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Dinosaur nesting ground from the Early Jurassic fluvial deposits, Holy Cross Mountains (Poland) — discussion

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A group of spherical objects has recently been described by G. Pieńkowski (1998) from Early Jurassic deposits of Sołtyków locality (also known as Odrowąż), Holy Cross Mountains, Poland. The structures were found in fluvial deposits, on the surface of a sandstone slab of a crevasse splay origin (G. Pieńkowski, 1998, pl. III). They were interpreted as "strongly altered post-egg structures" and a scenario explaining their taphonomic and diagenetic history has been put forward.

According to G. Pieńkowski (1998), there are two kinds of dinosaur eggs in the Sołtyków find. Larger eggs were laid down by the earliest sauropods, whereas the small ones by other dinosaurs. The alleged sauropod eggs were interpreted as an *in situ* clutch, while the smaller eggs were supposed to have been redeposited on the sauropod nesting ground by flood currents. Subsequently, the eggs were subjected to various diagenetic processes resulting in dissolution of their shells.

G. Pieńkowski (1998) claims that his "sensational" specimen (no collection number assigned) represents the first find of dinosaur egg structures in Poland and the second known Early Jurassic nesting ground world-wide. In our opinion, however, these claims are unsubstantiated. There are no positive arguments allowing the supposed "post-egg structures" from Sołtyków to be regarded as remains of dinosaur eggs. Let us review the arguments put forward by G. Pieńkowski (1998).

THE SHAPE, SIZE, AND ARRANGEMENT OF THE STRUCTURES

In the absence of shells, the strongest argument for the egg nature of the rounded structures was their regular shape and supposedly bimodal size distribution. Both features are indeed recognizable on a suggestive interpretive line-drawing of the "egg-bearing" slab (G. Pieńkowski, 1998, pl. III, fig. 2). However, this is not evident from the photo of the crucial sandstone slab (G. Pieńkowski, 1998, pl. III, fig. 1). Even at first glance it is obvious that some rounded bodies on the slab were omitted from the schematic drawing. Moreover, the objects shown as of approximately the same size on the drawing (e.g. those labelled A–D, G. Pieńkowski, 1998, on pl. III, fig.1), actually do show pronounced size differences. A comparison of the original drawing of G. Pieńkowski's specimen (Fig. 1A) with our drawing traced directly from his photograph (Fig. 1B) should make this clear. Regrettably, the Author did not present any table with measurements nor a plot demonstrating the postulated strictly bimodal distribution of the rounded structures.

According to G. Pieńkowski (1998), the larger objects (A–D) form a rim-like structure, supposed to be a nest of sauropod eggs. Unfortunately, the arrangement of four (out of about twenty) objects into a semicircular arch may be hardly interpreted as something beyond coincidence (objects A–D

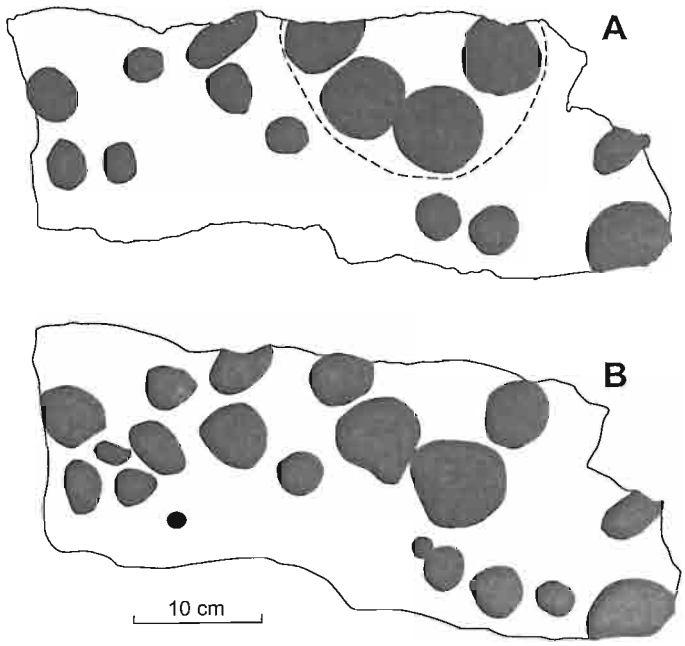

Fig. 1. The slab with the Early Jurassic "post-egg structures" from Sołtyków

A — the arrangement of objects as drawn by G. Pieńkowski (1998, pl. III, fig. 2); B — the arrangement of objects traced by K. Sabath from the original photograph (G. Pieńkowski, 1998, pl. III, fig. 1)

look like they formed a random cluster; one rounded object at the edge of a slab may be missing, giving an impression of an empty centre of a partial circular nest).

Moreover, the regularity of size, shape and arrangement of the "post-egg structures" stressed by G. Pieńkowski is absent from a specimen kindly shown to us by Gerard Gerliński (Polish Geological Institute, Warszawa). This is another slab of sandstone, coming from the same locality and layer as the purported post-egg structures, found in close proximity to the original specimen. The slab is replete with rounded structures which look exactly like those presented by G. Pieńkowski, which vary widely in size, shape (some of them are very irregular) and are chaotically distributed.

ASSOCIATION WITH SAUROPOD FOOTPRINTS

Genuine sauropod tracks have actually been found (G. Gierliński, 1997; G. Pieńkowski, 1998, pl. II) in the same strata as the purported eggs. This association, however, by no means can be treated as a proof for the egg origin of the objects under discussion.

ALLEGED EMBRYONIC REMAINS

G. Pieńkowski (1998, p. 466, figs. 6, 7, pl. III, fig. 5) claims that at least one "egg" contains embryonic dinosaur bones. He points to some dark objects visible in cross-section of the "egg", that he regards as the bones of an unhatched dinosaur. They are, however, unrecognizable lumps of chalcedony. No anatomical features confirming the identification by G. Pieńkowski could be found.

The Author claims further that in places, the original microstructure of the bone tissue has been preserved. The SEM photographs (G. Pieńkowski, 1998, figs. 6, 7) accompanying this claim are, however, at best inconclusive — no lamellae or other structures are evident.

G. Pieńkowski (1998, figs. 8, 9) presents also the EDS (Energy Dispersion System) profiles of the chemical content of the alleged embryonic bones and concludes that they contain a substantial amount of calcium, plus some phosphorus, remaining from the calcium phosphate of the embryonic skeleton. The presence of phosphorus is, however, doubtful: the letter "P" is labelled at the base of a steep slope of the artificial Au peak (from gold used to coat the sample); so that the actual amount of phosphorus (or, indeed its very presence in the sample) is impossible to confirm by the data available. The calcium present in the sample is too weak an evidence to claim a dinosaurian origin of any structure.

PURPORTED EGGSHELL REMAINS

G. Pieńkowski (1998) interpreted some chip-like fragments found near the rounded "egg" structures as remnants of "strongly altered" shell fragments. The chips consist of clay minerals and iron hydroxide and oxide; G. Pieńkowski also mentioned some traces of tiny radial canals perpendicular to the plate's surface as an evidence of the dinosaur egg origin of the chips. Such canals are absent, however, on the photograph claimed to illustrate them (G. Pieńkowski, 1998, fig. 10). Samples of purported eggshell examined by one of us (KS) under SEM also revealed no traces of ultrastructure typical for dinosaurian eggs; also the "shell" thickness varied by half at a distance of a few millimetres, so even the hypothesis of diagenetic changes obscuring the original arrangement of calcite crystals is unlikely.

TAPHONOMICAL INTERPRETATIONS

In our opinion, the objects under discussion are probably reworked concretions. G. Pieńkowski (1998, p. 462) briefly discussed such a possibility, only to reject it because of the alleged regularity of shape (see discussion above) and predepositional origin of these structures (pointing to the fact that they are covered by cross-bedded sediment). This would speak against synsedimentary origin of nodules. But the structures could easily have been reworked concretions. Thus, in discussing the concretion alternative, the Author in fact demolishes a straw man (another example of straw man alternatives is the discussion of a remote possibility that the objects

in question are plant seeds or stomach stones of Early Jurassic ruminants; see G. Pieńkowski, 1998, p. 463).

The concretional origin of the "post-egg structures" is additionally supported by specimens from G. Gierliński's collection. Some of them show in cross-section numerous veins of detritic matter and incorporated mudstone intraclasts, which are to be expected in nodules. Another specimen reveals a concentric structure typical of many concretions. Also, it should be noted that no horizontal lamination is visible in any specimen illustrated by G. Pieńkowski or available to us (and even if it were, this would not preclude concretional origin of the objects, contra G. Pieńkowski, pers. comm.).

The taphonomic scenario envisaged by G. Pieńkowski (1998, fig. 11) to explain the obliteration of all unequivocal remnants of eggs is very unlikely. The eggshell is supposed to dissolve shortly after the eggs were buried, and then clastic sediment would have filled the interior, quickly enough for the worms to feed on the egg contents and leave burrow traces in the infilling. However, no disturbance of the overlying sediment bedding is visible in cross-section of the slab (G. Pieńkowski, 1998, fig. 4). Usually, even if the shell is well preserved, not fully dissolved as claimed in this case, the upper part of the eggshell collapses, not retaining the original spherical shape, but filling the cup formed by the lower half of the egg (see e.g., R. Cousin *et al.*, 1994; G. Faccio, 1994; A. Sahni, I. Khosla, 1994). G. Pieńkowski's scenario pictures instead even the embryonic bones hovering inside the decayed ghost of an egg. It is difficult to imagine such a sequence and timing of events. It looks rather like the objects were solidified already before being buried by fluvial sediments.

CONCLUSION

To sum up, we see no proof of the objects described by G. Pieńkowski (1998) being even remotely related to dinosaur eggs, and we believe his story deserves relegation to the Red Herring category. Of course, dinosaurs, including sauropods, did live in the neighbourhood of the present-day Sołtyków. All dinosaurs laid eggs. The only problem is that the finds discussed here cannot be positively interpreted as dinosaur eggs.

In spite of the above criticisms, we believe that the locality Sołtyków deserves further study and protection due to many unquestionable fossils, of dinosaur (e.g. G. Gierliński, G. Sawicki, 1998), insect (P. Wegierek, V. V. Zherikhin, 1997) and plant (see e.g., E. Wcisło-Luraniec, 1991) origins.

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