, 1817 is both widely accepted and fits in original circumscription of the taxon to which it is applied: Latreille's family Saltatoria originally consisted of the genera (or subgenera, in Cuvier's sense) *Gryllotalpa*, *Tridactylus*, *Gryllus*, *Tettigonia*, *Pneumora*, *Acrida*, *Locusta* and *Tetrix*. It is preoccupied: the name SALTATORIA Retzius, 1783 was proposed for fleas; it is no longer in use (the fleas are named either APHANIPTERA Kirby & Spence, 1815 or SIPHONAPTERA Latreille, 1825), so the name SALTATORIA Latreille, 1817 can be adopted as valid.

SPECTRA Latreille, 1802

Circumscriptional synonyms:
— AMBULATORIA Westwood, 1839
— PHASMOPTERA Schwanwitsch, 1949
— PHASMATOPTERA Beier, 1955
Typified name: Phasma/fg

Some authors call the taxon that consists of stick- and leaf-insects "Cheleutoptera". However, the name CHELEUTOPTERA Crampton, 1915 was originally used to refer to an order where only the stick-like members were placed, whereas the leaf-like ones, such as *Phyllium*, were placed in PHYLLOPTERA Crampton, 1915. Thus, the name Cheleutoptera cannot be applied to any taxon that includes the leaf-insects.

SPECTRA Latreille, 1802 is the oldest name whose original circumscription fits this taxon. Latreille (1802) divided his family Mantides into two divisions: Spectra[6] (with the genera *Phyllium* and *Phasma*) and Raptoriae (with the genus *Mantis*).

The name Spectra is unavailable in typified nomenclature, and can thus be used as a non-typified circumscriptional name. The generic name *Spectrum* Stoll, 1787 was originally applied to a group (genus) consisting of all the stick- and leaf-insects and named "Spectres" (plural of "Spectre") in French (Stoll 1787). The generic name *Spectrum* is unavailable, being a junior homonym of *Spectrum* Scopoli, 1777; accordingly, its plural form cannot be available as typified family-group name. Lichtenstein (1796) proposed a new generic name, *Phasma*, to replace Stoll's *Spectrum*.

Introducing the name Spectra, Latreille did not derive it from the generic name *Spectrum*; so the name Spectra should be regarded non-typified (not based on the generic name *Spectrum*) and have the authorship "Latreille, 1802", not "Stoll, 1787".

The names AMBULATORIA Westwood, 1839, PHASMOPTERA Schwanwitsch, 1949 and PHASMATOPTERA Beier, 1955 are junior circumscriptional synonyms of Spectra, and can be used as valid for the taxon consisting of all stick- and leaf-insects if priority is not an issue.

The name *Phasma* Lichtenstein, 1796 is an available genus-group name and the oldest valid generic name among stick- and leaf-insects. The oldest family-group name based thereon is Phasmida Leach, 1815. However, ICZN's Opinion 716 (Anonymous 1964) states that the family name should be Phasmatidae, not Phasmidae, and misattributes the authorship of the family-group name to Gray, 1835. Since the Commission had not suppressed family-group names formed from *Phasma* prior to 1835, Leach's family name Phasmida should be deemed available, and all typified names based on *Phasma* should thus bear the formal authorship "Leach, 1815". So, in typified nomenclature, the taxon consisting of stick- and leaf-insects can be named Phasmida, Phasmatida, Phasmatodea, Phasmatoda, Phasmataria, etc., in each case with the authorship "Leach, 1815". Since the circumscriptional nomenclature is independent from typified nomenclature, the circumscriptional name Spectra Latreille, 1802 and the typified name Phasmida Leach, 1815 do not compete for priority, each being the oldest in its nomenclature.

PANDICTYOPTERA Crampton, 1917

Circumscriptional synonyms:
— PANISOPTERA Crampton, 1919
— BLATTOPTEROIDEA Martynov, 1924
— ISOPTERIA Crampton, 1938
Typified name: Blatta/fg

The taxon consisting of praying mantids, cockroaches and termites is often called "Dictyoptera" or "Dictuoptera", with "Leach, 1815" indicated as the author of both. In fact, Leach (1815) used the name DICTUOPTERA for an order consisting of a single genus, *Blatta* (i.e., what the current classification has as Neoblattariae), placing the praying mantids with the Orthoptera, and termites with the Neuroptera.

The name Dictyoptera (verbatim, "lacewings") was independently given to various groups of insects: DICTYOPTERA Clairville, 1798 is a junior circumscriptional synonym of NEUROPTERA Linnaeus, 1758. Brullé (1832) established the new order Dictyoptera to accommodate amphibiotic insects with incomplete metamorphosis (Odonata, Ephemeroptera and Plecoptera), formerly placed in the order Neuroptera; junior circumscriptional synonyms of DICTYOPTERA Brullé, 1832 are ARKIPTERA Laporte, 1834 and AMPHIBIOTICA Gerstaecker, 1863. The preoccupied name DICTYOPTERA Dohrn, 1866, suggested for a peculiar group of Paleozoic insects, was replaced by its objective synonym, PALAEODICTYOPTERA Goldenberg, 1877. Besides,

6. Semantically, the names Spectra and Phasma are identical: "spectra" is the plural of "spectrum", which is the Latin translation of the Greek φασμα (phasma).

Enderlein (1904) applied the name "Dictyoptera" to the taxon consisting of cockroaches and praying mantids, and Crampton (1915) to the taxon containing praying mantids only.

The name PANDICTYOPTERA Crampton, 1917 is the oldest name whose original circumscription fits the taxon consisting of praying mantids, cockroaches and termites, and should be used as its valid name. The names PANISOPTERA Crampton, 1919, BLATTOPTEROIDEA Martynov, 1924 and ISOPTERIA Crampton, 1938 are its junior circumscriptional synonyms. Each can also be used where priority is not an issue.

Based on extant taxa alone, the name Pandictyoptera and its circumscriptional synonyms Panisoptera, Blattopteroidea, Isopteria and Dictuopteroida in their original circumscriptions fit the taxon consisting of praying mantids, cockroaches and termites. However, the Paleozoic and Mesozoic PALAEOBLATTARIAE Scudder, 1879, undoubtedly related to the true cockroaches, do not fit the taxon Pandictyoptera as defined based solely on the extant fauna. Palaeoblattarians, together with true cockroaches, termites and praying mantids, form a holophyletic taxon, PANDICTYOPTERA s.1., with PANDICTYOPTERA s.str. as a subordinate taxon. As long as the extant fauna is concerned, or the context is other than taxonomic or morphological, the difference between Pandictyoptera s.l. and Pandictyoptera s.str. can be ignored. In some situations, though, this difference should be stressed: for example, the statement "all the females have an outer genital chamber" would be true for Pandictyoptera s.str., but not for Pandictyoptera s.l. To avoid confusion, I propose two new names: HOLOPANDICTYOPTERA **taxon nov.** for the Pandictyoptera s.l. (including Palaeoblattariae with their long ovipositor and no outer genital chamber) and CRYPTOVIPOSITORIA **taxon nov.** for the Pandictyoptera s.str., with ovipositor reduced and hidden (completely or partly) in the outer genital chamber formed by the enlarged abdominal sternum 7. Thus, the name Dictyoptera and its monosemantic circumscriptional synonyms Panisoptera, Blattopteroidea and Isopteria are non-monosemantic circumscriptional synonyms of Holopandictyoptera and Cryptovipositoria. Holopandictyoptera and Cryptovipositoria, on the other hand, are not circumscriptional synonyms and belong to different taxa subordinated one to another within the classification of Pandictyoptera shown in Table 5.

TABLE 5. Classification of the taxa of Pandictyoptera discussed in text (typified names are given in basic format).

1. HOLOPANDICTYOPTERA, or PANDICTYOPTERA s.l.
   Monosemantic circumscriptional name:
   — HOLOPANDICTYOPTERA **taxon nov.**
   Non-monosemantic circumscriptional name (fitting also Cryptovipositoria):
   — PANDICTYOPTERA Crampton, 1917, s.l.
   Typified name: Blatta/fg (incl. *Mylacris*)

1.1. †Plesiomorphon PALAEOBLATTARIAE
   Circumscriptional names:
   — PALAEOBLATTARIAE Scudder, 1879
   — PALAEOBLATTIDA Brongniart, 1893
   Typified name: Mylacris/fg

1.2. CRYPTOVIPOSITORIA, or PANDICTYOPTERA s.str.
   Monosemantic circumscriptional name:
   — CRYPTOVIPOSITORIA **taxon nov.**
   Non-monosemantic circumscriptional name (fitting also Cryptovipositoria):
   — PANDICTYOPTERA Crampton, 1917, s.str.
   Typified name: Blatta/fg (sine *Mylacris*;incl. *Mantis*)

1.2.1. RAPTORIAE
   Circumscriptional names:
   — RAPTORIAE Latreille, 1802
   — RAPTORIA Westwood, 1839
   — EUDICTYOPTERA Crampton, 1916*a*
   — MANTOPTERA Bey-Bienko, 1962
   Typified name: Mantis/fg

1.2.2. OOTHECOPHORA

Circumscriptional name:

— OOTHECOPHORA **taxon nov.**

Typified name: Blatta/fg (sine *Mantis*; incl. *Termes*)

1.2.2.1. Plesiomorphon NEOBLATTARIAE

Monosemantic circumscriptional name:

— NEOBLATTARIAE Scudder, 1895

Non-monosemantic circumscriptional names:

— DICTUOPTERA Leach, 1815, s.str.

— DERMATODA Billberg, 1820, s.str.

— OMALOPODA Duméril, 1823, s.str.

— STERNOPODA Fieber, 1853, s.str.

— PALAEOPTERA Crampton, 1915, s.str. (non Martynov, 1923)

Typified name: Blatta/fg (sine *Termes*)

1.2.2.2. ISOPTERA

Circumscriptional names:

— ISOPTERA Brullé, 1832

— SOCIALIA Gerstaecker, 1863 (non Burmeister, 1829)

— ISOPTERODEA Boudreaux, 1979

Typified name: Termes/fg

The new name OOTHECOPHORA **taxon nov.** is proposed here for the taxon Neoblattariae + Isoptera, separated from the Raptoriae by the following autapomorphic characters: (1) median ocellus absent; (2) ovipositor strongly reduced and completely hidden in the outer genital chamber, where the ootheca is formed (Isoptera and some Neoblattariae do not form oothecae); eggs are packed in two rows (this is true for Neoblattariae and Isoptera-Hemiclidoptera, whereas in Isoptera-Crypticlidoptera eggs are not packed); (3) six abdominal ganglia (vs. seven in Raptoriae).

The Isoptera are generally accepted to have originated from within the Neoblattariae. However, no circumscriptional name has been proposed yet for the holophyletic taxon Neoblattariae + Isoptera. Hennig (1969, 1981) applied to it the typified name Blattodea, traditionally used for cockroaches alone.

The plesiomorphon PALAEOBLATTARIAE Scudder, 1879 includes extinct taxa only whose long, functional ovipositor separates them from the Oothecophora (and Cryptovipositoria in general). Originally, Scudder (1879) included in the Palaeoblattariae the extinct forms placed in the genera *Mylacris* Scudder, 1868, *Archimylacris* Scudder, 1868, and the newly described genera *Lithomylacris*, *Necymylacris*, *Etoblattina*, *Anthracoblattina*, *Gerablattina*, *Hermatoblattina*, *Progonoblattina*, *Oryctoblattina* and *Petrablattina*. The NEOBLATTARIAE Scudder, 1895 originally encompassed all recent cockroaches plus the extinct Mesozoic genera *Neorthroblattina* Scudder, 1885 and *Scutinoblattina* Scudder, 1885, and originally excluded, besides the palaeoblattarian taxa listed above, the extinct forms arranged in the genera *Paromylacris* Scudder, 1885, *Microblattina* Scudder, 1895, *Spiloblattina* Scudder, 1884, *Poroblattina* Scudder, 1885 and *Leptoblattina* Woodward, 1887, all placed by Scudder (1895) with the Palaeoblattariae. All these extinct forms were originally described based on wing venation only; palaeoblattarian specimens with ovipositors were discovered later, but for most species Scudder originally included in the Palaeoblattariae there is still no evidence of ovipositor or lack thereof.

The name PALAEOBLATTIDA Brongniart, 1893 was introduced as emendation of PALAEOBLATTARIAE Scudder, 1879 and originally applied to a family consisting of the same set of taxa as Scudder's Palaeoblattariae, to which Brongniart added a number of new species. He also provided drawings of the *Anthracoblattina ensifer* and *Etoblattina* sp. females with long ovipositors (Brongniart 1893: pl. XLIII (32): fig. 2–4).

To avoid creating new names, I suggest to accept the original circumscriptions of both PALAEOBLATTARIAE Scudder, 1897 and PALAEOBLATTIDA Brongniart, 1893 as fitting the plesiomorphon

excluding Cryptovipositoria, and the original circumscription of NEOBLATTARIAE Scudder, 1895 as fitting a taxon within Cryptovipositoria-Oothecophora, until proven otherwise.

PARAMETABOLA Crampton, 1938

Objective synonym:
— HEMIPTERADELPHIA Crampton, 1938
Non-monosemantic circumscriptional synonyms:
— PANHOMOPTERA Crampton, 1919
— PARANEOPTERA Martynov, 1923
Typified name: Cimex/f=Cicada/g (incl. *Zorotypus*)

Paraneoptera is the most familiar name of the taxon consisting of Acercaria and Zoraptera. Martynov (1938) preferred the name PARANEOPTERA Martynov, 1923 as having priority over PARAMETABOLA Crampton, 1938. In 1938, Martynov applied the name Paraneoptera to the same taxon as Parametabola, explicitly including Zoraptera; however, earlier (e.g., Martynov 1923), he had defined the Paraneoptera rather vaguely (with Zoraptera not mentioned and Thysanoptera uncertainly placed), which later caused some authors (e.g., Grassé 1949; Grimaldi & Engel 2005) to apply the name Paraneoptera to a taxon excluding Zoraptera. Actually, the taxon excluding Zoraptera has an older and widely accepted name ACERCARIA Börner, 1904 (Börner 1904; Königsmann 1960; Hennig 1969, 1981). PANHOMOPTERA Crampton, 1919 (not Paraneoptera) is the oldest name for the taxon with no mention of Zoraptera in original circumscription. Crampton's (1919) superorder Panhomoptera included the orders "Corrodentia" (i.e., Copeognatha), Mallophaga, Siphunculata, Thysanoptera and "Hemiptera" (i.e., Arthroidignatha). The oldest names for the taxon expressly including Zoraptera are PARAMETABOLA = HEMIPTERADELPHIA Crampton, 1938, with Zoraptera listed in the original publication. Recent fierce debates around the placement of the Zoraptera underscores the need to use a name whose original circumscription monosemantically fits the taxon.

Weber (1933) used an identical name, Parametabola, to refer to male coccids (Gallinsecta) with their peculiar metamorphosis; since the females were not included, Weber's "Parametabola" is not a taxon name, but rather a term of no nomenclatural standing.

Some recent workers place Zoraptera with the Polyneoptera rather than see it as sister to the Acercaria. The taxon Zoraptera + Polyneoptera has a monosemantic circumscriptional name, UROTA Chen, 1962, and its junior monosemantical circumscriptional synonym is POLYNEOPTERATA Boudreaux, 1979.

PARASITA Latreille, 1796

Circumscriptional synonyms:
— ANOPLURA Leach, 1815
— PSEUDORHYNCHOTA Cholodkovsky, 1903
— PARASITICA Shipley, 1904 (non Hartig, 1837)
— PHTHIRAPTERIDA Boudreaux, 1979
Typified name: Pediculus/fg (incl. *Ricinus*)

Currently this taxon, consisting of the sucking lice (Siphunculata) and chewing lice (Mallophaga), is often called "Phthiraptera", whereas the taxon consisting of sucking lice only, "Anoplura". However, based on the original circumscriptions, the name Phthiraptera fits Siphunculata only, whereas the name Anoplura fits Siphunculata + Mallophaga.

Originally, PHTHIRAPTERA Haeckel, 1896 was a suborder of the order "Hemiptera" within the legion Pungentia (insects with piercing-sucking mouthparts), whereas the family Mallophaga was placed in the order Archiptera of the legion Mordentia (insects with chewing mouthparts). Thus, the taxon Phthiraptera included Siphunculata only, but not Mallophaga.

The taxon that kept together the sucking and chewing lice was generally recognized as early as in the 18th century as the genus *Pediculus* Linnaeus, 1758.

The oldest non-typified name of this taxon is PARASITA Latreille, 1796. This name was used in all of Latreille's works, and by some other 19th century workers. Originally introduced in French only as "Parasites" (Latreille 1796), this name was subsequently latinized as "Parasita" (Latreille 1802 and later). The name is not preoccupied but can be mistaken for a term referring to any parasites. A similar name, PARASITICA Hartig, 1837, is used to refer to a plesiomorphon of parasitoid Hymenoptera-Apocrita.

The name ANOPLURA Leach, 1815, a junior circumscriptional synonym of Parasita, was introduced as a replacement for the following reasons: both Latreille and Leach placed this order in the subclass of wingless hexapods[7] consisting of two orders, the lice order and the order accommodating all the primarily wingless hexapods and named THYSANOURA Latreille, 1796 or THYSANURA Leach, 1815 (see above). The character Leach indicated as separating the order Anoplura from the order Thysanura was Anoplura having "*tail without setae or filaments*". "*The animals of this order are parasitical, and were by Latreille placed in an order which he named Parasita. This name Dr Leach has changed for the sake of harmony, and also to render the name more easy of retention in the memory, the characters being drawn from the same parts*" (Leach 1815: 77). Now that the lice are placed with the Pterygota, the point of emphasizing differences between Anoplura and Thysanura has been lost. Leach's (1815) Anoplura included two tribes, Pediculides (genera *Pthirus* and *Pediculus*) and Nirmides (whith a single genus *Nirmus* = *Ricinus*), the counterparts of today's Siphunculata and Mallophaga, respectively.

The name PSEUDORHYNCHOTA Cholodkovsky, 1903, originally introduced for a taxon combining "Pediculiden" (German for Pediculida or Pediculidae) and Mallophaga, is a junior circumscriptional synonym of Parasita and Anoplura.

A possible classification of this taxon is given in Table 6.

TABLE 6. Classification of the taxa of Parasita discussed in text (typified names are given in basic format).

1. PARASITA

Circumscriptional names:

— PARASITA Latreille, 1796

— ANOPLURA Leach, 1815

— PSEUDORHYNCHOTA Cholodkovsky, 1903

— PARASITICA Shipley, 1904 (non Hartig, 1837)

— PHTHIRAPTERIDA Boudreaux, 1979

Typified name: Pediculus/fg (incl. *Philopterus*, *Ricinus*, *Haematomyzus*)

1.1. MALLOPHAGA

Circumscriptional names:

— ORNITHOMYZA Duméril, 1806

— MALLOPHAGA Nitzsch, 1818

— MANDIBULATA Latreille, 1825 (non Clairville, 1798; nec Snodgrass, 1935)

— LIPOPTERA Shipley, 1904

Typified name: Philopterus/f=Ricinus/g

1.1.1. AMBLYCERA

Circumscriptional name:

— AMBLYCERA Kellogg, 1896

Typified name: Ricinus/fg

1.1.2. ISCHNOCERA

Circumscriptional name:

— ISCHNOCERA Kellogg, 1896

Typified name: Philopterus/fg

7. The subclass they named APTERODICERA Latreille, 1802 or AMETABOLIA Leach, 1815.

1.2. SIPHUNCULATA

Circumscriptional names:

— ANTLIOTA Billberg, 1820

—SIPHUNCULATA Latreille, 1825 (non Latreille, 1802)

— EPIZOICA Burmeister, 1829

— AGNATHOSTOMATA Spinola, 1850

— PHTHIRAPTERA Haeckel, 1896

— ELLIPOPTERA Shipley, 1904

— LIPOGNATHA Börner, 1904

Typified name: Pediculus/fg (sine *Philopterus*, *Ricinus*, *Haematomyzus*)

1.3. RHYNCOPHTHIRINA

Circumscriptional names:

— RHYNCOPHTHIRINA Ferris, 1931

— RHYNCOPHTHIRAPTERA Mukerji & Sen-Sarma, 1955

Typified name: Haematomyzus/fg

What caused the confusion around the names Anoplura and Phthiraptera was probably the changing view on the relationships between sucking and chewing lice. During the 18th and beginning of the 19th century, both groups were considered related based on similar looks and habits; the mouthparts were ignored. The taxon accommodating sucking and chewing lice was variously named *Pediculus*, Parasita or Anoplura. Once the striking difference in the mouthparts had been discovered, the concept of the two groups being related got rejected and the sucking lice placed either with Arthroidignatha, whose mouth apparatus is also sucking (e.g., Burmeister 1835–1839) or separately from all other insects (Spinola 1850), while the chewing lice accommodated among other insects with chewing mouthparts. At that time the old name Anoplura got applied to differently defined taxa that consisted either of chewing lice only (e.g., Billberg 1820; Burmeister 1835–1839) or of sucking lice only (e.g., Sharp 1899). In the 20th century, both lice groups were put back together based on newly discovered synapomorphies. However, the lingering misconception that the name Anoplura originally meant sucking lice only, causes a different name to be still misused for the taxon including both sucking and chewing lice.

ARTHROIDIGNATHA Spinola, 1850

Senior circumscriptional synonym:

— SEMIVAGINATA Schluga, 1766

Junior circumscriptional synonyms:

— HEMIPTEROIDEA Handlirsch, 1903

— HEMIPTERADELPHIA Crampton, 1924

— PANHEMIPTERA Crampton, 1924

— HEMIPTERIFORMA Metcalf, 1951

— HEMIPTERIDA Boudreaux, 1979

— HOMOPTEROIDEA Brodsky, 1994

Typified name: Cimex/f=Cicada/g (sine *Thrips*; incl. *Aphis*)

The widespread use of the names “Hemiptera” and “Rhynchota” to refer to the taxon consisting of Heteroptera, Coleorrhyncha, Auchenorrhyncha and Plantisuga, goes against circumscriptional principles.

The original circumscriptions of the names Ryngota, Rhyngota and Rhynchota do not fit the taxon Arthroidignatha.

The name RYNGOTA Fabricius, 1775 and its emendation RHYNGOTA Fabricius, 1799 were originally proposed for a taxon (order or class) that included, besides the genera of Arthroidignatha[8], the genera *Thrips* and *Pulex*, consistent with the current Thysanoptera and Aphaniptera. The fleas (Aphaniptera) being now placed with the Metabola, the taxon Ryngota is unacceptable as polyphyletic and, consequently, its name should be not used.

The original circumscription of the name RHYNCHOTA Burmeister, 1835 also does not fit the Arthroidignatha. Burmeister (1835) introduced the name Rhynchota as an emendation of Fabricius's Rhyngota, yet used it for a differently circumscribed taxon, Arthroidignatha + Siphunculata. Thus, unlike Rhyngota, the original circumscription of the name Rhynchota does not include Aphaniptera and Thysanoptera, but includes Siphunculata. Such unjustified emendation of a circumscriptional name is considered a new name with its own authorship, year and circumscription. By the mid-19th century, the taxon Rhynchota got adopted by some workers who believed arthroidignathan and siphunculatan piercing-sucking mouth apparatuses share the same origin—which, as we have learned, is not the case.[9] Nowadays, the taxon Rhynchota is rejected as being polyphyletic. The name RHYNCHOTA Burmeister, 1835 is preoccupied by RHYNCHOTA Billberg, 1820, which is a junior circumscriptional synonym of APHANIPTERA Kirby & Spence, 1815.

During the 18th century, the name HEMIPTERA was variously applied to an assemblage of orthopterans, fireflies, ants, true bugs and scorpions (Linnaeus 1735); to insects with somewhat hardened forewings—orthopterans and bugs (Linnaeus 1789); to orthopterans only (Retzius 1783); or to bugs and allies (Linnaeus 1758). Under the starting point rule, the formal authorship is HEMIPTERA Linnaeus, 1758, and the original circumscription of this name is the one adopted in the 10th edition of the *Systema Naturae* where (unlike in some other editions thereof, both earlier and later) the order Hemiptera consisted of the genera *Cicada*, *Notonecta*, *Nepa*, *Cimex*, *Aphis*, *Chermes*, *Coccus* and *Thrips* with a combined circumscription of Arthroidignatha + Thysanoptera. Thus, the name Hemiptera is a circumscriptional synonym of CONDYLOGNATHA Börner, 1904, not Arthroidignatha.

The name Semivaginata (a Latin rendering of the Greek "Hemiptera") was probably first used, both as "Semivaginata" and "Semi-vaginata", by Schluga (1766) who somewhat modified the Linnaean classification—e.g., by moving the genus *Thrips* from the Hemiptera (his Semivaginata) to the Coleoptera (his Vaginata). If Schluga's (1767) is the oldest use of the name Semivaginata, then SEMIVAGINATA Schluga, 1766 fits Arthroidignatha in original circumscription. The name Semivaginata has not been in use in recent times. The Latin "semi-vaginata" is a verbatim equivalent of the Greek "hem-elytrata" (from ήμι- and ελυτρον). The name HEMELYTRATA Fallén, 1829 has recently been applied to a taxon subordinated to the Arthroidignatha, so the use of its Latin translation for Arthroidignatha may cause confusion.

The name ARTHROIDIGNATHA Spinola, 1850 in its original circumscription perfectly fits the taxon in question. Spinola (1850) properly defined Arthroidignatha by the presence of an articulated beak (sometimes vestigial, as in coccids) and explained why it was wrong to combine Arthroidignatha with Siphunculata (= AGNATHOSTOMATA Spinola, 1850) into Rhynchota (in Arthroidignatha, the mouthparts are paired, in Siphunculata they are not) and to mix Thysanoptera (= ANYPEROGNATHA Spinola, 1850) with Hemiptera (Thysanoptera have no unpaired articulated beak but have paired maxillary and labial palpi).

8. These are the genera *Fulgora*, *Membracis*, *Tettigonia*, *Cicada*, *Cercopis*, *Notonecta*, *Sigara*, *Nepa*, *Naucoris*, *Acanthia*, *Cimex*, *Reduvius*, *Aphis*, *Chermes* and *Coccus*.

9. In the Siphunculata, the piercing-sucking apparatus is formed by the labium and hypopharynx; in Arthroidignatha, by the mandibles and maxillary laciniae.

PLANTISUGA Duméril, 1806

Objective synonyms:
— PLANTISUGAE Duméril, 1806
— PLANTISUGES Duméril, 1806
— PHYTADELGA Duméril, 1806
— PHYTADELGI Duméril, 1806
— PHYTADELGES Duméril, 1806
— PHYTATHELGA Duméril, 1806
— PHYTATHELGI Duméril, 1806

Circumscriptional synonyms:
— PENDULIROSTRES Spinola, 1839
— STERNORHYNCHI Amyot & Serville, 1843
— STERNORHYNCHA Fieber, 1851
— APHIDOPTERA Haeckel, 1896
— STERNORRHYNCHA Meyers & China, 1929

Typified name: Aphis/fg (incl. *Coccus*, *Psylla*, *Aleyrodes*)

The taxon consisting of Gynaptera (aphids), Gallinsecta (coccids), Saltipedes (psyllids), and Scytinelytra (aleyrodids or whiteflies) is known as Sternorrhyncha, the name often used with the authorship "Amyot & Serville, 1843". However, the name they introduced was STERNORHYNCHI Amyot & Serville, 1843, not Sternorrhyncha. Both STERNORHYNCHA Fieber, 1851 and STERNORRHYNCHA Meyers & China, 1929 are subsequent emendations of the name Sternorhynchi and should be used with their own authorships. All three were proposed to refer to the same taxon and are therefore circumscriptional synonyms, being junior synonyms of PLANTISUGA Duméril, 1806. Generally speaking, using a junior synonym is not against the principles of circumscriptional nomenclature and in some cases may be justified, but in this case such usage caused an unexpected problem.

The taxon Sternorrhyncha is often combined with Auchenorrhyncha into a paraphyletic taxon incorrectly called "Homoptera". The names "Sternorrhyncha" and "Auchenorrhyncha" imply differently positioned beaks. Some workers take this character seriously and use it in keys and phylogenetic analyses. Actually, among the Sternorrhyncha, only Saltipedes (i.e., Psylla/fg) have the beak shifting to the thoracic sternum, whereas Gynaptera (i.e., Aphis/fg) and Scytinelytra (i.e., Aleyrodes/fg) have it positioned the same way as Auchenorrhyncha, at the head's base; in Gallinsecta (i.e., Coccus/fg) this character is absent, because males have no beak, and females have no outlined head. Although etymology is no ground for renaming a taxon (see "Nomenclatures other than type- or circumscription-based"), in this case applying priority (again, optional in circumscriptional nomenclature) would help avoiding problems caused by the semantics.

The oldest circumscriptional names for the taxon consisting of aphids, coccids, psyllids and aleyrodids, are PLANTISUGA (-AE, -ES) Duméril, 1806 and PHYTADELGA (-DELGI, -DELGES, -THELGA, -THELGI) Duméril, 1806. Originally, Duméril (1806*a*–*b*) introduced these names in four versions each: (1) Latin transliterated in the French way; (2) Greek transliterated in the French way; (3) Latin transliterated in the German way; and (4) Greek transliterated in the German way—but no Latin spelling *per se*. Such names should be available with original authorship and subsequent Latin spelling (see "The circumscriptional nomenclature"). The family consisting of the genera *Aleyrodes*, *Coccus*, *Aphis*, *Chermes* and *Psylla* was originally named in French "Plantisuges ou Phytadelges" (Duméril 1806*a*) and in German "Pflanzesauger oder Phytathelgen" (Duméril 1806*b*).

The Latin version, spelt "Plantisuges" in French, can be spelt in Latin as either "Plantisuga" or "Plantisugae". Jourdan's (1834) dictionary, besides the French "Plantisuges", provides the Latin spelling as "Plantisuga". In his last work, Duméril (1860) added the Latin rendering "Plantisugae". Bogdanov (1861), citing Duméril's (1860) insect classification, changed "Plantisuges" to "Plantisuga".

The Greek version of the name, indicated to have been derived from φυτον + αθελγω, was spelt "Phytadelges" in French and "Phytathelgen" in German. The same French name "Phytadelges" and the Greek verb αθελγω were repeated by Duméril (1860) in his last book. French transliteration of "θ" as "d" is

unorthodox. Jourdan's (1834) dictionary provides, along with the French "Phytadelges", the Latin spelling "Phytadelgi" and the Greek source, as φυτον + αδελγω. The word αδελγω is not known in Greek and seems to be a mere misinterpretation of Duméril's French transliteration "-adelges". Amyot & Serville (1843) gave an alternative Latin spelling, "Phytathelgi", marked it as a new name, and cited "Phytadelges Dum." as a synonym of their Phytathelgi. However, they applied the name Phytathelgi to a smaller taxon consisting of coccids only (their Orthezides and Coccides), and called "section Sternorhynchi" the group fitting Duméril's "Plantisuges ou Phytadelges". Following the tradition to derive non-typified names by adding the plural neutral ending "-a", Duméril's Phytadelges and Phytathelgen can be latinized either as "Phytadelga" (from the French version) or "Phytathelga" (reflecting the German version and the etymology).

As Duméril failed to latinize his "Plantisuges ou Phytadelges", all Latin rendering thereof shall have the same authorship and original circumscription, i.e., PLANTISUGA Duméril, 1806 = PLANTISUGAE Duméril, 1806 = PLANTISUGES Duméril, 1806 = PHYTADELGA Duméril, 1806 = PHYTADELGI Duméril, 1806 = PHYTADELGES Duméril, 1806 = PHYTATHELGA Duméril, 1806 = PHYTATHELGI Duméril, 1806—all being circumscriptional synonyms referring to the taxon Gynaptera + Gallinsecta + Saltipedes + Scytinelytra. Thus, the name "Phytathelgi" should be considered misapplied by Amyot & Serville to a taxon inconsistent with Duméril's one in circumscription. The French "Phytadelges" has too many options of Latin transliteration, one of which (Phytathelgi) may prove controversial in terms of original circumscription. Therefore, the valid name should be chosen among latinized versions of the original "Plantisuges"—preferably, PLANTISUGA Duméril, 1806, as being the oldest one and formed using the most popular model.

METABOLA Burmeister, 1832

Circumscriptional synonyms:

— HETEROMORPHA Westwood, 1839 (non HETEROMORPHES Blainville, 1816)
— HETEROGNATHA Börner 1920 (non Saussure & Humbert, 1872; nec Chen, 1962)
— OLIGONEOPTERA Martynov, 1923
— EUNEOPTERA Martynov, 1924
— ENDOPTERYGOTIDA Boudreaux, 1979
— ENDONEOPTERA Kukalova-Peck & Brauckmann, 1992

Typified name: Scarabaeus/fg (sine *Cicada*; incl. *Hemerobius*, *Papilio*)

The taxon Metabola (= Oligoneoptera) encompassing all insects with complete metamorphosis, is generally accepted. Its newly discovered autapomorphies and the nature of the metamorphosis have been discussed in an earlier paper (Kluge 2005*a*).

The name "Holometabola", routinely applied to this taxon, does not fit it in its original circumscription. The name was first published in the *Handbuch der Entomologie* (Burmeister 1832–1855). Volume 1 (1832) has no mention of Holometabola; the insects are divided into "Insecta ametabola" and "Insecta metabola", the latter containing what we include in this taxon now. The names Hemimetabola and Holometabola first appear in Part 1 of the Volume 2 (1835), with "Insecta ametabola Leach" mentioned as a synonym of Hemimetabola, and "Insecta metabola Leach" as a synonym of Holometabola. However, Leach (1815) used the names Ametabolia and Metabolia rather than Ametabola and Metabola, and placed with METABOLIA Leach, 1815 all the winged insects, not just those with complete metamorphosis.

In Volume 2, Burmeister defined Hemimetabola and Holometabola differently from "Insecta ametabola" and "Insecta metabola" in Volume 1: In Vol. 1, what is now Trichoptera, Mecaptera and Neuropteroidea was placed among the "Insecta metabola", but in Vol. 2 among the Hemimetabola (Table 7), based on their walking pupa[10] . Now we know that the pupae of the Trichoptera, Rhaphidioptera and of some Birostrata can walk only at pharate imago phase; prior to that the pupal legs are immovable (Kluge 2005*a*).

10. At this time, the terms "pupa" and "nymph" were used interchangeably and applied to insects with any type of metamorphosis.

TABLE 7. The name Metabola: original circumscription and names misconstrued as its synonyms.
1, currently recognized taxa; 2, Leach 1815; 3, Burmeister 1832–1855 Vol. 1; 4, Burmeister 1832–1855 Vol. 2; 5, Sharp 1899.

1	Entognatha Triplura	Parasita	Ephemeroptera Odonata Polyneoptera Copeognatha Condylognatha	Neuropteroidea Mecaptera Trichoptera	Coleoptera Strepsiptera Hymenoptera Diptera Lepidoptera	Aphaniptera
2	**Ametabolia** Leach, 1815		**Metabolia** Leach, 1815			
3	**Ametabola** Burmeister, 1832			**Metabola** Burmeister, 1832		
4	**Hemimetabola** Burmeister, 1835				**Holometabola** Burmeister, 1835	
5	**Apterygota** Lang, 1888	**Anapterygota** Sharp, 1899, partim	**Exopterygota** Sharp, 1899	**Endopterygota** Sharp, 1899		**Anapterygota** Sharp, 1899, partim

Circumscriptional rules prohibit applying the name HOLOMETABOLA Burmeister, 1835 to any taxon that includes Trichoptera, Mecaptera or Neuropteroidea. The artificial taxon fitting the original circumscription of the name Holometabola is no longer recognized. On the other hand, the name METABOLA Burmeister, 1832 in its original circumscription fits a larger taxon, generally recognized and considered holophyletic.

"Endopterygota" is another name widely used to refer to this taxon. However, the original circumscription of the name ENDOPTERYGOTA Sharp, 1899 does not fit Metabola, since it does not include the fleas, which were placed then with the ANAPTERYGOTA Sharp, 1899, a polyphyletic assemblage of insects that have lost wings (Table 7). Some like the name Endopterygota because it reflects an alleged major autapomorphy of this taxon—the internal larval wing anlagen, which is in fact a misinterpreted feature (Kluge 2005*a*).

BIROSTRATA Kluge, 2005*b*

Typified name: Myrmeleon/f=Hemerobius/g (sine *Raphidia*, *Chauliodes*)

Nowadays the taxon BIROSTRATA Kluge, 2005*b* (the lacewings with paired piercing-sucking larval mouth apparatus) is usually called "Neuroptera" or "Planipennia". The circumscription originally assigned to either name is inconsistent with the taxon as presently recognized.

The name NEUROPTERA Linnaeus, 1758 originally refers to an order including the genera *Libellula*, *Ephemera*, *Phryganea*, *Hemerobius*, *Panorpa* and *Raphidia* with a combined circumscription of Odonata + Ephemeroptera + Trichoptera + Plecoptera + Meganeuroptera + Birostrata + Isoptera + Copeognatha + Mecaptera + Rhaphidioptera. Neuroptera sensu Linnaeus (1758) is now considered to be paraphyletic and no longer recognized as a taxon. Subsequently, this Linnaean order was broken down into a number of smaller orders, one of which inherited the name Neuroptera. MacLeay (1821) designated *Libellula* as the type for the name Neuroptera, so some workers, splitting Linnaean Neuroptera, applied the name Neuroptera to the group where the dragon- and damselflies were placed. Others, however, did, and still do, variously apply the name to groups not including *Libellula* (Table 8) and mostly treated as orders, so this non-typified name is misused as a rank-based one (see "Type-based rank-based nomenclatures").

TABLE 8. The name Neuroptera: usage examples.

Taxa included in the Neuroptera by various authors:		e.g., Linnaeus 1758	Kirby 1892	Retzius 1783	e.g., Burmeister 1829	Newman 1853	e.g., Haeckel 1866	e.g., Banks 1892	e.g., Brauer 1885	e.g., Handlirsch 1903	Crampton 1916*a*
Collembola			+								
Triplura			+								
Thysanoptera			+			+					
Ephemeroptera		+	+			+					
Copeognatha		+	+			+					
Isoptera		+	+	+		+					
Odonata		+	+	+		+					
Plecoptera		+	+	+	+	+					
Birostrata	Hemerobioidea	+	+	+	+		+	+	+	+	+
	Myrmeleontoidea	+	+	+	+		+	+	+	+	
Meganeuroptera		+	+	+	+		+	+	+		
Rhaphidioptera		+	+	+	+		+	+	+		
Mecaptera		+	+	+	+		+	+			
Trichoptera		+	+		+		+				
Strepsiptera							+				

The name PLANIPENNES Latreille, 1817 is sometimes misinterpreted as French and therefore often spelled "Planipennia"; however, Latreille (1825) spelt "Planipennes" in both Latin and French elsewhere. Originally (Latreille 1817), the family Planipennes consisted of genera (or subgenera in Cuvier's sense) *Nemoptera*, *Bittacus*, *Panorpa*, *Boreus*, *Myrmeleon*, *Ascalaphus*, *Hemerobius*, *Osmylus*, "*Semblis*" (i.e., *Sialis*), *Raphidia*, *Termes*, *Psocus* and *Perla*, with a combined circumscription of Mecaptera + Birostrata + Meganeuroptera + Rhaphidioptera + Isoptera + Copeognatha + Plecoptera. Thus, Planipennes is a junior circumscriptional synonym of STEGOPTERA Duméril, 1806.

Burmeister (1835–1839) was the first to use the spelling "Planipennia". His tribe PLANIPENNIA Burmeister, 1839 consisted of the families "Sialidae" (which should be Corydalidae), Panorpina, Rhaphidiodea, Hemerobiidae and Myrmeleontidae, with combined circumscription of Meganeuroptera + Mecaptera + Rhaphidioptera + Birostrata. Some modern authors used the name "Planipennia" for Birostrata. This usage goes back to *Brehms Tierleben* (Heymons 1915) and is inconsistent with circumscriptional pinciples.

In Burmeister's (1839) classification, the taxon fitting Birostrata and consisting of his families Hemerobiidae and Myrmeleontidae was named Megaloptera. Originally, the name MEGALOPTERA Latreille, 1802 was proposed for a taxon consisting of Meganeuroptera + Rhaphidioptera but no member of Birostrata (see below).

BIROSTRATA Kluge, 2005*b* is the name I gave this taxon, generally accepted for a century yet having no valid circumscriptional name. The taxon is characterized by unique paired piercing-sucking larval mouth apparatus whose homology was first established in the same paper (Kluge 2005*b*).

RHAPHIDIOPTERA Navás, 1916
Senior circumscriptional synonyms:
— TETRAMERA Billberg, 1820 (non Duméril, 1806; nec al.)
— APONEUROPTERA Crampton, 1916*a*
Junior circumscriptional synonym:
— RAPHIDIOPTERA Martynov, 1938
Typified name: Raphidia/fg

Based on traditional Greek-to-Latin transliteration, Navás (1916) believed the correct spelling of the generic name to be *Rhaphidia* rather than *Raphidia*, and thus named the family Rhaphididae and his new order Rhaphidioptera. The original spelling of generic name should be used whether or not grammatically correct (the *Code*, Art. 32.5.1); any different subsequent spelling (unjustified emendation) being regarded as a junior objective synonym with its own author and date (the *Code*, Art. 33.2.3), and family-group names should be based on the original spelling (the *Code*, Art. 35.4.1). Thus, the generic name from which family-group names should be derived is *Raphidia* Linnaeus, 1758, not *Rhaphidia* Billberg, 1820. However, the name Rhaphidioptera is not subject to these rules, since it is not a family-group name and includes the additional "-pter-" element, so in this case the original spelling of RHAPHIDIOPTERA Navás, 1916 should be used with its author and date, whereas RAPHIDIOPTERA Martynov, 1938 should be considered its unjustified emendation and a circumscriptional synonym, used with its own author and date.

MEGANEUROPTERA Crampton, 1916*a*
Circumscriptional synonym:
— EUMEGALOPTERIDA Krausse & Wolff, 1919
Typified name: Corydalus/f=Chauliodes/g (incl. *Sialis*)

Currently, the taxon consisting of Eumegaloptera and Nothomegaloptera is usually called "Megaloptera", the name also used sometimes to refer to the taxon Eumegaloptera + Nothomegaloptera + Rhaphidioptera (Tillyard 1918; Hennig 1953; Mickoleit 1969; Hinton 1981). Originally, the name MEGALOPTERA Latreille, 1802 was proposed for a family consisting of the genera *Chauliodes*, *Corydalus*, *Sialis* and *Raphidia*, and fitting EMMENOGNATHA Börner, 1904 in circumscription. Later on, Latreille (1807, 1810, 1825) called "Megaloptera" a smaller taxon consisting of *Chauliodes*, *Corydalus* and *Sialis* only, i.e., what was later named MEGANEUROPTERA Crampton, 1916*a*. As the name Megaloptera is currently used both ways, the first of which only is circumscriptionally correct, its extensive alternative use is misleading. Burmeister (1839) used the name "Megaloptera" for Birostrata (see above).

The oldest circumscriptional name whose original circumscription fits the taxon that includes Eumegaloptera and Nothomegaloptera but excludes Rhaphidioptera is MEGANEUROPTERA Crampton, 1916*a*. It is derived from "mega" + "Neuroptera" and should be not confused with its junior homonym MEGANEUROPTERA Tillyard, 1918 (derived from "*Meganeura*" + "ptera").

ELEUTERATA Fabricius, 1775
Typified name: Scarabaeus/fg (incl. *Cupes*)

This generally recognized taxon, the beetles, is mostly called "Coleoptera". The name dates back to Aristotle and has the history of being applied to various taxa accommodating a range of insects with wing covers, not just beetles. Under the starting point rule, its formal authorship is COLEOPTERA Linnaeus, 1758. Originally, Coleoptera included besides true beetles[11], the genera *Forficula*, *Blatta* and *Gryllus* (incl. *Mantis*, *Acrida*, *Bulla*, *Acheta*, *Tettigonia*, *Locusta*) with a combined circumscription of Dermatoptera + Neoblattariae +

Raptoriae + Spectra + Saltatoria. Thus, the original circumscription of the name Coleoptera does not fit the taxon to which it is now applied.

Fabricius (1775) split the Linnaean Coleoptera into two orders, Eleuterata and Ulonata. ELEUTERATA Fabricius, 1775 is the oldest circumscriptional name for the taxon that includes true beetles only.

Until the end of the 18th century, the name Coleoptera was often used to refer to a taxon which, besides beetles, included at least *Forficula* (Olivier 1789), but since the beginning of 19th century, the name was applied to beetles only, with Eleuterata as its junior synonym.

In cases where the strict enforcement of the *Code* goes against a deeply rooted tradition, the International Commission on Zoological Nomenclature may rule to legalize the traditional usage. The Commission does not deal with circumscriptional names yet, but in the future, with articles regulating circumscriptional names added to the *Code*, the Commission might consider this case. I would propose to have the name Coleoptera suppressed in all pre-1774 publications and conserve the name COLEOPTERA De Geer, 1774 as a senior circumscriptional synonym of ELEUTERATA Fabricius, 1775. De Geer (1774) was the first to apply the name Coleoptera to nothing but true beetles.

PANZYGOTHORACA Kluge, 2004

Typified name: Papilio/fg (incl. *Cinyps*, *Panorpa*, *Pulex*, *Oestrus*)

In an earlier paper (Kluge 2004*b*), I proposed the new name Panzygothoraca for a widely accepted taxon consisting of Hymenoptera, Mecaptera, Aphaniptera, Diptera, Trichoptera and Lepidoptera. This group had been called "Mecopteroidea", "Mecopteria" or "Hymenopterida", with no clear circumscription or authorship specified for any of the three names. The oldest publications where these names are found suggest that their original circumscriptions do not fit Panzygothoraca.

The authorship of the name MECOPTEROIDEA is unknown. The name emerged as a replacement for Handlirsch's (1903) name Panorpoidea. The name Panorpoidea appears typified and derived by adding the suffix and ending "-oidea" to the generic name *Panorpa*. Under the *Code* (Art. 29.2), this name may only apply to a superfamily whose oldest family-group name is formed from *Panorpa*, so Handlirsch's name Panorpoidea was replaced with Mecopteroidea. Handlirsch's Panorpoidea included the Mecaptera, Aphaniptera, Diptera, Trichoptera and Lepidoptera, but did not include the Hymenoptera. The name Mecopteroidea is often used the same way. Rohdendorf (1977) attributed the name Mecopteroidea to Martynov (1938). However, Martynov's last paper has not been published in full, whereas the published part (Martynov 1938) makes no mention of Mecopteroidea. Earlier, Crampton (1924: 36, footnote) used the English form of this name as "mecopteroid insects". Although the name Mecopteroidea is indeed often applied to Handlirsch's Panorpoidea, the actual usage may vary (Table 9) and refers, e.g., to a taxon consisting of Hymenoptera, Mecaptera, Aphaniptera, Diptera, Trichoptera and Lepidoptera (Bey-Bienko 1964). This meaning is probably inconsistent with the original concept of Mecopteroidea, so the name should not be used.

TABLE 9. The name Mecopteroidea: usage examples.

	Neuropteroidea	Hymenoptera	Aphaniptera	Mecaptera	Diptera	Trichoptera	Lepidoptera
Crampton 1924 "mecopteroid orders"	–	–	+	+	+	+	+
Chen 1946	–	+		+	–	–	+
Grassé 1949, Hennig 1969	–	–	–	+	+	+	+
Rohdendorf 1962	–	–	+	+	+	+	+
Bey-Bienko 1962	+	+	+	+	+	+	+
Bey-Bienko 1964	–	+	+	+	+	+	+

11. Genera *Scarabaeus, Dermestes, Hister*, *Silpha, Cassida, Coccinella, Chrysomela, Curculio, Attelabus, Cerambyx, Leptura, Cantharis, Elater*, *Cicindela, Buprestis, Dytiscus, Carabus, Tenebrio, Meloe*, *Mordella, Necydalis* and *Staphylinus*

The name "Mecopteria" was used by Mickoleit (1969) for the taxon consisting of Hymenoptera, Mecaptera, Aphaniptera, Diptera, Trichoptera and Lepidoptera. This name is an emendation of Mecopteroidea. Originally, the name MECOPTERIA Hennig, 1953 was used for a taxon that did not include Hymenoptera and Aphaniptera. Later this name was variously used for other taxa (Table 10).

TABLE 10. The name Mecopteria: usage examples.

	Hymenoptera	Aphaniptera	Mecaptera	Diptera	Trichoptera	Lepidoptera
Hennig 1953	–	–	+	+	+	+
Hennig 1962	–	–	+	+	–	–
Mickoleit 1969	+	+	+	+	+	+
Kristensen 1995	–	+	+	+	+	+

The name "Hymenopterida" was used by Weaver (1984) for the taxon consisting of Hymenoptera, Mecaptera, Aphaniptera, Diptera, Trichoptera and Lepidoptera. Earlier the name HYMENOPTERIDA Boudreaux, 1979 was introduced as an emendation of HYMENOPTEROIDEA Handlirsch, 1903 and was applied to a subcohort consisting of Hymenoptera only (Boudreaux 1979). Both Hymenopteroidea and Hymenopterida are thus junior circumscriptional synonyms of HYMENOPTERA Linnaeus, 1758.

PANZYGOTHORACA Kluge, 2004 is the only circumscriptional name for the taxon consisting of Hymenoptera, Mecaptera, Aphaniptera, Diptera, Trichoptera and Lepidoptera. The name is derived from ZYGOTHORACA Schoch, 1884[12], a name proposed to include Hymenoptera, Diptera and Lepidoptera only, with Trichoptera and Mecaptera left among Neuroptera. The Zygothoraca was explicitly established as a polyphyletic taxon: Hymenoptera, Diptera and Lepidoptera were assumed to have originated independently from the ancestral (i.e., paraphyletic) taxon "Neuroptera" (Schoch 1884; Woodworth 1906). The word "Zygothoraca" refers to the fused adult thoracic segments[13]. The taxon Panzygothoraca is probably holophyletic (Kluge 2004*b*) and consists of the original membership of Zygothoraca (i.e., Hymenoptera, Diptera and Lepidoptera) plus their allies Mecaptera, Aphaniptera and Trichoptera.

LEPIDOPTERA Linnaeus, 1758

Circumscriptional synonyms:
— FARINACEA = FARINOSA Schluga, 1767
— GLOSSATA Fabricius, 1775
— GLOSSOSTOMA Leach, 1815
— MICROGNATHA Spinola, 1850
— SORBENTIA Haeckel, 1889
Typified name: Papilio/fg (*sine Phryganea*; incl. *Micropterix*)

In its original circumscription, the generally accepted name LEPIDOPTERA Linnaeus, 1758 fits the taxon to which it had always been applied. The name was actually introduced by Aristotle, but under the starting point rule the formal authorship is Linnaeus (1758). The original Linnaean Lepidoptera included, among other species, the whiteflies under the species name *Phalaena* (*Tinea*) *proletella*. The whiteflies (Scytinelytra or Aleyrodes/fg1) are currently placed in the Arthroidignatha. Linnaeus's placing them with Lepidoptera was clearly a mistake rather than a reflection of his views on classification: he simply mistook the whitefly rostrum for "lingua inflexa", and the waxy wing cover, for scales. Hence, *proletella* [*Phalaena*] should not be considered a part of the original net included membership of Lepidoptera, so Lepidoptera should be a valid circumscriptional name for this taxon excluding *proletella* [*Phalaena*].

12. Circumscriptional synonyms of ZYGOTHORACA Schoch, 1884 are NEOPTERA Woodworth, 1906 (non Martynov, 1923) and HOMOPTERA Burmeister, 1835 (non Latreille, 1810).

13. Not all the members share this feature, as there is no fusion in some primitive hymenopterans and lepidopterans.

In my earlier papers (Kluge 2004*b*, 2005*a*), I wrongly referred to the taxon Lepidoptera + Trichoptera as "Sorbentia Haeckel, 1896" because I believed that Haeckel's (1896) usage was the original one. It turns out, however, that the name goes back to Haeckel's (1889) paper where Sorbentia consisted of nothing but Lepidoptera, whereas the caddisflies (under the generic name *Phryganea* within Neuroptera) were treated separately among Mordentia. Thus, the name SORBENTIA Haeckel, 1889 is a junior circumscriptional synonym of Lepidoptera (Mielke & Casagrande 2006). The oldest circumscriptional name for Lepidoptera + Trichoptera is not Sorbentia, but AMPHIESMENOPTERA Kiriakoff, 1948.

Some modern workers treat the name GLOSSATA Fabricius, 1775 not as a synonym of Lepidoptera but as a valid name of a taxon that does not include the laciniate moths (Micropterigidae). However, Fabricius (1775) applied Glossata to all the butterflies and moths, including the laciniate moths, e.g., *calthella* Linnaeus, 1758 [*Phalaena* (*Tinea*)]. The entire original diagnosis of Glossata is just "*Os palpis linguaque spirali*", although diagnoses of some genera treated by Fabricius in the Glossata suggest that they lack spiral lingua, which means that placing the laciniate moths (those with no spiral lingua) within Glossata was deliberate (unlike the Linnaeus's placing the whiteflies with Lepidoptera).

Packard (1895) was the first to divide the Lepidoptera into those retaining the chewing laciniae and those who have lost them, and proposed the name LEPIDOPTERA HAUSTELLATA Packard, 1895 for the latter, stipulating, however, that "*If the term* haustellata *should be thought inapplicable from use by former authors the term* Lepidoptera glossata *could be used instead*" (p. 233, footnote 4). Indeed, the name Haustellata is preoccupied: during the early 19th century, the name HAUSTELLATA Clairville, 1798 was used to refer to a polyphyletic taxon accommodating an assortment of insects with sucking mouthparts. Packard (1895) clearly regarded both Haustellata and Glossata as new names proposed by him for a newly established taxon, but did not use Fabricius's name Glossata. However, some recent authors (e.g., Speidel 1977) misapplied the name GLOSSATA Fabricius, 1775 to Packard's taxon. As this taxon had no non-homonymous name, I proposed to name it GLOSSOLEPIDOPTERA Kluge, 2005. A simplified classification of higher lepidopteran taxa is shown in Table 11.

TABLE 11. A simplified classification of the higher taxa of Lepidoptera (typified names are given in basic format).

1. LEPIDOPTERA

Circumscriptional names:

— LEPIDOPTERA Linnaeus, 1758
— FARINACEA = FARINOSA Schluga, 1767
— GLOSSATA Fabricius, 1775
— GLOSSOSTOMA Leach, 1815
— MICROGNATHA Spinola, 1850
— SORBENTIA Haeckel, 1889

Typified name: Papilio/fg (incl. *Micropterix*)

1.1. Plesiomorphon PROTOLEPIDOPTERA

Circumscriptional names:

— MICROJUGATAE Comstock, 1893
— PROTOLEPIDOPTERA Packard, 1895
— LACINIATA Packard, 1895
— TRICHOLEPIDOPTERA Crampton, 1916*a*
— ZEUGLOPTERA Chapman, 1917

Typified name: Micropterix/fg

1.2. GLOSSOLEPIDOPTERA

Circumscriptional names:

— HAUSTELLATA Packard, 1895 (non Clairville, 1798)
— GLOSSATA Packard, 1895 (non Fabricius, 1775)
— GLOSSOLEPIDOPTERA Kluge, 2005

Typified name: Papilio/fg (sene *Micropterix*; incl. *Eriocrania*)

1.2.1. Plesiomorphon PALAEOLEPIDOPTERA

Circumscriptional names:

— PALAEOLEPIDOPTERA Packard, 1895

— DACNONYMPHA Hinton, 1946

— HOPLOSTOMATOPTERA Kiriakoff, 1948

Typified name: Eriocrania/fg

1.2.2. NEOLEPIDOPTERA

Circumscriptional name:

— NEOLEPIDOPTERA Packard 1895

Typified name: Papilio/fg (sene *Eriocrania*)

ENTERACANTHA taxon nov.

Typified name: Panorpa/fg (incl. *Pulex*).

According to the widely accepted idea about flea origin, the order Aphaniptera (= Siphonaptera) is a sister group to the family Boreidae, which belongs to the order Mecaptera (= Mecoptera), Mecaptera being thus paraphyletic. It is also generally accepted that taxa whose paraphyly is revealed should be dismantled and substituted by holophyletic taxa. However, the paraphyletic taxon Mecaptera is still in general use, whereas the holophyletic taxa Mecapera + Aphaniptera and Boreidae + Aphaniptera remain to be unnamed (Zrzavy 2008).

TABLE 12. Classification of the taxa of Enteracantha discussed in text (typified names are given in basic format).

1. ENTERACANTHA

Circumscriptional name:

— ENTERACANTHA **taxon nov.**

Typified name: Panorpa/fg (incl. *Pulex*)

1.1. SCORPIOMUSCI

Circumscriptional name:

— SCORPIOMUSCI Kluge, 2004*b*

Typified name: Panorpa/fg (sine *Pulex*; incl. *Merope*, *Chorista*, *Notiothauma*)

1.2. NANNOMECOPTERA

Circumscriptional name:

— NANNOMECOPTERA Hinton, 1981

Typified name: Nannochorista/fg

1.3. METAMECOPTERA

Circumscriptional names:

— METAMECOPTERA Crampton, 1930

— RAPTIPEDIA Willmann, 1987

Typified name: Bittacus/fg

1.4. PLEUROPTERA

Circumscriptional name:

— PLEUROPTERA **taxon nov.**

Typified name: Pulex/fg (incl. *Boreus*)

1.4.1. RAPHIOPTERA

Circumscriptional name:

— RAPHIOPTERA MacLeay, 1821

— NEOMECOPTERA Crampton, 1930

Typified name: Boreus/fg

1.4.2. APHANIPTERA

Circumscriptional names:

— SALTATORIA Retzius, 1783 (non Latreille, 1817)
— SUCTORIA Retzius, 1783
— ROPHOTEIRA Clairville, 1798
— APHANIPTERA Kirby & Spence, 1815
— MEDANOPTERA Leach, 1815
— RHYNCHOTA Billberg, 1820 (non Burmeister, 1835)
— SIPHONAPTERA Latreille, 1825
— SIPHONAPTEROIDEA Grassé, 1949

Typified name: Pulex/fg (sine *Boreus*)

The taxon that consists of the scorpionflies and their relatives, but excludes fleas, has the circumscriptional name MECAPTERA Packard, 1886. Originally the name Mecaptera was applied to an order that did not include fleas (treated as a separate order, Siphonaptera). The name Mecaptera was generally accepted until the beginning of 20th century (Banks 1907); then MECOPTERA Hyatt & Arms, 1891, its unjustified emendation and junior circumscriptional synonym, became prevalent.

I propose a new name, ENTERACANTHA **taxon nov.**, for the taxon Mecaptera + Aphaniptera. The name refers to the acanthae present in adult proventricula, its autapomorphic character. The typified name of this taxon should be derived from *Panorpa* rather than *Pulex*, because the earliest established family-group name is Panorpatae Latreille, 1802, not Pulicides Billberg, 1820, and the generic name *Panorpa* Linnaeus, 1758 (genus 221, page 551) has page priority over *Pulex* Linnaeus, 1768 (genus 234, page 614).

PLEUROPTERA **taxon nov.** is the name I propose for the taxon consisting of Raphioptera (= Neomecoptera = Boreus/fg1) and Aphaniptera. This name refers to one of autapomorphies of this taxon—partial fusion of wing vestiges with thoracic pleurites. Male *Boreus* have wings transformed into sclerotized pointed hooks partly fused basally with the pleurite (and thus of limited mobility) and used to restrain the female during mating. In Aphaniptera wings are lost, but remnants of their fusion with pleurites are retained: mesothorax has a pair of separated pleural ridges, hidden under integral external pleural walls; metathorax has tergal flaps, which overlap dorsal parts of pleural ridges (Snodgrass 1946). The Pleuroptera is a part of Enteracantha. The classification of the Enteracantha other than Pleuroptera is being disputed. Table 12 presents a possible arrangement.

The taxon SCORPIOMUSCI Kluge, 2004*b* includes Panorpidae, Meropeidae, Choristidae, Notiothaumidae and allies. Its holophyly is proven by (1) the presence of "notal organ"—a clasper formed by outgrowths of abdominal terga 3 and 4 (present in Panorpidae and Notiothaumidae, but lost in Meropeidae and Choristidae); (2) the unique structure of the male seminal pump; (3) the unique structure of the female abdominal sterna 8 and 9; (4) the unique structure of the female abdominal tip (Mickoleit 1975; Willmann 1981; Kluge 2004*b*).

NANNOMECOPTERA Hinton, 1981 is group of a few closely related Notogean species. Probably, it is a young group related to Scorpiomusci. Claims that the larvae possess archaic features are not sustainable (Kluge 2004*b*).

METAMECOPTERA Crampton, 1930 (= RAPTIPEDIA Willmann, 1987) is clearly holophyletic. Its relationships with the other Enteracantha are being discussed.

Acknowledgements

The author thanks V. Belov (USA) for language improvement. He also thanks F. Chérot (Free University of Brussels, Belgium) and A. Dubois (Muséum National d'Histoire Naturelle, Paris, France) for useful suggestions concerning manuscript. This investigation was supported by the Russian Federal Program on Support of Leading Scientific Schools, grant No. 332.2010.4.

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■ *Accepted by Alain Dubois: 30 November 2010. – Published: 24 December 2010.*