

Locality and biostratigraphy

All of the fossils illustrated in this study are of 'Orsten'-type preservation¹. They were obtained by acid digestion techniques from limestone nodules within black shales of the upper portion of the Lower Cambrian Yu'anshan Formation at the Xiaotan section in Yongshan, Yunnan, southern China, where the fossiliferous strata are well exposed along the south bank of the Jinsha River. Co-occurring with these 'Orsten'-type fossils is the trilobite *Eoredlichia* sp.², a typical redlichiid of the *Eoredlichia-Wutingaspis* Biozone, the second trilobite biozone of southern China³. The specimens of *Eoredlichia* sp. have been identified from calcitic exoskeletons in the limestone. Also present in the acid residues is the bradoriid arthropod *Kunmingella typica*, previously recorded only from localities in the lower Cambrian Qiongzhusi Formation *Eoredlichia-Wutingaspis* Biozone in Chengjiang County, Yunnan Province, southern China⁴. Below the trilobite-bearing horizon the lower portion of the Yu'anshan Formation and the Dengying Formation have yielded small shelly fossils⁵. Thus, the geological age of the rocks containing *Yicaris* correspond to the upper part of the Lower Cambrian Qiongzhusian, and approximately equal to late Atdabanian Stage of Siberia.

Justification of phylogenetic assignment of *Yicaris dianensis*

It is well known that DNA sequence data have provided a novel way for phylogenetic analysis. Yet the results are still rather controversial, as exemplified by the suggested affiliation of insects with each major eucrustacean taxon, e.g. insects and malacostracans⁶⁻⁸; insects, malacostracans and remipedes^{9,10}; insects and branchiopods¹¹⁻¹⁴; insects and ostracods¹⁵. It has been suggested that the Cambrian 'Orsten' *Rehbachiella* represents the sister taxon of the Branchiopoda^{16,17}, having the same type of specific feeding apparatus as the living representatives. Many details of this apparatus are, in a general sense, indeed also common to *Y. dianensis* and Branchiopoda and also living cephalocarids. Very similar limbs are also present in two more 'Orsten' species, *Dala peilertae* Müller, 1983, a putative stem-lineage derivative of Maxillopoda¹⁸ and *Waloszekia quinquespinosa* Müller, 1983¹⁹. The characters they have in common, such as the specific design of the fourth head limb (recognizable as a mouthpart), the shape of the post-mandibular limbs, and the possession of labrophoran features (labrum, sternum, paragnaths etc.^{20,21}) argues for their eucrustacean membership. Having the same set of characters *Y. dianensis* is also assigned to the Eucrustacea rather than into the stem-group of either labrophorans or eucrustaceans.

Within Eucrustacea Malacostraca have accumulated a large set of autapomorphies in their evolutionary lineage, and they can be readily distinguished as a monophylum²². None of these characters is present in any of the known larval stages of *Y. dianensis*. However, as given above *Y. dianensis* shares many features with cephalocarids, branchiopods and, using *D. peilertae* as a data platform for ancestral maxillopod shape, also with Maxillopoda. This not only makes an affiliation of *Y. dianensis* with the one or other of these taxa more plausible, but – since these features are lacking in Malacostracans, or their features exhibit the plesiomorphic state by comparison – also gives further support for a monophyletic origin of this taxon set, namely the Entomostraca. Less parsimonious at present is the option that these taxa represent a paraphyletic assemblage, as this would cause many character conflicts and reversals to be hypothesized if one tries to sequence them on the evolutionary lineage toward the Malacostraca.

The question of the phylogenetic position of insects (and possibly myriapods) as either sister taxon of one of the major eucrustacean groups or as sister taxon to the Eucrustacea as a whole is independent to the question of the systematic position of *Yicaris* or the possible monophyly of Entomostraca²¹. The phylogenetic position of insects, as tentatively

indicated in Figure 3 (for a detailed discussion of the crustacean characters see Ref. 20), is based on the assumption that in insects structures such as the labrum, the hypopharynx²³, the specific shape of the mandibular coxa as a specialised mouth part and the maxillula as an additional mouth part are homologous to corresponding structures of Eucrustacea. Autapomorphies that characterise the Entomostraca on the one hand and the Malacostraca on the other hand are not present in insects. Most of them would have to be interpreted *a posteriori* as lost, which is weak evidence. This also holds true for the developmental pattern of crustaceans and particularly the (ortho)nauplius as a specific hatching stage of Eucrustacea. In our view, the best – and least conflicting – solution, at present, is that insects (or ateloceratans) within the crustacean system are most parsimoniously placed above the Phosphatocopina and below the Eucrustacea (Malacostraca + Entomostraca).

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