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Short Communication

SOME PROBLEMATIC SHALLOW-MARINE STRUCTURES

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SUMMARY

The lowermost Devonian beds in Gotland (Sweden) were deposited in a very shallow marine environment, close to the coast. In these beds three structures were observed, whose mode of formation cannot be explained by the author.

INTRODUCTION

Gotland is a Swedish island in the Baltic. The series of strata found in Gotland forms part of a large Palaeozoic basin, the oldest deposits of which occur in the mainlands of Sweden and Russia, whereas the younger sediments (Silurian, Devonian) are found closer to the centre of the basin, including the islands of Gotland and Saaremaa (Ösel). The author is engaged in a study of the reef limestones in the Middle Palaeozoic succession in Gotland, but has also paid some attention to the other rocks of the island, particularly as far as they can be of help in understanding the palaeogeographical and palaeoecological conditions under which the reefs of Gotland formed.

The Palaeozoic of Gotland is subdivided into several stratigraphic units, which have an average dip of about 0°.30′ in a southeasterly direction, and thus crop out in belts that generally have a northeast–southwest orientation. The youngest rocks are exposed in the south. The Burgsvik Beds, with which this paper is concerned, underlie the Hamra and Sundre limestones, the latter being the youngest Palaeozoic deposits present in Gotland.

THE UPPER BURGSVIK BEDS

The Burgsvik Beds are exposed in southern Gotland. In the west, they reach a thickness of about 47 m, eastwards they thin out rather rapidly. This paper deals

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Fig.1. Upper Burgsvik sandstone with varying thickness of the layers. The thinner layers generally contain a higher fraction of silt- and clay-size material. Quarry at Valar.

Fig.2. Local occurrence of claystone, in the shape of an elongated lense, in between sandstone. Upper Burgsvik Beds, Valar.

only with the Upper Burgsvik Beds, about 7 m thick, in the west of southern Gotland. The age of these beds is presumably lowermost Devonian (Downtonian). They are not tectonically affected.

Lithologically, the Upper Burgsvik Beds consist of oolite, sandstone (Fig.1), argillaceous shaly sandstone and some claystone. The uppermost oolite layer occurs throughout most of the area where the Upper Burgsvik Beds are exposed, and constitutes a good index horizon. The other oolite layers are not continuous, as is also the case with the occurrences of claystone, but to a much stronger degree (Fig.2).

The Upper Burgsvik Beds have characteristics that suggest formation very close to the shore line on a beach faintly sloping toward an open sea and affected

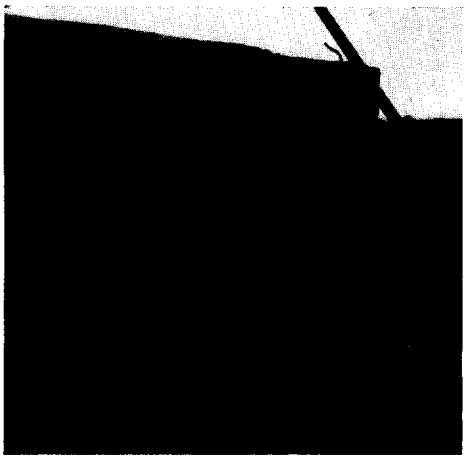

Fig.3. Transverse section through Upper Burgsvik sandstone, presumably the upper part of a beach deposit. Cross-bedding in an alternation of light and dark grey lamellae; the cut of which indicates that the upper part probably belonged to the filling sediment of a small depression in the beach. At the top an erosion level. Quarry Hansén and Co, Valar.

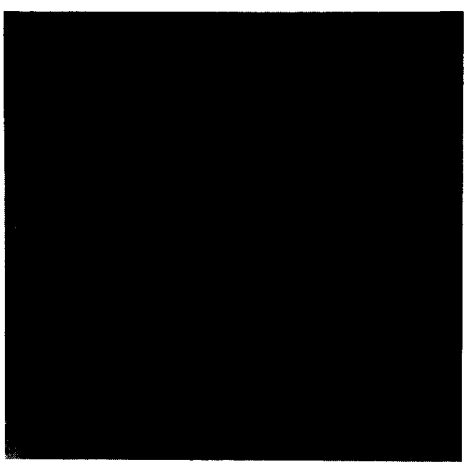

Fig.4. Part of the bottom bedding plane of a layer of Upper Burgsvik sandstone. Quarry Hansén and Co., Valar. The surface shows the filling sediment of pothole-like excavations in the surface of the underlying layer. The excavations may be either circular or irregular in outline, generally 7–30 cm; they are shallow, and filled with thin layers which generally follow the contours of the excavation, very occasionally the upper bedding plane of such a layer is vaguely rippled. The structures probably originated on an open beach as a result of interference of water currents.

by tidal action. These include: (*1*) cross-bedding (Fig.3); (*2*) ripple marks; (*3*) some offshore bars: (*4*) oolites; (*5*) occurrence of rounded pebbles of oolite in the sandstone and oolite; (*6*) sorting to size of partly rounded fossils at the transition from the sandstone to the uppermost oolite layer; (*7*) a high percentage of lamellibranchs

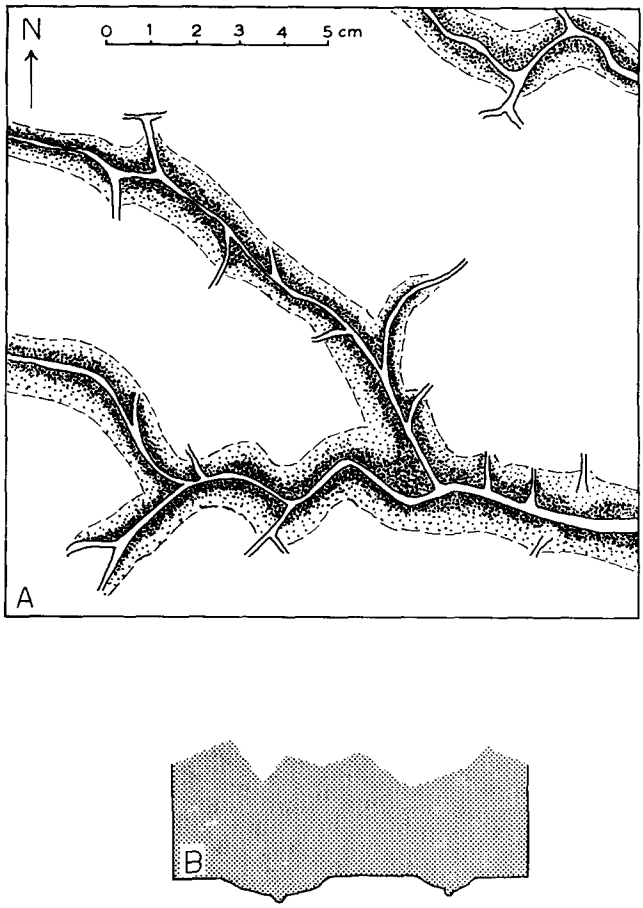

Fig.5. Part of a dendritic pattern of rill marks in the bottom plane of a layer of Burgsvik sandstone, south of the second hillock of Hoburgen, about 1 m below the top of the Burgsvik Beds. A.Surface of bottom plane; B.Cross-section. The marks suggest formation on a beach which periodically fell dry.

with thick shells; (*8*) rarity of burrows; (*9*) clay lenses, probably deposited behind low barriers; (*10*) erosion channels; (*11*) pothole-like excavations (Fig.4); (*12*) mud cracks; and (*13*) dendritic patterns of rill marks (Fig.5).

The direction of the coast line, at the time of deposition of the Upper Burgsvik Beds, was probably about north–south with the open sea at the east side.

PROBLEMATIC STRUCTURES

In the Upper Burgsvik Beds the author observed three structures that he is unable to explain. They are described in this paper in the hope that workers on recent shallow-marine phenomena will be able to produce the desired explanations.

First, groups of small and shallow (1–2 mm) grooves may occur en-echelon

in a belt (Fig.6A), irregularly distributed (Fig.6B), roughly parallel (Fig.6C) or in a fan-like pattern (Fig.6D). They are in the top plane of sandstone layers, in parts of one to a few square decimetres large, and are not rare. In cross-section, most of the grooves are roughly symmetrical. In sandstone layers near these problematic

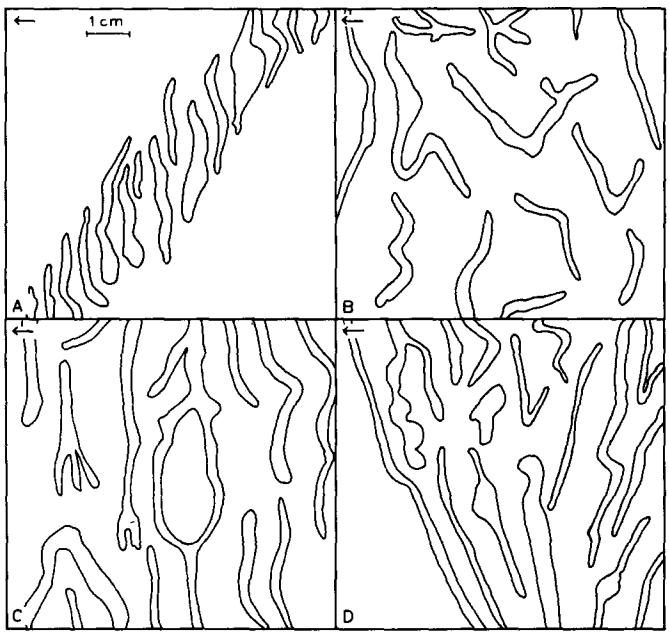

Fig.6. Groove marks of unknown origin, found in Upper Burgsvik sandstone, south of the second hillock of Hoburgen, about 1.30 m below the top of the Burgsvik Beds.

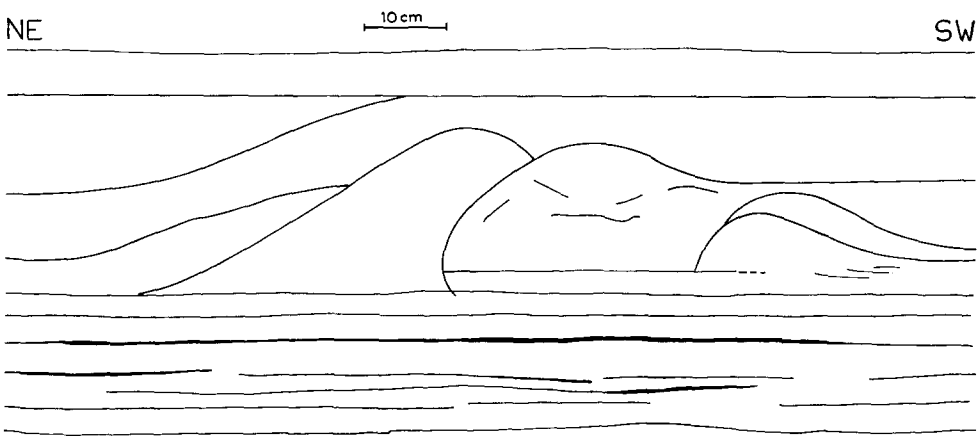

Fig.7. Remarkable lumps, found in a layer of Upper Burgsvik sandstone, south of the second hillock of Hoburgen, about 1.50 m below the top of the Burgsvik Beds. Towards both the northeast and southwest a normal stratification is present at the level at which the lumps occur. The mode of formation of the lumps is unknown.

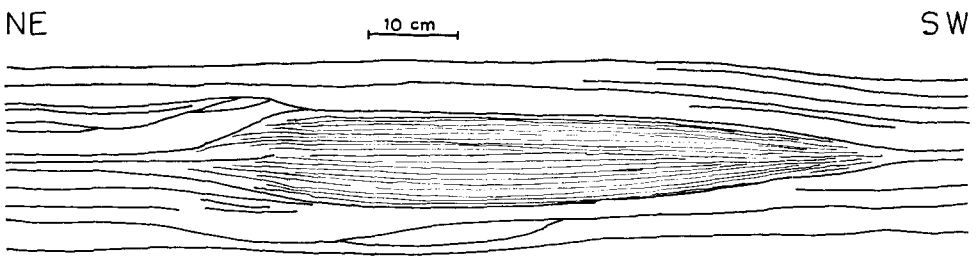

Fig.8. Lense-like intercalation within shaly sandstone. Upper Burgsvik Beds, south of the second hillock of Hoburgen, about 1.60 m below the top of the Burgsvik Beds.

marks, rill marks were found (Fig.5). These have a somewhat different pattern and contain a deeper median subgroove (Fig.5B), that was nowhere observed in the marks of Fig.6. If the latter would also be rill marks it is difficult to understand why they differ distinctly from the marks of Fig.5, that occur in their near vicinity.

The second problematic structure was found in a 6 cm-thick sandstone bed, that overlies shaly sandstone (Fig.7). Over almost its entire exposed length the bed has a normal, parallel stratification. At one place, however, are remarkable lumps. The nature of the boundaries of these lumps is similar to the stratification planes northeast and southwest of them in the same bed. The chemical and mineral composition of the rock of the lumps is not different from that of the rock in the other parts of the bed. Can the lumps be explained as pillows caused by sliding?

The third structure is a lense-like intercalation within thinly parting shaly sandstone (Fig.8). It was found only a little lower in the stratigraphic column of the Burgsvik Beds, and rather close to the structure of Fig.7. The lense had a very thin lamination. It is slightly more clayey than the surrounding shaly sandstone, but the difference is not great. No indications were found of deposition in a somewhat sheltered environment.

Whereas the structures of Fig.6 were observed in several localities in the west of southern Gotland, the structures of Fig.7 and 8 were both found in one place only.

The author offers his apologies that he has nothing important to tell to the readers of this journal, but on the contrary, hopes to learn something from them. Any comments which help to understand the nature and origin of these structures will be much appreciated.