

ERRATA & ADDENDUM

Replace:

pp. 81-82 Abstract by Mothchurova-Dekova, Bengston, Belivanova & Harper with abstract pp. 81-82 by Mutchorova-Dekova & Harper.

Insert:

p. 128 Abstract by Jansen.

Replace:

pp. 128-129 Author Index with pp. 129-130 Author Index.

A NON-DESTRUCTIVE METHOD TO STUDY THE BRACHIOPOD SHELL INTERIOR: PRELIMINARY REPORT

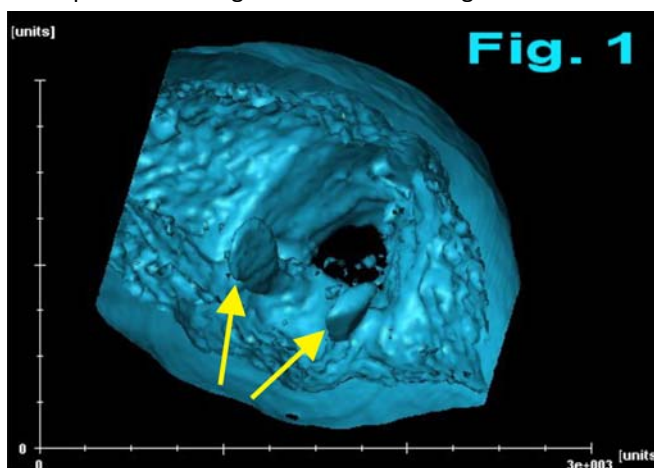
Neda Motchurova-Dekova¹ & David A.T. Harper²

¹ National Museum of Natural History, Sofia, Bulgaria (neda_dekova@yahoo.com)

² Natural History Museum of Denmark (Geological Museum), University of Copenhagen, Copenhagen, Denmark
(dharp@snm.ku.dk)

Brachiopods are one of the prime examples among all animal phyla in which the morphology of the shell interior has proved crucial for the classification and understanding of their phylogeny. In order to reveal the internal structures of fossil brachiopods with a consolidated internal matrix, destructive serial sectioning has most commonly been applied. In several cases, this technique is the only way to reveal the important internal morphological features of fossil taxa. The advantage of such destructive techniques is that they are usually relatively cheap and efficient. However, they have several major disadvantages: (i) destruction of the specimen, (ii) providing a poor volumetric representation of the internal structures and (iii) time and labour consuming. Many of the taxa investigated with this technique were based on a very small number of specimens (sometimes only one specimen), thus only parts of the internal morphology of some were studied and variability was often neglected and/or open nomenclature was applied more often than desirable.

Here we report some pilot studies using a novel and quite advanced method to reveal the cardinalium of fossil brachiopods. Synchrotron radiation X-ray tomographic microscopy (SRXTM) is a non-destructive technique for investigation and visualizing the internal features of solid opaque objects which allows



reconstruction of a complete three-dimensional image of the internal structures by recording of the differences in the effects on the passage of waves of energy reacting with those structures. It uses a synchrotron, a form of particle accelerator, as a bright monochromatic X-ray source. SRXTM can produce tomographic data of exceptional resolution and clarity (Sutton, 2008). We have applied SRXTM for three-dimensional records of the internal morphology of two fossil brachiopod taxa: (i) the rhynchonellide '*Rhynchonella*' *flustracea* Schlotheim from Faxø Quarry, Danian of Denmark and (ii)

the terebratulide *Terebratulina imbricata* Owen from the Lower Cenomanian in northern Bulgaria. These analyses were performed at the Swiss Light Source (SLS), Paul Scherrer Institut, Villigen, Switzerland. In '*Rh.*' *flustracea* it was possible to observe the shape of the crura (see arrows in Fig. 1) that helped to confirm our hypothesis that this species belongs to a new basiliolide genus (to be formally erected elsewhere), while in *T. imbricata* it was possible to reveal the details of the terebratulide loop forming a ring. SRXTM was previously used to obtain three-dimensional information from Recent brachiopods to ascertain the function and growth of punctae in the shell and increase understanding of the role of cell biology in the context of biomineralisation (Pérez-Huerta et al., 2009). Here we report encouraging results from the use of the SRXTM for purely taxonomic purposes: an attempt to find out an alternative of the disadvantages of the serial sectioning method and the several methods of dissection. The scans were done at the lowest available resolution, one that could be accomplished at more easily accessible X-ray micro-

tomography (XMT) scanners that are available at several institutions worldwide. X-ray tomographic microscopy is now rather a routine method for several other groups of fossils (Sutton, 2008).

Alvarez and Brunton (2008) noted that very often, due to the scarcity of well-preserved specimens and the destructive nature of the technique, some authors chose the worst specimens for serial sectioning, keeping the best preserved (frequently only one) for the holotype. In future holotypes may be preferentially subjected to this mode of analysis in order to check their conspecificity with the sectioned paratypes. The X-ray tomographic microscopy provides an opportunity to study the interiors of many taxa established only on exteriors, confirming or otherwise their taxonomic placement.

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BRACHIOPOD STRATIGRAPHY OF THE RHENISH LOWER DEVONIA (GERMANY)

Ulrich Jansen

Senckenberg Forschungsinstitut und Naturmuseum, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany [ulrich.jansen@senckenberg.de]

The Pridolian to Eifelian succession of the Rhenish Massif (Germany) documents the history of an extensive siliciclastic shelf sea along the southern border of Laurussia. Due to the lack of pelagic index fossils, marine biostratigraphy is predominantly based on articulate brachiopods showing high diversity and abundance. Recent studies have resulted in numerous taxonomic revisions, biostratigraphic refinements, correlations and re-assignments of strata. In several genera, phylogenetical lineages or trees could be reconstructed.

A brachiopod zonation beginning in the Pridolian (uppermost Silurian) and ending in the Eifelian (lower Middle Devonian) is proposed. This biozonation presently consists of 24 taxon-range zones with spiriferid species and subspecies as zonal fossils. Corresponding to these, 19 "faunal intervals" with characteristic articulate brachiopod assemblages are defined. This two-fold biozonation is currently even further subdivided by the definition of overlapping, acme and phylogenetic subzones. The biozones allow the correlation of open-marine, marginal-marine and deltaic deposits.

Finally, the development of Rhenish brachiopod faunas reflects local, regional as well as global environmental fluctuations. The new biostratigraphy helps in correlation of the classic Rhenish "Siegenian/Emsian" and "Lower/Upper Emsian" boundaries which are of interest in the course of the (re-) definition of the basal Emsian and mid-Emsian GSSP boundaries conducted by the international Subcommission on Devonian Stratigraphy.

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