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Chelicerae of arachnids: facts and fiction

Хелицеры арахнид: факты и вымысел

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ABSTRACT. Chelicerae of some Arachnida were studied to demonstrate that there is proof that the thelyphonid chelicerae are three-articulated. The phylogeny of Uropygi-Ambypygi-Araneae is briefly discussed and the term «Pedipalpi», as an ordinal name, is treated as inappropriate.

РЕЗЮМЕ. Изучены хелицеры некоторых Arachnida и показано, что хелицеры телифонид следует считать трехчленистыми. Кратко обсуждается филогения Uropygi-Ambypygi-Araneae, и делается вывод, что термин «Pedipalpi» не годится для употребления в качестве таксономического названия.

Introduction

The chelicerae of Scorpions, Opiliones, Palpigradi and some Acari are three-articulated. The rest of Arachnida orders (Amblypygi, Araneae, Ricinulei, Pseudoscorpiones, Solifugae and part of Acari) have two-articulated chelicerae. In the Handbook of Zoology, Kästner [1932] wrote that the chelicerae of Arachnids are generally two-articulated, and this fact remains widely accepted, even with regards to Uropygi. Yet Kästner also added a drawing [Op. cit.: fig. 15], which clearly shows a three-jointed chelicera of Schizopeltidia. Unfortunately, his other figures (e.g., of Holopeltidia) are cut off in their proximal parts. Interestingly, such a drawing of the Schizomid chelicera also appeared in the work by Zonstein [2003: fig. 34], but both authors did not pay any attention to this detail. This fact has given rise to the question on whether the chelicerae of Uropygi are also three-articulated? The present brief note is not intended as a theoretical discussion of the problem of plagiaxiality in arachnids, but rather allows me to concur with the earlier opinion by Weygoldt & Paulus [1979 a,b] regarding the sister group of Araneae.

Results and discussion

During dissections of the whip scorpions (the genera *Typopeltis* and *Labochirus*) it was found that plesiomorphic chelicerae are likely to be three-jointed (Figs 1, 2). By means of the polarization optics (Wild Stereoscan M8 with Canon Powershot) it has been revealed that there are two sets of musculature. One set inserts outside (extrinsic muscles; Shultz [1993]) to adjust the chelicerae in longitudinal direction (Fig. 3: simple arrow). In their posterior part, the median muscles insert at a cuticular process reaching backwards in between the two chelicerae. Another set is located inside the chelicerae (intrinsic muscles, not mentioned by Shultz [1993]; Fig. 3: double arrow). The latter observation is far more interesting, as it might indicate the existence of a third article.

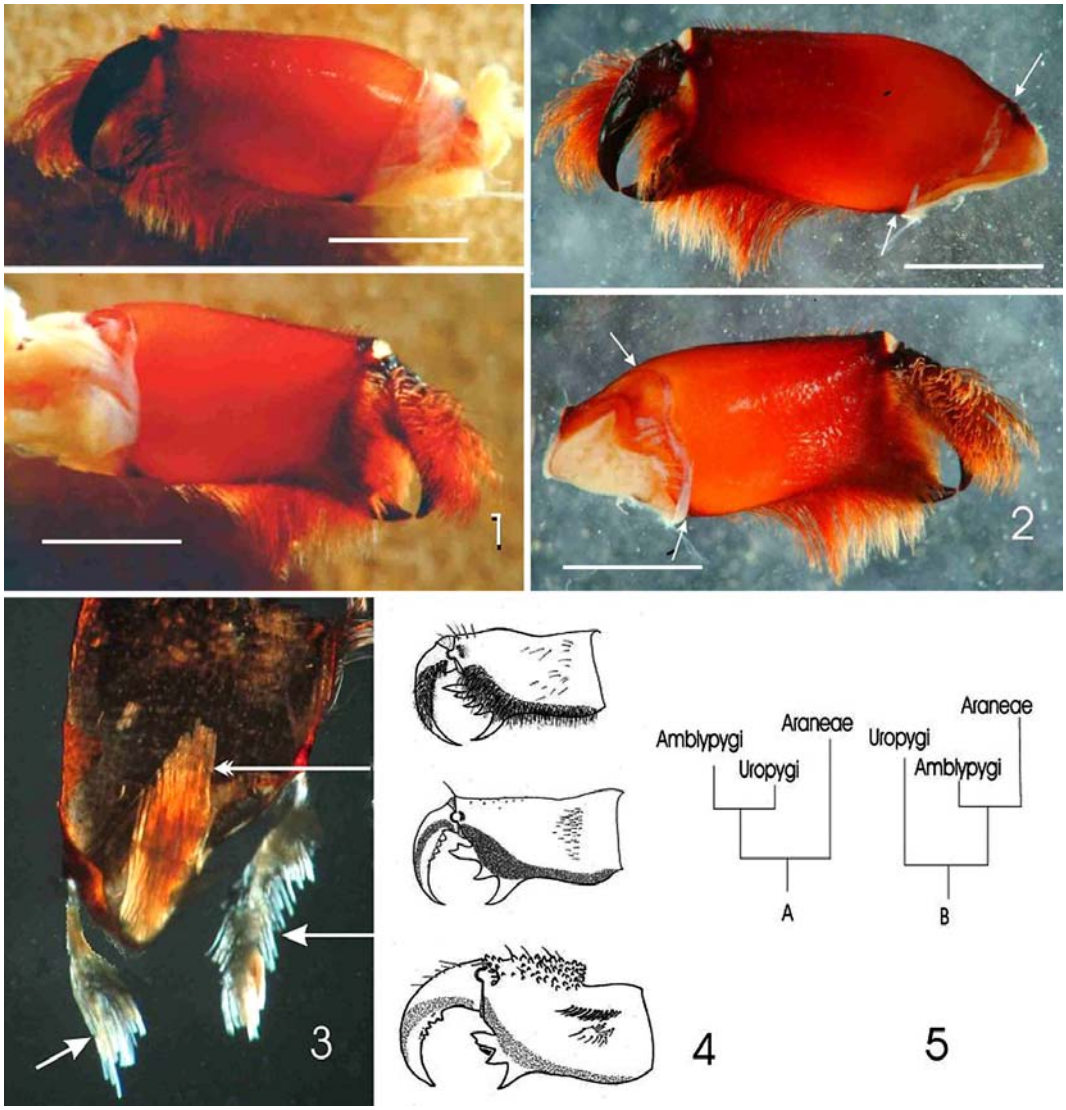
Nevertheless, the intrinsic muscles are continuous from the end of «third articulation» to the beginning of second articulation, although the "third part" of chelicera is clearly limited by a suture which goes round on both sides of the chelicera.

Three cheliceral articles are considered plesiomorphic for Chelicerata [Shultz, 2007]. Generally, the state of muscles is considered if it has to be decided whether an additional articulation is there. I prefer the following interpretation: once an articulation is going to disappear, first the muscles are going to adjust to the new situation. On the cuticle there may be a suture left (Fig. 2) as a last hint of the vanishing articulation.

Although the paper by Zonstein [2003] deals mostly with the chelicerae of araneids and their origin, the scope is wide enough to also include other orders such as Amblypygi and Uropygi. Apparently, the evolution of chelicerae has been parallel in Trigonotarbida [Dunlop, 1997; Zonstein, 2003, Fig. 34 D, E] and in Uropygi and Amblypygi [Zonstein, 2003: Fig. 34 B, C].

An analysis on the phylogeny of Uropygi, Amblypygi and Araneae revealed that Uropygi possess chelae [Shultz, 1993 p. 346]. The chelicerae of living thelyphonids move alternately like scissors (as do those of Solifugae), the last (movable) part is inserted in the dorsal part of the second joint as in any chela. Amblypygi and Araneae (Mesothelae and Mygalomorphae) have orthognathous chelicerae [Weygoldt, 2000], i.e., subchelae, in which the final claw moves against the basal joint (Fig. 4).

These orders Uropygi, Amblypygi and Araneae represent a phylogenetic series. By comparison of the leg



Figs 1–5. Chelicerae and the phylogeny of Araneae, Amblypigi and Uropygi: 1 — Chelicerae of *Typopeltis crucifer*; 2 — Ditto, with the external musculature removed, arrows point to the limit between 2nd and 3rd article; 3 — Under polarized light, the muscles in Uropygid chelicerae: extrinsic muscles 53 (left) and 58 (right)(simple arrows) according to Shultz [1993], (the intrinsic muscle (double arrow) is not listed by Shultz), explanations in the text; 4 — Chelicerae of three different Amblypygi genera; from top to bottom: *Charinus brasilianus*, *Heterophrynus longicornis*, *Phrynichus exophthalums*) [modified from Weygoldt, 2000]; 5 — The opposing versions of the phylogeny of Tetrapulmonata (A) and Megoperculata (B) [after Shultz, 1990 and Weygoldt & Paulus, 1979a,b]. Scale lines: (1–2) 1 mm.

Рис. 1–5. Хелицеры и филогения Araneae, Amblypigi и Uropygi: 1 — хелицеры *Typopeltis crucifer*; 2 — тоже, с удаленной внешней мускулатурой, стрелки указывают на границу между 2-м и 3-м члеником; 3 — мышцы хелицеры Uropygi под поляризованным светом: внешние мышцы 53 (левая) и 58 (правая)(простая стрелка) согласно Шульцу [Shultz, 1993], (внутренняя мышца (двойная стрелка) не отмечена Шульцем), пояснения в тексте; 4 — хелицеры трех различных родов Amblypygi; сверху вниз: *Charinus brasilianus*, *Heterophrynus longicornis*, *Phrynichus exophthalums*) [изменено из Weygoldt, 2000]; 5 — противоречащие версии филогении Tetrapulmonata (A) и Megoperculata (B) [по Shultz, 1990 и Weygoldt & Paulus, 1979a,b]. Масштаб: (1–2) 1 мм.

musculature, Shultz [1990, 1993, 1999, 2007] stated that he had studied over-all morphological details and, as a result, resurrected the ordinal name «Pedipalpi». It is not quite clear why Shultz [2007] insisted on using «Pedipalpi», as earlier [Shultz, 1993: p. 346] he clearly stated that Thelyphonida have chelae. Yet, Weygoldt & Paulus [1979a,b], who analysed a great number of different characters, arrived at a different conclusion: Amblypygi and Araneae (Mesothelae and Mygalomorphae) should be sister groups, and their sister group should be Uropygi (Fig. 5). Apparently, the second opinion (B) is to be favoured, as both the chelicerae of Amblypygi and Araneae (Mesothelae and Mygalomorphae) are orthognathous. The chelicerae of Uropygi are to be considered plesiomorphic. Based on this argumentation, the term “Pedipalpi”, as an ordinal name, is hardly appropriated and is better to be rejected.

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