

Dedicated to Prof. Dr F. F. STEININGER

Ostracods of the Paratethys Sea and Lake Pannon – Perspectives for renewal of cooperative projects

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Abstract

Ideas from a workshop with the title ‘Ostracods of the Paratethys Sea and Lake Pannon’, organised during the 6th European Ostracodologists’ Meeting (EOM-VI), are briefly presented. The necessity to start a new active communication between palaeontologists and neontologists on the evolution and palaeoecology of ostracods of the marine Paratethys and Lake Pannon during the Cenozoic in Europe and Asia is stressed. This should continue and extend studies of earlier generations of ostracodologists who contributed to the chronostratigraphic and palaeobiogeographic understanding of this domain. Several research topics are proposed and their importance is supported by such arguments as: (1) the high relevance of studies dealing with the origin and diversification of the fauna of (palaeo)ancient lakes; (2) the reconciliation of the systematics of fossil and Recent ostracod taxa, for a better reconstruction of evolutionary histories; (3) a better perception of the developmental trajectories of various Recent and fossil ostracod taxa to facilitate the application of ostracods for palaeoecological studies. Finally, topics for future workshops dealing with Cenozoic ostracods are proposed.

Key words: Ostracoda, Paratethys, Lake Pannon, scientific cooperation

The fossils are trying to tell us many things – we must learn to listen.

A. J. BOUCOT (1982)

Introduction

During the period preceding the European Ostracodologists’ Meeting (EOM-VI) 2007 in Frankfurt/Main one of us (D.L.D.) had discussions with colleagues about a possible reactivation of collaborative investigations on ostracods from the Paratethys Sea and the Lake Pannon, a research direction which was very active during the 1970’s. A workshop covering aspects of this topic was convened and eight contributions were presented during a full morning session at the EOM-VI. The ideas offered during the workshop concerning future progress of fossil ostracod research in the Paratethys Sea and the Lake Pannon are briefly documented here.

In the mid-seventies HEINZ MALZ, for many years head of the Micropalaeontology Section at the Senckenberg Museum, published a state-of-the-art summary of relevant ostracod research (MALZ 1975). The author stressed the high number of publications dealing with ostracods during the period

1955–1975, metaphorically called an “ostracodal deluge”, and identified within the published “flood of information” several “hot research topics”, including the discovery of fossil ostracods with preserved body limbs, the progress in the description of the ornamented ostracod valves, the study of the sexual dimorphism, progress in the study of ontogeny and phylogeny of selected ostracod groups, regional chronostratigraphic correlations and palaeogeographic reconstructions. In the same publication MALZ noted that the principles of the taxonomy for fossil ostracods were those adopted in the standard monographs of V. POKORNÝ, R. C. MOORE, F. P. C. M. van MORKHOVEN and in publications of Russian colleagues like P. S. LJUBIMOVA and M. J. MANDELSTAM (cf. references, MALZ 1975).

Important contributions to the taxonomy of ostracods of the Paratethys/Lake Pannon domain were produced *inter alia* by K. KOLLMANN, V. POKORNÝ, A.V. SUZIN, M. STANCHEVA, N. KRSTIĆ, A. SOKAČ, R. JIŘIČEK, M. SZÉLES and R. OLTEANU; their data were published either as separate publications, like

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N. KRSTIĆ (1972) and A. SOKAČ (1972), or as special chapters in various volumes of the monographic series “Chronostratigraphie und Neostratotypen” originally edited by Professor A. PAPP in Austria and continued afterwards under the patronage of the “Working group on Paratethys stratigraphy of the regional committee on Mediterranean Neogene Stratigraphy” (e.g. PAPP et al. 1985). Over the years a large number of new ostracod species and genera was described by those specialists, supporting the idea that long lasting ecosystems like the Paratethys Sea and the Lake Pannon promote a substantial increase in the biological diversity. Such evidence, together with information from other animal groups and biostratigraphic data (cf. CÍCHA et al. 1998) allowed the production of a large palaeogeographic synthesis (cf. RÖGL & STEININGER 1983, RÖGL 1998, POPOV et al. 2004, HARZHAUSER & PILLER 2007). F. F. STEININGER made a significant contribution to this achievement with the development of close collaboration between the various working groups involved in the reconstruction of the evolution of Paratethys Sea-Lake Pannon. Unfortunately, this kind of multidisciplinary co-operation, where ostracod research is well integrated, seems to have languished in recent years. Indeed, MATZKE-KARASZ et al. (2007) identified a shift in the main research interests of ostracodologists in the last 20 years. Ecology, especially the study of ostracod assemblage diversity, represents a “hot topic” of investigation while other issues such as ostracod taxonomy and biogeography were perceived by these authors as if they “did not perform well recently”. Several contributions to the workshop organised during the EOM-VI confirm a similar perception.

Below we expand on three “hot topics” that were discussed: a) the ecological and/or geographical distribution of ostracods within the Paratethys Sea/Lake Pannon; b) the systematics of Lake Pannon ostracods; and c) the need to document the developmental trajectories of both Recent and fossil ostracod taxa from the area. Finally, we offer prospects for possible research activities to be implemented during the near future.

Ecological and geographical distribution of ostracods within the Paratethys Sea and Lake Pannon

Three communications dealt explicitly with this topic. Based on changes in ostracod assemblages TUNOĞLU & ERTEKIN (2007) reconstructed the palaeogeographic fragmentation of the Tethyan Ocean and the spatial extension of the Paratethys Sea during the Cenozoic Era for the northern part of Anatolia. Some of the bioprovinces recognised with ostracods were confirmed by the distribution of other biota like Foraminifera and mollusks.

PIPIK et al. (2007) documented the ecological radiation of the *Cyprideis* lineage during the Middle Miocene in the Paratethyan Sea and Late Miocene in Lake Pannon. Based on extensive sampling in Slovakia, Austria and Hungary as well as on taxonomic studies using quantitative data and multivariate statistics, the authors could show that between Middle Miocene (Sarmatian) and Late Miocene there were a succession of different *Cyprideis* species which corresponds to the ecological changes of the lake, especially changes in salinity concentrations over time.

GROSS et al. (2007, 2008) presented a high-resolution distribution of ostracods of the Upper Miocene from the Styrian Basin, at Mataschen. Several cores, totaling 1.5 m in length, were analyzed in 0.5 cm layers using the so-called Piller corer. Parallel to this, a long section of approximately 30 m was also sedimentologically analyzed. Lake level oscillations are reflected also in the abundance fluctuations of various ostracod taxa. Based on biostratigraphical and regional information the whole section is evaluated to contain a time span of approximately 300,000 years. Oscillations within repetitive 5 to 10 mm sediment layers could reflect a cyclicity of 50 to 200 years, which would range within the interval of the solar band. The differential distribution of two new *Cyprideis* new species (GROSS et al. 2008) were related to ecological changes.

Need for improvement of the systematics of Lake Pannon's ostracod fauna

Modern systematics of the Paratethys ostracods take into account well-documented material, described with modern methods such as electron microscopy. Hence one can produce a relatively objective picture of the fauna at hand (e.g. GROSS 2006). This latter author showed that in the Vienna Basin, at Hainburg, during the Badenian/Sarmatian, a rich and diversified marine fauna existed, dominated by cytheroids (e.g. 55 species of Cytheroidea belonging to 31 genera and 11 families). Most of the species are well ornamented and offer sufficient morphological traits to be confidently identified. A completely different picture emerges for the fauna of the Lake Pannon during the Late Miocene. A typical brackish ostracod fauna developed, represented by few cytheroid species and many cypridoid, mainly endemic candonids (e.g. GROSS 2004).

The Candonidae are known to be difficult to identify, due to their reduced ornamentation and very few clear morphological traits. Additionally, the description of the many Pannonian ostracod species by the previous generation of ostracodologists needs to be revised.

Three contributions dealing explicitly with this topic were presented during the workshop. KRSTIĆ (2007) presented brief descriptions of two new taxa, one belonging to the Cyprididae. The presentation reflected exactly the main purposes of the workshop, that is the need to produce more objective taxonomical diagnoses, based on both qualitative and quantitative data.

DANIELOPOL, BUTTINGER et al. (2007, 2008) illustrated the advantages of using a quantitative approach for ostracod description, viz. geometric morphometrics combined with multivariate statistics. They also recommended a better integration between knowledge of Recent ostracods and that on fossil taxa. The example used was the analysis of fossil species of Lake Pannon attributed to *Hungarocypris VÁVRA*, 1906, a genus with living species. Comparing the valve morphology of the living species *Hungarocypris madarászi* (ÖRLEY, 1886) (cf. MEISCH 2000), with that of the fossil *H. auriculata* (REUSS, 1850), it became clear that the latter belongs to the genus *Herpetocyprilla* DADAY, 1909 with a living species in the Kyrgyzstan Lake Issyk-Kul (BRONSHTEIN 1947). This ancient lake has a brackish water fauna similar to that occurring in the palaeo-Lake Pannon (RICKETTS 2001).

A substantiation of the previous approach, respectively the usage of both fossil and Recent data was offered by PICHLER et al. (2007). The advantages for reconstruction of a phylogenetic lineage using systematics based on both quantitative and qualitative criteria and both living and fossil taxa, became immediately clear when the authors' proceeded to biogeographic and ecological reconstructions.

Discussions that followed these presentations raised questions about the way one should define fossil species. Some of the disputants opted for a clear delineation of species based on the presence of morphological gaps, whereas others were in favour of a more unconstrained way of defining a taxon (e.g. to use only partly well separated morphological populations, as in the definition of evolutionary taxa proposed by SIMPSON (1960). Alternatively, it was also proposed to define species using a multidimensional approach, as in the model of SBORDONI (1993).

Developmental trajectories of Recent and fossil ostracod taxa

DANIELOPOL, BALTANÁS et al. (2007, 2008), demand more data on the morphology of post-embryonal stages of ostracods, stressing the scarcity of proper descriptions of the developmental trajectories of the valves of many ostracod taxa. This is important because after each molt the ostracod shape is modified. The information provided by the study of the sequence of changes which occur during an organisms ontogeny (its developmental trajectory) can be applied to ostracod systematics, (palaeo)ecology and/or evolutionary biology. It helps to describe and define ostracod taxa more clearly. For instance, knowing the morphological changes which happened in the last post-embryonal stages (A-1 and A-2) of *Pseudocandona albicans* (BRADY) (cf. DANIELOPOL 1978, NAMIOTKO & DANIELOPOL 2004) made it clear that species formerly attributed to the genus *Candoniella* SHNEIDER 1956 (cf. MANDELSHTAM & SHNEIDER 1963) were in fact juveniles of species belonging to the genus *Pseudocandona* KAUFMANN 1900 (cf. MEISCH 2000). Additionally, information on developmental stages and exact species identification is a prerequisite for research dealing with the isotopic content of the ostracod valves (von GRAFENSTEIN 2002). Finally, it is also expected that knowledge of the developmental trajectories of ostracod taxa will markedly improve the process of phylogenetic reconstruction.

Final remarks – research prospects for the near future

The unavoidable conclusion that came from the EOM-VI workshop was that the ostracodologist community is ripe to attempt new cooperation between specialists working on the different regional sectors of the Paratethys Sea and the Lake Pannon domains. The following issues are worth highlighting as priorities:

(1) A re-sampling programme of "classic" sites with chronostratigraphic importance, similar to what previous generations of palaeontologists did for their correlation programmes. Some of the participants (PIPIK, GROSS,

DANIELOPOL) reported that they had already started such activities, resampling classic sites for Miocene ostracods, like Hodonin (Slovakia), Soceni (Romania) or various sites in the Vienna Basin (Austria). This material is now under study, linked to classic collections of ostracods made by well-known specialists like A. E. REUSS or K. KOLLMANN, and is interpreted within the new perspective of an integrated high-resolution stratigraphy and/or sequence stratigraphy (for this latter approach cf. KOVÁČ et al. 2004, HARZHAUSER et al. 2004).

- (2) Further research efforts on ostracod biodiversity, with emphasis on the structure of ostracod assemblages (the latter allows regional comparisons and chronostratigraphical correlations) and their evolutionary dynamics.
- (3) To update the systematics of the main ostracod groups, especially for those documented to occur in Lake Pannon. The need to match the systematics of fossil ostracods with those of living faunas is reflected in the ostracodological research of many specialists and was repeatedly discussed (TRIEBEL 1941, MALZ 1975, HORNE et al. 2002). For present needs the adoption of a pluralistic, flexible, strategy based on more quantitative data with objective discussion was recommended. The combined use of quantitative methods (traditional plus geometric morphometrics) for the description of ostracods is in our opinion the best option. However, qualitative descriptors as used by former generations of ostracodologists (e.g. general aspect) must not be discarded at all, as they provide valuable, supplementary information which is still of great help for ostracod research.
- (4) The transfer of ostracodological information derived from Recent and palaeo-environments should follow the so-called reciprocal illumination process, meaning that the information should circulate in both directions from palaeontologists to neontologists as well as through the reverse channel. The case of Lake Pannon is especially relevant to this argument as it is a palaeo-ancient lake, in existence for several million years (MAGYAR et al. 1999, HARZHAUSER et al. 2004), which displays similarities to those of some classic but still extant ancient lakes. The Lake Pannon ostracod fauna displays convergent species diversity and/or morphologic disparities to those of Recent ancient lakes like the Baikal, the Ohrid or the Tanganyika (MARTENS & SCHÖN 1999, MAZEPOVA 1994, WOUTERS & MARTENS 2001) as well as to Recent European groundwater ostracod lineages (DANIELOPOL 1978). All this merits closer investigation in the near future.
- (5) To support and encourage the organisation of workshops similar to that conveyed at the EOM-VI. Possible topics proposed for those future workshops were suggested: (a) high resolution sampling methods for microfossils in the field and their applications; (b) introduction to geometric morphometrics using software developed by various specialists; (c) implementation of techniques for isotope measurements on ostracod valves. This agenda reflects in some way the research programme proposed by STEININGER (1998) for palaeobiodiversity studies. The Commission for Palaeontological and Stratigraphical Research of Austria, of the Austrian Academy of Sciences, and the Institute of Earth Sciences of the University of Graz, have offered to organise such an event in 2008.

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