DISCUSSSION

DISCOVERY OF LOWER CAMBRIAN SMALL SHELLY FOSSILS AND BRACHIOPODS FROM THE LOWER VINDHYAN OF SON VALLEY CENTRAL INDIA, by R.J. Azmi, Jour. Geol. Soc. India, v.52, pp.381-389, 1998

Martin Brasier, University of Oxford, writes under the title "**DEEP QUESTIONS ABOUT VINDHYAN FOSSILS**":

Could the rocks of the Vindhyan Supergroup of India hold fossil clues to the emergence of animal life? This is a question which has much exercised the minds of scientists around the world over the last year. Debate has followed the claims by Seilacher et al. (1998) to have found undermat burrows made by 'triploblastic metazoans' in the Chorhat Formation, traditionally dated at *c.* 1100 Ma; and by Azmi (1998a, b) to have found 'extremely well preserved' and 'indisputable small shelly fossils (SSFs) and small inarticulate brachiopods' of early Cambrian type in the overlying Rohtas Limestone, of supposedly similar great antiquity (Azmi, 1998a, b; 1999a, b).

These two claims have considerable bearing on the scientific dispute concerning the timetable for the emergence of multicellular animals: the so-called 'deep-time' versus the 'late arrivals' models (Brasier, 1998; Conway Morris et al. 1998). My view is that the molecular evidence, such as that used for the deep-time hypothesis for the origin of animals before *c.*1200 Ma, is notoriously difficult to calibrate. Fossil evidence is therefore crucial. But any fossil evidence must firstly be accepted as animal in origin by the scientific community, and secondly, demonstrably as old as claimed using up-to-date geochronology. Both criteria are liable to lead to lively debate, and we should welcome this.

The bald assumptions made by Seilacher et al. (1998) regarding the metazoan nature of markings described from the Chorhat Formation demand to be questioned. Are they triploblastic metazoan? (Brasier, 1998). Are they even organic? (Conway Morris et al. 1998). One of the co-authors tells me that he is 85% sure that the burrow-like markings are organic (F. Pflueger, pers. comm., November 1998), but many scientists who have since visited the site remain largely unconvinced of their biogenicity (Banerjee, pers. comm., November 1998). Experience shows us that some claims to the biogenicity of Precambrian fossils cannot be easily resolved.

More tractable is the question of the age of the Vindhyan Supergroup. Could we still be in for "a big surprise" regarding the age of these rocks, as I suggested last year? (Brasier, 1998). My scepticism about the published K/Ar, Rb/Sr and F-T isochrons has been widely shared (e.g. Bowring *in* Kerr, 1998). There are other lines of evidence that should lead us to be cautious about the Mesoproterozoic age. Carbon isotopic oscillations from the limestones in the Bhander Group are purported to compare with those known from the Neoproterozoic-Cambrian interval (Friedman et al. 1996), though older matches could no doubt be made.

Sulphur isotopes from sulphates in the Vindhyan are more distinctive; these yield δ34S values of +29 to +35‰ (n= 14; Dr G. Shields, pers, comm, 1998, from data of H. Strauss) and not only invite comparison with those from the Hanseran evaporite group of the Trans-Aravalli Vindhyans (mean 31.6‰; Banerjee et al. 1998) but with latest Neoproterozoic-Cambrian values in general (cf. Strauss 1993, 1997). Even the $^{87}Sr/^{86}Sr$ isotope ratio obtained from the Vindhyan (>0.7085; n= 3; G. Shields, pers. comm., 1998, from data of H. Strauss), if unaltered, would suggest an age in the 600-500 Ma interval (*cf.* Brasier et al. 1996).

And, while meaning no disrespect to my palaeontological colleagues, geologists should be eternally vigilant about accepting claims for the biostratigraphic utility of Precambrian fossils. *Chuaria* group fossils from the latest Neoproterozoic-Cambrian (Brasier et al. 1979; Hamdi, 1989) actually occur around or above the Precambrian-Cambrian boundary as now defined. Large, conical, *Conophyton*-like stromatolites and silicified microbiotas are also present not far beneath the Precambrian-Cambrian boundary in the Huqf region of eastern Oman (McCarron, Allen and Brasier, unpublished observations). These occurrences may have lain quite close to the Vindhyan basin in Neoproterozoic times. The report of a *Sekwia excentrica* from the lower Bhander Limestone in the upper part of the Vindhyan (Maithy, 1999), if confirmed, would suggest an age between 700 and 543 Ma.

It is, therefore, gratifying to report that Dhiraj Banerjee of Delhi University and Wolfgang Frank of Vienna University have now obtained preliminary Ar/Ar results from fine-grained volcanic material in the Porcellanite Formation below the Rohtas Formation, from which the supposed SSFs of Azmi (1998a) have come. This yields an isochron of 619±3.2 Ma (Banerjee and Frank, 1999), which is remarkably close to the base of the Terminal Neoproterozoic (estimated at *c.* 600-590 Ma). Detrital mica from underlying and overlying rocks have given Ar/Ar ages of between 1520 and 930 Ma, while detrital micas from the earliest Cambrian Tal Formation in the Lesser Himalaya give an age of 830 Ma (Banerjee and Frank, 1999). These authors suggest that the older ages obtained from these sediments give the age of the provenance. Hence, even if the markings of Seilacher et al. (1998) were to be accepted by the scientific community as triploblastic metazoans, they could be little more than half the age claimed. We await proper verification of these geochronological results.

When contemplating the Seilacher et al. (1998) claim last year, I was particularly intrigued to note that scientists in India had also questioned the great age of the Vindhyan succession, including Azmi (1998), whose paper I had briefly seen in the review stage. Indeed I had myself become drawn into this dispute (Brasier and Singh, 1986). Even palaeobiologists without that background have found themselves seduced by the SEM photographs of 'small shelly fossils' from the Rohtas Limestone (Azmi 1998a, b), and been struck by their resemblance to earliest Cambrian fossils. Douglas Erwin of the Natural History Museum in Washington D.C. was even to say: "Everybody would say, yes these are small shellies" (Kerr, 1998).

Unfortunately, when Azmi made arrangements to show his material to specialists in Cambridge, during the full furore of the public debate within the journals of 'Science' and 'Nature', he neglected to make any arrangements to show them to specialists in Oxford, or even to let us even know of his visit to England. Nick Butterfield at Cambridge, reported to me that he was, initially, 'entirely convinced that he (Azmi) had an assemblage of typical Lower Cambrian small shelly fossils'. But once he saw the material for himself, he was convinced the supposed small shelly fossil impressions were latex casts of cone-in-cone mineral growths (Conway Morris et al. 1998), with some possible accentuation of the conical form through dissolution (pers. comm., October 1998).

It is clear that the SEM's of latex casts presented by Azmi (1998a) did not reveal the full geological context of the structures, thereby tending to mislead the many who saw them from photographs alone. This non-biogenic interpretation is shared by those who have seen the material illustrated by Azmi (1998a) in plate 1, figs 1 to 23, including some scientists who visited the outcrops with Azmi recently (Banerjee, pers. comm., March 1999). In fairness to Azmi, he has now withdrawn his claim that brachiopods are present (Azmi, 1999a). In other respects, however, he has attempted to refute the non-biogenic interpretation and presented us with a new series of pictures of isolated specimens, some of which undoubtedly resemble microfossils known from the Neoproterozoic-Cambrian (Azmi, 1999b). *Spirellus shankari* (Plate 4) is almost certainly the

mold of a spiral cyanobacterial sheath, related to *Obruchevella*, and hence could range well back into the Proterozoic. His globular *Olivooides multisulcatus* includes forms (Plate 5, figs 1, 4) which compare reasonably well with that taxon, and other forms (Plate 5, figs 2, 3, 5, 6) that are closer to *Archaeoooides granulatus* from the Precambrian-Cambrian boundary in South China (cf. Qian and Bengtson, 1989, fig. 90). Both *Spirellus shankari* and *Olivooides multisulcatus* are also common in phosphorites of the Tal Formation (e.g. Brasier and Singh, 1986). Now *Olivooides multisulcatus* has recently been interpreted as the phosphatized remains of an early Cambrian metazoan embryo (Bengtson and Yue, 1997). And the specimen in Plate 5, fig. 3, resembles possible phosphatized embryos etched out of the Terminal Neoproterozoic Doushantuo Formation of South China, some 570 Ma old (Xiao et al. 1998, fig. 5h). Indeed it is hard to imagine how Azmi's forms could have been preserved other than by phosphatization. I gather however, that some specimens shown by Azmi resemble inorganic minerals do not respond to Shapiro's test (D. Banerjee, pers. comm., March 1999). Another way to test for phosphate would be to remove the SEM coating of the figured specimens and geochemically probe and thin section them.

Has Azmi stumbled upon phosphatized evidence for the world's oldest animal embryos, in Vindhyan rocks that could be close to 620 Ma old? During the recent joint visit of the Indian investigation team to the Badanpur section near Maihar, from which these isolated small shelly fossils were said to have come, we learn that Azmi's 'limestone' was found to be a siliceous porcellanite that does not react with acid (Banerjee, pers. comm., March 1999). It is not clear to me how the microfossils illustrated in Azmi (1999b, Plates 4 and 5) could have been obtained from a siliceous porcellanite by acid maceration. Attempts are now being made by various laboratories to test if such microfossils are indeed present. If this proves to be so, then Azmi can be absolved from some of the charges now mounting. If no fossils are forthcoming, then the situation becomes more serious, and we must consider other options, such as the possibility of sample contamination and misinterpretation.

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R.J. Azmi, Wadia Institute of Himalayan Geology, Dehradun - 248 001, responds:

As I mentioned earlier (Azmi, 1999b, fig. 2), I had followed the field guide of Bhattacharyya et al. (1986, p.3) wherein the occurrence of the uppermost 'Rohtas Limestone' is mentioned in the section near Badanpur of Maihar area. My observation in field, however, had revealed that the lithology under reference is instead a 'cherty limestone with minor shale intercalations' from which I took bulk samples (including shale intercalations) for the recovery of SSFs through usual acetic acid treatment. These samples fortunately yielded SSFs. Now having come to know from our recent joint field visit (March, 1999) that this SSF yielding lithology is a 'cherty shale'/ 'cherty siltstone' (S.V. Srikantia, pers. comm., March 1999) with minor shale intercalations and not a porcellanite (everybody agreed to it excepting Dhiraj Banerjee), I found it obvious that only these brownish shaly intercalations must have been the source for the small shelly fossils. I am yet to confirm whether these brownish shales contain any amount of phosphate. On my return from the field I tried to check the recovery from my previously collected samples. This time I used hydrogen peroxide for macerating shale rich portion of the bulk samples. I found it a better technique as it yielded SSFs in higher frequency.

I, as Convener of the Vindhyan Field Meeting (21-25 March, 1999), was definitely very happy with all the field investigations jointly carried out by the 13-member team representing various organizations (WIHG, GSI, Geological Society of India, Palaeontological Society of India, and some Indian Universities). Precision of the locations of fossil yielding sections was appreciated by everyone including the GSI officers who had earlier located both the sections of Maihar and Rohtas areas, which I described in January, 1999. They were even successful in reproducing the material I described as *scleritome* forming SSFs from the Rohtas area. My only unhappiness during the field visit was my misjudgement of the lithology as 'limestone' in the Maihar section. This correction pertaining to lithology would further help in better recoveries of additional small shelly fossils.