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Tympanicysta and the Terminal Permian Events

Valentin A. Krassilov
Sergey A. Afonin
Paleontological Institute
123 Profsoyusnaya
Moscow 117647 Russia
vkras@paleo.ru

Sophia S. Barinova
Institute of Nature Conservation
Znamenskye Sadki
Moscow 113628 Russia

Terminal Permian non-marine sequences are marked by the so-called fungal event, a sharp increase of fungal remains presumably reflecting a rise of saprophytic organisms related to catastrophic devastation of arboreal vegetation (Visscher *et al*., 1996). Dominant among the supposed fungal remains are filamentous fossils assigned to *Tympanicysta* Balme or the related, if not congeneric, *Reduviasporinites* Wilson and *Chordecystia* Foster.

Though originally described as *incertae sedis* of either fungal or algal or else animal origin (Balme, 1980), they were recently interpreted as conidia of ascomycetes. However our study of *Tympanicysta* from the transitional Permian to Triassic microfossil assemblages of Nedubrovo, Vologda Region of European Russia (Krassilov *et al*., 1999) failed to support a fungal interpretation for neither the cell shapes and dimensions, nor their contacts in the linear filaments correspond to any known conidial structures.

At the same time this fossil is most similar to extant zygnematalean green algae *Spirogyra* and *Mougeotia* that have typically unbranched filaments of cylindrical cells that can be swollen at forming thick-walled dormant cells, or acinetes. In the same way, *Tympanicysta* is represented by two kinds of filaments - slender with cylindrical cells and relatively robust with barrel-shaped thick-walled cells (Fig. 1, B) the latter perhaps overrepresented in microfossil assemblages. Moreover, a typical acinete with double wall is found in our material (Fig.1, D).

Other morphological features of *Tympanicysta* also match the typical zygnematalean characters. Thus, in *Spirogyra* the terminal cells of filaments differ from the rest in their elliptical or conical shape which is also the case in *Tympanicysta*. In the extant genus the transverse cell walls, or septae, can be smooth, forming a lenticular joint, or folded, sometimes with an annular thickening. In *Tympanicysta* the septae are either smooth or, in the thick-walled forms, folded by invagination of the cell wall (Fig. 1, C). A granular dark matter in the central part of the cells corresponds to chloroplast of zygnematalean algae in which it can be either axial or parietal, laminar or star-shaped, but in compressed cells appearing exactly as in the fossil.

There might be a fungal event caused by an increased deadmass production in disturbed terrestrial plant communities at about the P/T boundary, but the rise of *Tympanicysta* requires a different explanation. The extant Zygnematales (Zygnematophyceae) include 16 genera of fresh-water and terrestrial green algae of which *Spirogyra* is the largest and the most common genus, comprising about 350 species. They typically inhabit river ponds and lakes, mostly oligotrophic, sometimes swampy, but also occur in brackish waters and mineral springs. In warm well lighted shoal-waters they form dense bottom mats or floating masses sometimes causing water blooms. As fossils zygnemataleans are represented primarily by their characteristic zygospores that appear in the Carboniferous and are occasionally recorded in palynological assemblages later on. An increase of zygnematalean remains in the terminal Permian to lowermost Triassic might be due to the rise of ground water level and a widespread ponding of rivers at the early stage of the end-Permian transgression. Incidentally, this explanations fits the facial occurrence of *Tympanicysta* in the floodplain pond de-

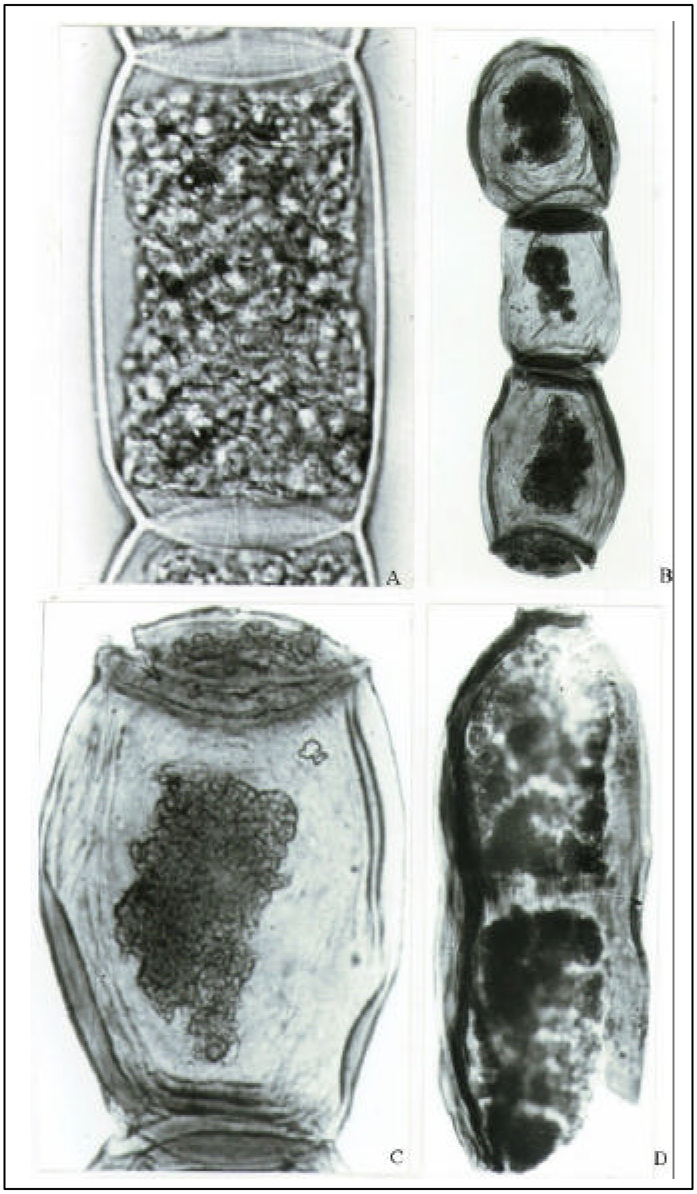

Figure. 1. Extant *Spirogyra* sp. (A, x600) form a flood-plain pond of the Bitsa River, Moscow River Basin, and *Tympanicysta* sp. (B - filament with elliptical terminal cell, x246, C - folded septa, x620, D - acinete, x634) from the latest Permian to lowermost Triassic basal Vetlugian deposits of Nedubrovo, Vologda Region, Russian Platform.

posits of Nedubrovo locality.

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Studies of the Upper Permian Reefs in Hunan Province (People Republic of China)

I.S. Barskov
Geology Faculty
Moscow State University and
Paleontological Institute of Russian Academy of Sciences
Moscow 119899 Russia

Wang Yongbia
Chinese University of Geosciences
Wuhan 430074a
People Republic of China

Gong Shuyong
Chinese University of Geosciences
Wuhan 430074a
People Republic of China

Joint Chinese-Russian studies of Permian reefs began in the September-October 1999. This year the Upper Permian organogenic carbonate buildups were studied in North-Western (Cili Region) and Southern (Chenzhou Region) Hunan Province, China. The Upper Permian (Changhsingian) reef complex in the Cili Region consists of the coral shore-reef (Gaoya section) and the deeper water sponge reef (Daluokeng section) separated by a shallow-water lagoon with normal marine sedimentation (Wang Yongbia *et al*., 1997, 1998,1999). The coral reef framework is built by branching colonies of *Waagenophyllum*. The spaces between the colonies and their branches are filled by fine-grained cement (grainstone) consisting of coral and crinoid fragments. Observed horizons of hollows filled by coarse-grained, white calcite apparently indicate the recurrent draining of the reef surface following lowering of sea level, accompanied by weathering and dissolution of the reef surface by the terrestrial fresh water. Dolomitization observed in some parts of the reef supports this interpretation.

Each cycle separated by periods of drainage shows specific lithology. The grainstone beds lie in the basal parts of the cycles and form a hard base on which the coral frame developed. The grainstone covers the coral framestone in the upper part of the cycle. Relative thickness of these elements of the cycles and horizons of hollows indicate the rate of the sea level decrease and duration of the periods of drainage of the reef surface. More than 10 cycles were observed in the upper half of the reef body having the thickness of 20-30 m. The cycles are 0.5-2.0 m thick. The final cycle at the top of the reef is approximately 2 m thick and consists of the basal grainstone and coral framestone, while the upper grainstone member is absent. Such cycles indicate a very rapid sea level drop so that the upper grainstone member did not have sufficient time for accumulation.

The hollows in the top of this final cycle penetrate all beds of the cycle. The periodic sea level drop and rise corresponded to small-scale eustatic movements or local changes of the shoreline. The greatest and fastest sea level drop traced at the top of the reef body resulted in the extinction of the reef-building corals. We propose that this level corresponds to the global eustatic fall of the sea level in the middle Changhsingian time (Glenister *et al*., 1999).

The frame of sponge reef is built by plate-like, low branching,