SVERIGES GEOLOGISKA UNDERSÖKNING
SERIE C NR 771 AVHANDLINGAR OCH UPPSATSER ÅRSBOK 73 NR 12

ADA DE MARINO

THE UPPER LOWER CAMBRIAN STRATA SOUTH OF SIMRISHAMN SCANIA, SWEDEN

A TRANSGRESSIVE – REGRESSIVE SHIFT THROUGH A LIMESTONE SEQUENCE

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ABSTRACT

de Marino, A., 1980: The upper Lower Cambrian strata south of Simrishamn, Scania, Sweden. A transgressive-regressive shift through a limestone sequence. Sver. geol. undersökn. C 771

Much of the upper Lower Cambrian strata south of Simrishamn, Scania, Sweden, is composed of a limestone sequence, chiefly clayey and silty biomicrosparites and biomicrosparrudites, with intercalated layers of clay-silt sediments, claystones and carbonate mudstone. The fossil content is represented predominantly by trilobite carapaces, and in minor amounts by echinoderm fragments, probably hyolithids, bivalved shells and other unidentified shelly fragments. The limestone sequence is underlain by a calcareous, fossiliferous, phosphorite-bearing quartzarenite, and overlain by a glauconite-arenite deposit. Deposition of the calcareous beds took place within a shallow marine to tidal flat environment. Fenestral cavities are common in the uppermost limestone bed at Brantevik. The presence of celestobaryte in the upper part of the sequence may suggest a semiarid climate and evaporitic tendency during the last stage of its deposition. The lithological analysis of the sequence indicates a transgressive-regressive shift during the deposition.

INTRODUCTION

The Cambrian deposits of Scania, Sweden, were formed in a shallow sea which transgressed from the Baltic basin in a west-northwesterly direction over the south of Sweden (Regnéll 1960). The uppermost Lower Cambrian strata in the southeast of Scania (for stratigraphy, see Ahlberg and Bergström 1978, Fig. 1) are exposed in the Andrarum area and along the Baltic coast. Continuous and good exposures are seldom accessible there because most of the sections lie under the normal sea water level.

The rock samples discussed in this paper were collected 600 m north of Gislövshammar (55° 29′ 35″ Long. W.; 14° 19′ 21″ Lat. N.) and 1 km south of Brantevik (55° 30′ 17″ Long. W.; 14° 20′ 22″ Lat. N.), Scania, (Fig. 1) at a water level of about 13 cm below normal (information provided by the harbour office at Simrishamn).

The term "shale" and the terminology and classification of the fine-grained clastic rocks have been discussed by many authors, including Folk (1954, 1974), Folk *et al.* (1970), Krumbein (1947), Krynine (1948), Pettijohn (1975), Picard (1971), Shepard (1954), Trefethen (1950) and Tourtelot (1960). Although Tourtelot, after a long discussion arrived at the conclusion that the term shale must continue to be used, Selley (1976) stated that shale is an ill-defined term which does

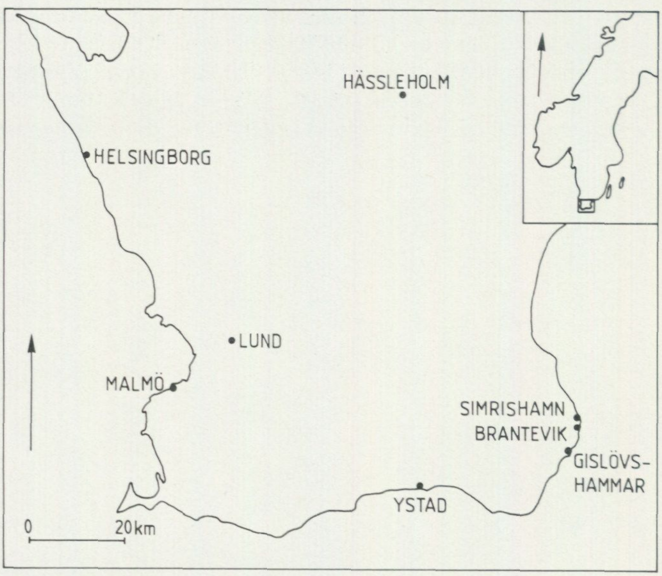

Fig. 1. Map showing the localities of Brantevik and Gislövshammar, 1 km south and 600 m north of which respectively the studied rocks were sampled.

not differentiate silt from clay-grade sediment, and suggested that this term could perhaps usefully be abandoned by geologists, except in cases where a general, not strictly defined term may be adequate.

In the present study, rocks in which allochemical and orthochemical carbonate fractions together exceed 50% were classified according to Folk's carbonate nomenclature (1959, 1962). In cases where these fractions were less than 50%, Picards classification (1971) was used. According to this author, there are three possibilities for classification of rocks which are mixtures of carbonate, clay and silt (or sand) when none of these components reaches the 50%. One of these possibilities is that they might be called carbonate mudstone (Fig. 2).

The lithology of the sequence dealt with (Figs. 3, 4) has been studied in part by Hadding (1929, 1958). A dark green, glauconitic sandstone was reported by Westergård (1944) from a drilling core at Gislövshammar. The writer has only

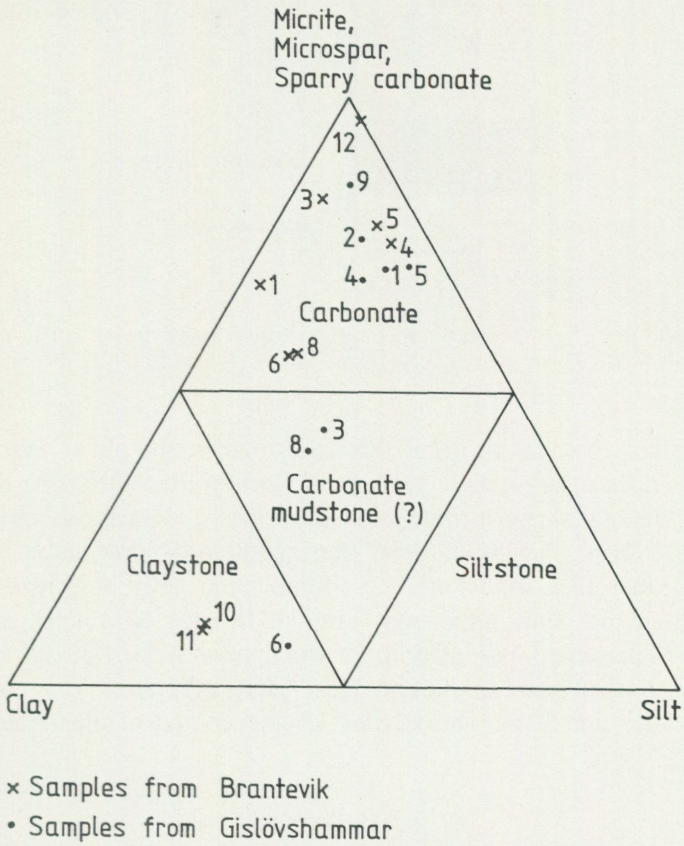

Fig. 2. Plot of samples. The percentage is relative, not absolute. The end-member triangle of silt, clay and carbonate is after Picard (1971). The samples Br-78-1, Br-78-13, and Gi-77-11 were plotted in another similar end-member triangle with the sand pole instead of the clay pole.

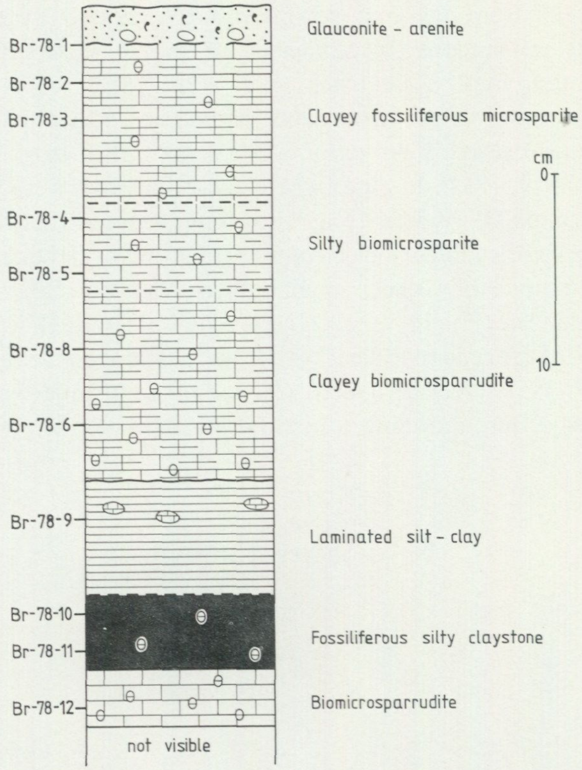

Fig. 3. Exposed lithologies of the uppermost Lower Cambrian at Brantevik, Scania. Egg-shaped symbol with girdle: fossil fragments.

found the very base (1–2 cm) of this sandstone, at the top of the outcrop at Brantevik and in an ice- or wave-transported block situated 30 m north of the latter. In both situations, this glauconite-arenite overlies a characteristic greyish black limestone (N2). At Gislövshammar the measured exposed sequence directly overlies the Rispebjerg Sandstone. X-ray diffractograms (Cu, Kα) show that calcite and quartz are the main components in most of the studied samples, that the clay mineral is represented by illite and, for the uppermost part of the sequence at Brantevik, that carbonate apatite and celestobaryte are present. Chemical analysis results (Walkey and Black method) show a higher content of organic carbon there.

LIMESTONES

Rocks of different lithology are divided by bedding planes which delimit thin-bedded sedimentation units (McKee and Weir 1953). Layers with variable amounts of microcrystalline carbonate ooze, clay, silt and fossil fragments have

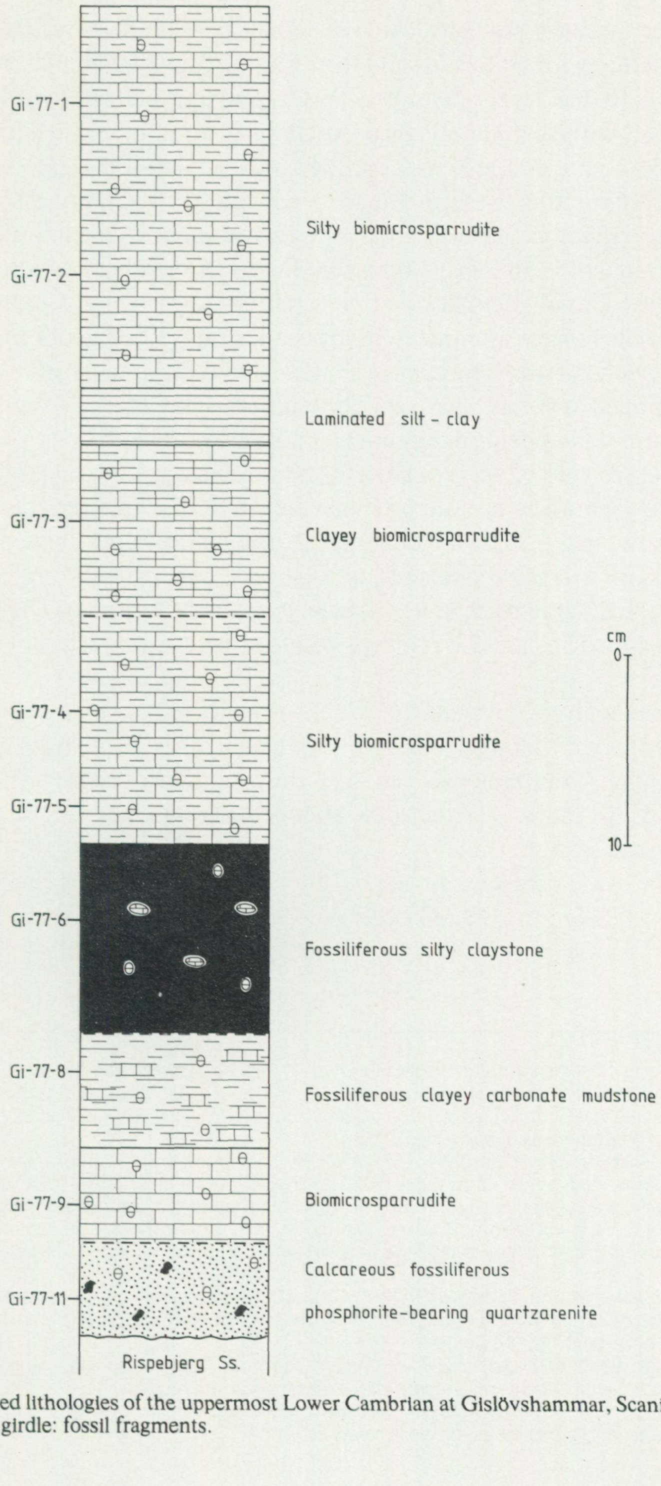

Fig. 4. Exposed lithologies of the uppermost Lower Cambrian at Gislövshammar, Scania. Egg-shaped symbol with girdle: fossil fragments.

generally been intensively bioturbated. The bioturbation destroyed most of the internal structure within the beds and the resulting rocks are either "massive" or mottled or with the layers disrupted and swept upward or downward. Thus restricted areas with slight lithological variations may be present within the same bed. A burrow 2 cm wide and 3 cm deep, filled with geopetal sediment was observed at the level of 16 cm from the top of the section at Brantevik. Clayey, discontinuous millimeter-thick laminae are occasionally preserved within the limestone. They are only more frequent at the level corresponding to the sample Br-78-6 at the last named locality. This might indicate either variations in the rate of deposition or that the bioturbation was less intense (cf. Reineck and Singh 1973). At 44 cm below the top of the section at Gislövshammar a short segment of a trace fossil was noticed. It was determined as *Palaeophycus* sp. The width is about 3.5 cm. Other characters are too indistinct for a determination at ichnospecies level.

Two principal types of cavities are common in the uppermost black limestone bed at Brantevik, both in the outcrop and in the erratic block, being larger and more abundant in the latter. They are either small, irregularly ovoid-shaped, generally less than 1 cm, or large, elongated, up to several centimetres long and several millimeters thick, lying more or less parallel to the bedding plane. The latter form may be branched. They are filled with geopetal sediment and/or clear blocky sparry calcite.

Point-count analyses have shown that the limestones are chiefly clayey or silty biomicrosparites and biomicrosparrudites. However, as previously mentioned, because of the bioturbational activity, the component distribution is not homogeneous. In this way, patches of slightly different composition are formed within the same stratum (Fig. 5A).

The colour, which follows the slight lithological variations, is predominantly greenish-grey (5G 6/1 to 5GY 6/1) at Gislövshammar and medium dark grey (N4) at Brantevik. At the latter locality the uppermost bed is greyish black (N2) due to

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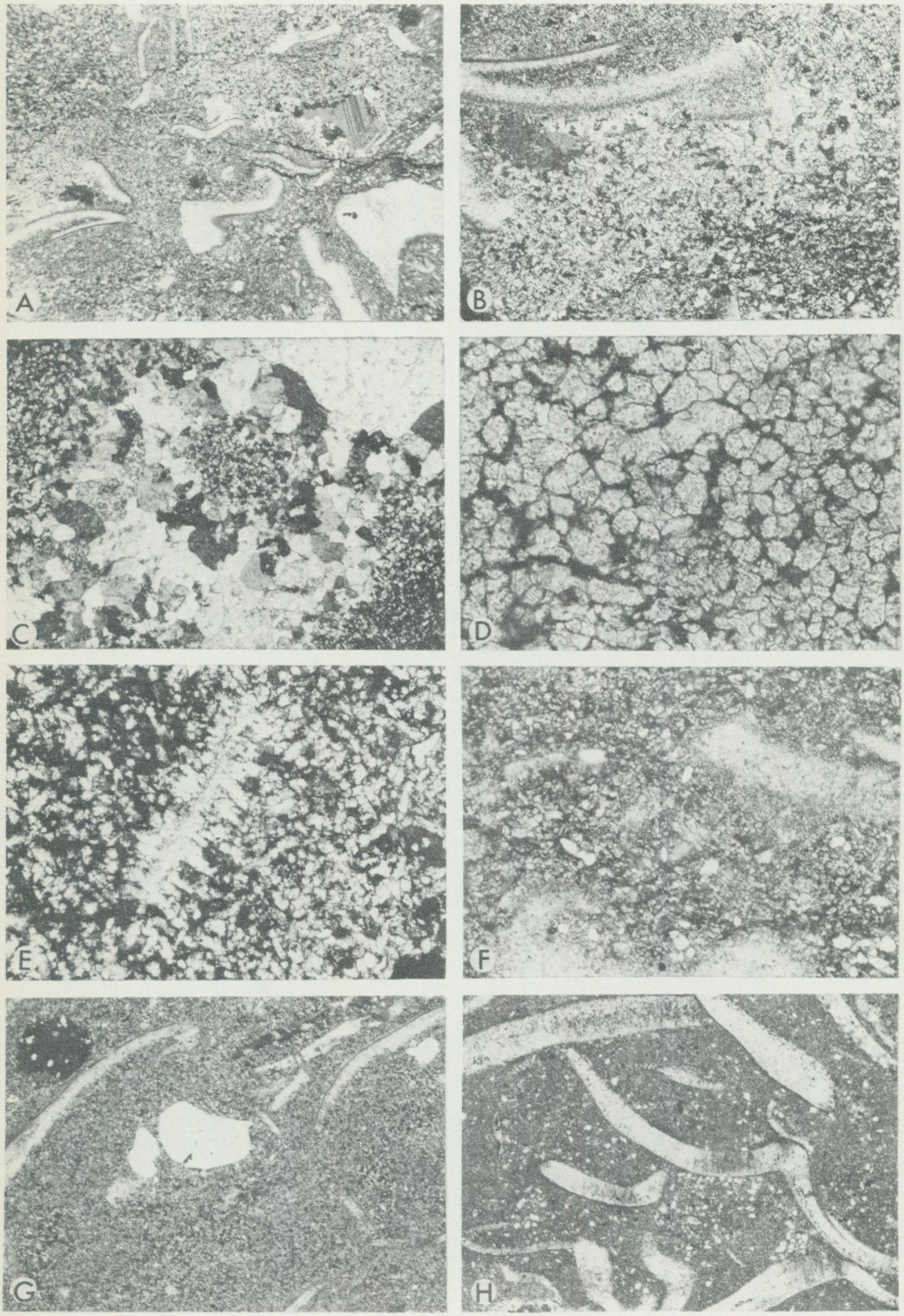
Fig. 5. A–B, silty biomicrosparrudite. A. Sample Gi-77-1, Gislövshammar, Scania, crossed nicols, x 11: patchy distribution of particularly silt-rich zones within the limestone. At the right center of the figure, spar filling a former cavity. B. Sample Gi-77-4, Gislövshammar, Scania, crossed nicols, x 30: microspar crystals grading to pseudospar (larger than 30 μm).

C–E, clayey, fossiliferous microsparite. C. Sample Br-78-3, Brantevik, Scania, crossed nicols, x 16: stellate mass of pseudospar crystals arranged radial from a core of equant microspar. D. Sample Br-78-3, Brantevik, Scania, plane polarized light, x 100: neomorphic alteration of micrite developed pseudospar crystals. Bladed shape is not clearly shown. E. Sample Br-78-1, Brantevik, Scania, crossed nicols, x 52: fibrous neomorphic calcite arranged radial to a fossil fragment. Note the expelled impurities between the fibres.

F., silty biomicrosparrudite. Sample Gi-77-1, Gislövshammar, Scania, plane polarized light, x 52: quartz silt scattered throughout the limestone. Note the very thin, discontinuous clay-laminae at the center left and lower right of the figure.

G., biomicrosparrudite. Sample Gi-77-9, Gislövshammar, Scania, crossed nicols, x 16: fossil fragments, quartz sand and silt, phosphatic clast embedded in microspar.

H., silty biomicrosparrudite. Sample Gi-77-2, Gislövshammar, Scania, crossed nicols, x 16: trilobite fragments are the dominant fossils in this limestone.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both the partial phosphatization of the limestone (carbonate-apatite according to X-ray diffractometry) and the higher content of organic matter.

Microspar (Folk 1965) has resulted from recrystallization of the micritic calcareous mud. The crystals are commonly equant in shape and of 5–15 μm, though they may reach 20–30 μm and even more (Fig. 5B). Micritic remnants may be present within the microspar. In the uppermost limestone bed at Brantevik, pseudospar crystals were observed arranged radially from a core of microspar, developing a stellate mass (Fig. 5C; see also Bathurst 1971). Near the top of this bed, there are small areas which are characterized by a predominance of pseudospar crystals of 30–80 μm and even larger, of equant or bladed shapes (Fig. 5D; see also Folk 1965). Fibrous neomorphic calcite, arranged radial to skeletal particles, which constitute centres of recrystallization, has been reported by Orme and Brown, 1963. This kind of neomorphic crystals was noticed in samples from Gislövshammar and Brantevik (Fig. 5E).

Silt particles are in general irregularly scattered within the rock, but patchy distribution may also be present within a single sample. Clay particles may be found between the microspar crystals, concentrated in patches or disposed in very fine, discontinuous laminae more or less parallel to the bedding plane (Fig. 5F). According to X-ray diffractometry, illite in low amounts is the clay mineral present in these limestones. Quartz is the chief mineral in the silt fraction, but occasionally a few feldspar grains and one or two muscovite flakes were also recorded in some samples. A few sand-size quartz grains and phosphatic clasts are scattered in the biomicrosparite level at Gislövshammar (Fig. 5G).

Calcareous skeletal fragments constitute the dominant fossil content in the limestone sequence, though phosphatic fossil debris in trace amounts were recorded in several samples. Smosna and Warshauer (1978a) defined "petrographic fossil diversity" as the total number of all dissimilar fossil types observed in thin section. Trilobite carapaces are the dominant fossil throughout the section and in

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Fig. 6. A–C, silty biomicrosparrudite. A. Sample Gi-77-5, Gislövshammar, Scania, crossed nicols, x 11: trilobite fragments, possible hyolithid fragment, echinoderm fragment, bivalved shell and unidentified shelly fragments in silty microspar. B. Sample Gi-77-5, Gislövshammar, Scania, crossed nicols, x 30: coarse crystalline fossil fragments. The mosaic calcite may be either void-filling or recrystallized (CO_3Ca). C. Sample Gi-77-4, Gislövshammar, Scania, crossed nicols, x 16: sheltered cavity filled by sparry calcite at the lower center of the figure. A sand-size echinoderm fragment, at the upper left.

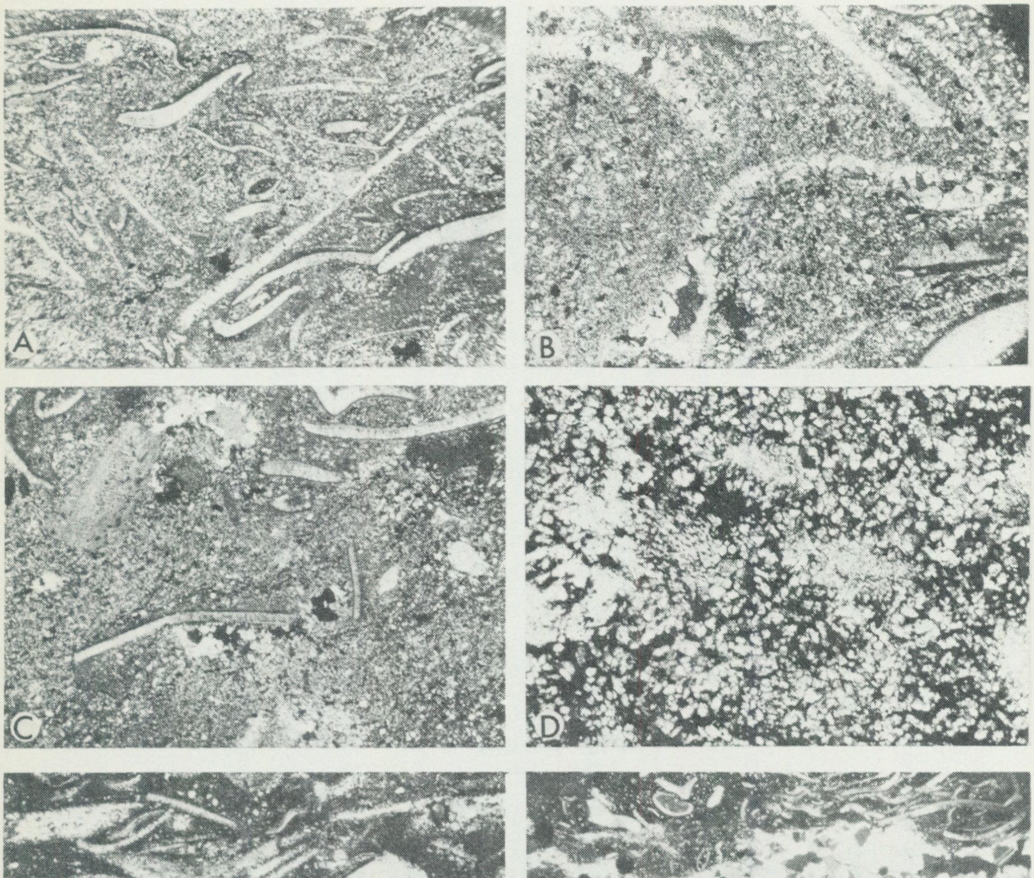
D., clayey, fossiliferous microsparite. Sample Br-78-2, Brantevik, Scania, plane polarized light, x 52: local concentration of obliterated fossil fragments embedded in a neomorphic calcite.

E., biomicrosparrudite. Sample Br-78-12, Brantevik, Scania, crossed nicols, x 16: sparry calcite filled the sheltered cavity at the center of the figure and the cavities within the shells, partially filled by geopetal sediment.

F., biomicrosparite. Sample Br-78-16, Brantevik, Scania, crossed nicols, x 6: fenestral cavity floored by geopetal sediment which developed an horizontal roof. Over the latter, a blocky calcite mosaic filled the remaining void.

G., clayey, fossiliferous microsparite. Sample Br-78-2, Brantevik, Scania, plane polarized light, x 52: microspar transecting a calcareous fossil fragment.

H., biomicrosparrudite. Sample Br-78-12, Brantevik, Scania, crossed nicols, x 52: at the center of the figure, a trilobite fragment partially recrystallized to microspar.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many layers practically the only ones (Fig. 5H), hence these rocks are characterized by a low petrographic faunal diversity. However, echinoderm fragments, probably hyolithids, bivalved shells and other unidentified shelly fragments may also be present (Fig. 6A) and there are samples in which echinoderm debris are rather frequent. All these fossils are represented in abundance in the samples Br-78-8, Br-78-12, and Gi-77-5, which are characterized by moderate petrographic fossil diversity. Also common at these levels are coarsely crystalline fragments (mollusc fragments? algal fragments?), which are now occupied by a mosaic calcite (Fig. 6B). The latter may be formed by either space-filling precipitated calcite or neomorphic recrystallization of the original carbonate, presumably originally of aragonitic composition. The first possibility implies previous dissolution of the material of the fossil fragment, leaving a cast which afterwards was filled with sparry calcite. Harbaugh (1961) shows a figure with such coarse crystalline fragments, which he interpreted as fragments of leaflike algae and assumed that the interiors of algae are occupied by void-filling calcite. Sheltered cavities filled by sparry calcite cement (Fig. 6C) occur only in the last mentioned samples from Brantevik and in the sample Gi-77-4 from Gislövshammar. In the latter, two echinoderm fragments with rim cement (Bathurst 1958) were observed.

The size of the fossil debris ranges from very fine sand-size (125–250 μm) to larger than 1 mm. There are horizons in which large skeletal bodies are mixed with other smaller ones. Nearly obliterated, small fossil fragments are locally common within a level of the uppermost limestone bed at Brantevik (Fig. 6D). The amount of fossil fragments varies between the different beds and local concentrations may be found within the same bed. Throughout the sequence, with exception of the uppermost limestone bed at Brantevik, they range from 17% up to 30% with an extreme value of 40% in the sample Br-78-6. In the upper black limestone bed at Brantevik, the calcareous fossil content is very low. Only restricted areas show skeletal concentrations of low faunal diversity.

Cavities within calcite shells, such as those in shells interpreted as hyolithids, are generally completely filled with sediment, though there are cases in which the cavities are only partially filled with sediment, the remaining space being filled with sparry calcite (Fig. 6E). The previously mentioned small, irregularly ovoid-shaped and the large, thin, elongated cavities, commonly present in the black limestone bed at the top of the section at Brantevik and in the block, are filled up by calcite cement or are floored by geopetal sediment. This sediment occupies about one third or less of the space and may form a horizontal roof over which a drusy calcite crust has crystallized which is replaced toward the center of the cavity by a blocky calcite mosaic (Fig. 6F). The sediment-filling is commonly lighter than the surrounding primary sediment and is devoid of terrigenous particles and apparently unfossiliferous. Morrow (1978) reported microspar adjacent to and within burrow fillings. In the studied samples, both cavity-filling and the surrounding host sediment have been recrystallized to equant microspar. This kind of structure in carbonate rocks was termed "bird's-eye." Ham (1954) discussed its origin. Tebbutt *et al.* (1965) referred to it as fenestra and defined it as a primary or penecontemporaneous gap in rock framework, larger than grain-supported interstices. Grover and Read (1978) differentiated between three types of fenestrae.

The neomorphized geopetal sediment found in these fenestral structures, in certain instances, might resemble Dunham's vadose silt (Dunham 1969), but unlike the latter, it is not underlain by any early calcite cement. In some samples microspar transecting allochems (Fig. 6G), as well as fossil fragments partially recrystallized to microspar (Fig. 6H) and even to pseudospar, were recorded.

Trace amounts of glauconite were recorded in most of the samples and traces of glauconitization were noticed only in connection with clay-rich zones at the level of 26 cm from the top of the section and at the uppermost limestone bed at Gislövshammar. Very small amounts of pyrite are present as finely disseminated or small crystals throughout the limestone, being more abundant near the top of the section at Brantevik, especially in the erratic block. There, pyrite is, in certain cases, concentrated within the fenestral cavities.

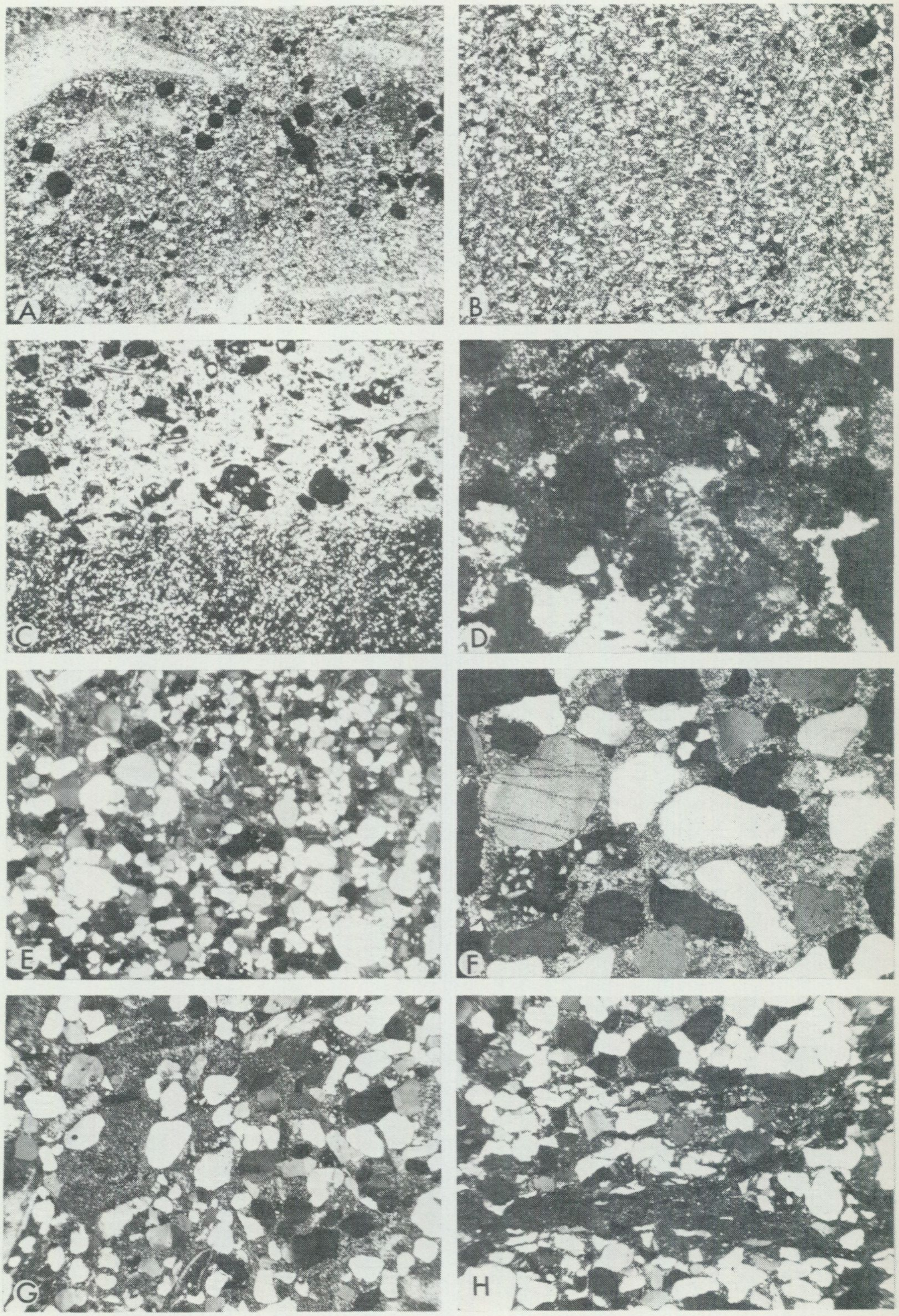
CARBONATE MUDSTONE

This lithology has a greenish-grey color (5 GY 6/1), and thin-bedded stratification (cf. McKee and Weir 1953). Compositionally it is a fossiliferous clayey carbonate mudstone (cf. Picard 1971), i.e. a rock composed of a mixture of silt, clay and carbonate with none of these components reaching 50% (Fig. 7A). The distribution of the different components of this lithology is not homogeneous throughout the rock. There are irregular patches richer in carbonate, while others are silt-clay rich with a low amount of calcite.

Scattered fossil fragments, mostly trilobite carapaces, reach 9% of the total rock composition. They may lie in horizontal position or totally vertical due to bioturbational activity. The calcite crystals are in the size of 10 μm or smaller. Quartz is the chief mineral in the silt fraction, but a few muscovite laminae are randomly orientated within the thin section. Illite is the clay mineral present in this rock. Pyrite, as finely disseminated and small crystals up to medium sand-size, is rather common, reaching 7% of the total rock composition.

CLAYSTONE

This lithology is characterized by beds with shaly partings at Brantevik and shaly to flaggy beds at Gislövshammar. The colour is greenish-grey (5G 6/1). Layers of finely laminated, silt-clay sediments, totally unconsolidated, are present in both sections. At Brantevik, calcareous fossil fragments were observed within this sediment, in which are intercalated very thin, light calcareous laminae, similar to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others with reddish-brown colour that indicate oxidizing conditions. Limestone bodies, flattened or irregular in shape and of variable size up to 9 cm long, were found within the claystone and in the silt-clay sediment.

Compositionally this lithology is a fossiliferous poorly sorted silty claystone with less than 75% of clay (cf. Picard 1971). Microscopically the rocks are composed chiefly of clay and silt particles. Skeletal debris, mostly trilobite carapaces, is present in very low amounts and does in no case exceed 4% of the total rock composition. The silt and clay particles show a rather homogeneous distribution (Fig. 7B), though some restricted clay concentrations may be scattered throughout the rock. The clay particles have generally a random orientation, being disposed around the silt grains, but they may also be arranged parallel to the bedding plane. The silt fraction is composed dominantly of angular quartz and a few mica flakes which do not present any preferred orientation. As has been previously noticed, illite is the clay mineral present in this lithology.

The percentage of calcite cement varies between the different samples, occurring always in low amounts and not exceeding 10% of the total rock composition. Only traces of glauconite and very little glauconitization were noticed in a single sample. Small quantities of pyrite, ranging from finely disseminated up to crystals of very fine sand-size, are present in the claystones. In the samples from Brantevik there is pyrite within and also delineating calcareous fossil fragments as well as elongated, discontinuous calcite "laminae" of variable thickness (0–80 μm) and uncertain origin, which occur approximately parallel to the bedding plane.

SANDSTONE

Sandstone layers are present at the base of the section at Gislövshammar and at the top of the sequence at Brantevik. Little can be said about the glauconite-arenite

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Fig. 7. A., fossiliferous clayey carbonate mudstone. Sample Gi-77-8, Gislövshammar, Scania, crossed nicols, x 30: quartz silt, clay, calcite and fossil fragments. The black grains are pyrite. Note the patchy distribution of the pelitic detritus.

B., fossiliferous silty claystone. Sample Gi-77-6, Gislövshammar, Scania, crossed nicols, x 30: clay and quartz silt particles homogeneously distributed throughout the rock. The clay particles are randomly orientated. The black specks are pyrite.

C–D, glauconite-arenite. C. Sample Br-78-1, Brantevik, Scania, crossed nicols, x 16: scour surface between the basal layer of this sandstone above, and the underlying clayey fossiliferous microsparite. D. Sample Br-78-13, Brantevik, Scania, crossed nicols, x 100: partially phosphatized glauconite grains. Note irregular shape and ill-defined boundaries of some of them.

E–H, calcareous, fossiliferous, phosphorite-bearing quartzarenite. E. Sample Gi-77-11, Gislövshammar, Scania, crossed nicols, x 6: terrigenous grains of sand and silt size, calcareous and non-calcareous allochems and microcrystalline calcite. F. Sample Gi-77-11, Gislövshammar, Scania, crossed nicols, x 11: note the variable size, shape and roundness of the terrigenous quartz. Phosphorite clasts at the lower left of the figure. G. Sample Gi-77-11, Gislövshammar, Scania, crossed nicols, x 11: framework embedded in recrystallized calcareous mud. Note the patchy loose packing of the former. H. Sample Gi-77-11, Gislövshammar, Scania, crossed nicols, x 11: intergranular solution and microstylolitization in a clay-rich lamina. Note the anomalous shapes of some quartz grains.

because of lack of material. Unfortunately the samples of the drilling-core made by the Geological Survey of Sweden at Gislövshammar were impossible to locate (information from Carl-Olof Ericsson, Geol. Survey of Sweden). In the outcrop at Brantevik, the glauconite-arenite is virtually absent beneath the Middle Cambrian.

An irregular scour surface with 1–2 cm relief separates the underlying clayey fossiliferous microsparite from the glauconite-arenite above (Fig. 7C). Gravel-size quartz and phosphatic clasts are present at the base of the sandstone. Burrows in the underlying limestone are filled with the overlying sediment. Partial destruction of the surface between the two lithologies, due to bioturbation, results in a mixture of the sediments in the contact zone. The latter indicates that the substratum was still soft at the time of deposition of the overlying material.

The framework is represented by glauconite, terrigenous grains, phosphatic clasts and shell fragments. Sparry calcite and recrystallized calcareous mud are present. The glauconite grains, very fine to medium sand-size, of variable shape, often subrounded to rounded, but also with corroded and embayed edges, show partial phosphatization (Fig. 7D). The phosphatic clasts, irregular in shape, are in the sand and gravel size. Fossil fragments were noticed within them. The fauna in the glauconite-arenite is represented predominantly by small phosphatic shell fragments. Pyrite is finely disseminated and as lumps larger than 2 mm.

Variations in the competence of the current during deposition of the basal 1–2 cm of the glauconite-arenite may be the cause of the changes observed in the amounts of matrix and/or cement and framework. Thus the base of the sandstone shows an alternation of irregular, not well-defined laminae, the composition of which ranges from that of glauconitic limestone to glauconite sandstone.

Usually the elongated phosphatic fossil fragments are current-laid, but they may also be in perpendicular position due to bioturbation. Furthermore, soft sediment deformation was observed. Upward, there is an increase in the amount of glauconite grains and the packing is closer. Celestobaryte, as isolated, euhedral or bladed crystals up to gravel size and as irregular aggregates replacing calcite, is present in this lithology.

The calcareous, fossiliferous, phosphorite-bearing quartzarenite is structurally massive although, mostly at the base, it is intercalated by thin, argillaceous, discontinous laminae. The colour is medium light grey (N6). This rock grades into the overlying biomicrosparite.

Microscopically the rock is composed chiefly of sand-size quartz grains, rare feldspar grains, and calcareous and non-calcareous allochems embedded in a calcitic crystalline ground mass (Fig. 7E). The calcite crystals, ranging from 10 to 30 μm are recrystallized calcareous mud. A few silt quartz particles are scattered throughout the rock and one quartz grain found was larger than 2 mm. The rounding of the terrigenous sand is very variable. Subrounded and rounded quartz grains alternate with others which have been split during transport or others in which boundaries are corroded and embayed (Fig. 7F). Two or three quartz sand grains with phosphatic oolitic rims were noticed in this lithology. The packing of the framework grades upward from being close at the base to being patchy and loose at the top. This patchy distribution (Fig. 7G) reveals bioturbational activity.

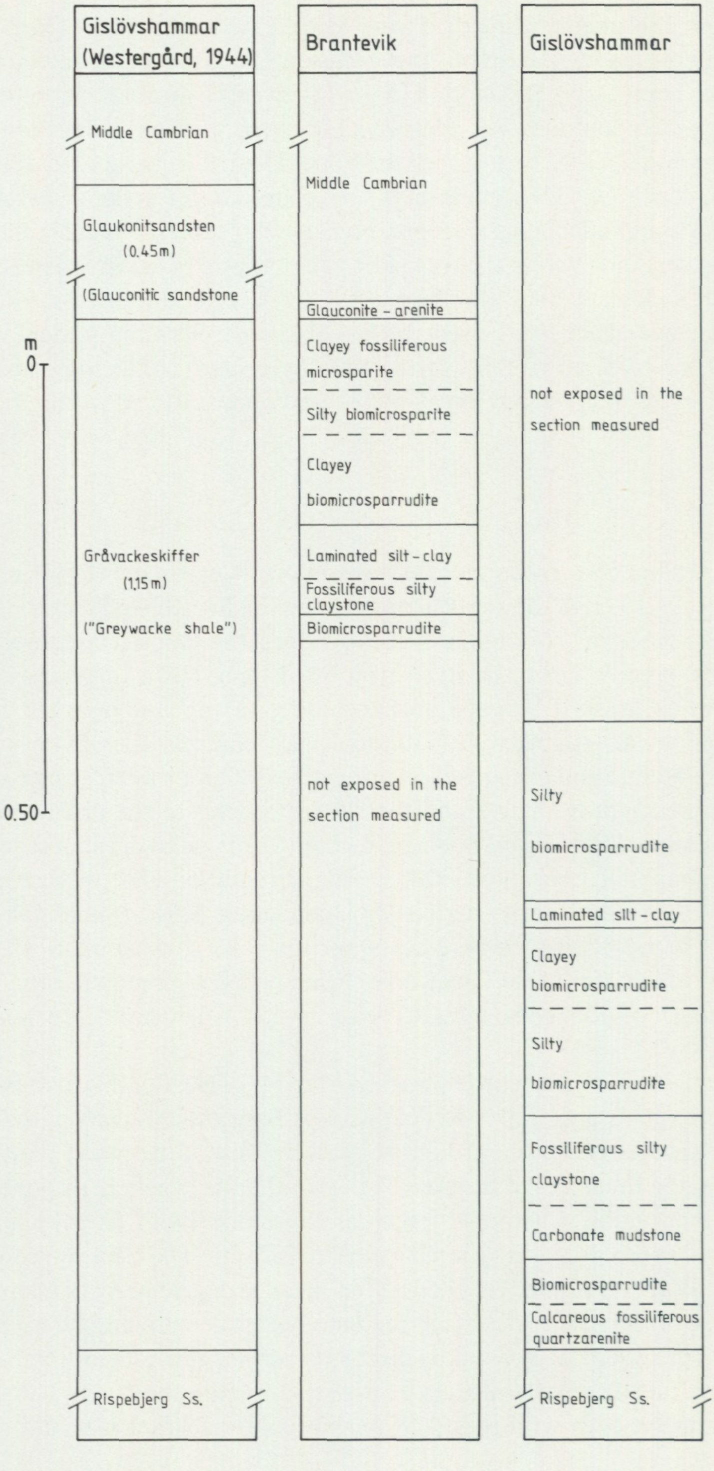
Intergranular solution and microstylolitic structures were developed in the clay-rich zones near the base of the sandstone. There the quartz sand-grains are of irregular shape (Fig. 7H) because of the large amounts of material dissolved.

The calcareous allochems are represented by very low amounts of calcitic fossil fragments scattered within the rock. Phosphatic clasts in the medium and coarse sand-size, and glauconite grains in the very fine to fine sand-sizes, are the non-calcareous allochems present in this lithology. Glauconitization as well as chemical replacement of the quartz-grains by calcite, producing corroded and embayed edges, was noticed. Small pyrite grains are scattered within the rock.

DISCUSSION AND CONCLUSIONS

From a drilling-core made at Gislövshammar, Westergård (1944) reported a thickness of 1.15 m for the strata lying between the Rispebjerg Sandstone and the glauconitic sandstone. 600 m north of this village, the exposed measured section, which lies directly above the Rispebjerg Sandstone, has a thickness of 70 cm. Therefore, as far as I can see and according to my findings, the following interpretation is possible. The lithological contact found between the glauconite-arenite and the underlying clayey fossiliferous microsparite at the top of the sequence at Brantevik and the similar contact in the drilling-core from Gislövshammar (Westergård 1944; see also Fig. 8), may allow an almost conclusive lithostratigraphical correlation in that horizon. In addition, the fossil content is not conclusive, as far as the exact correlation is concerned, as the *Holmia kjerulfi* Zone fossils are found only at the base of the section at Gislövshammar, whereas the remainder of this section and the whole of the section at Brantevik contain fossils characteristic of the beds with *Comluella?* (Jan Bergström, personal communication).

A water level of 24 cm below normal on May 14, 1979, after this manuscript had been sent to publication, allowed field work at Brantevik, in parts of the sections normally not accessible. About 30 m north of the described section 1 km south of Brantevik, the thickness of the strata between the Rispebjerg Sandstone and the base of the Middle Cambrian fragment limestone (with trilobite fragments determined as paradoxidids by Jan Bergström) is 76 cm. The black limestone at the top is 8–10 cm. The underlying beds differ in some degree in macroscopical view from those of the nearby described section. The glauconite-arenite is apparently missing. The difference will not be discussed further as a comparison can not be pursued on the microscopical scale. However, it is interesting to note that there is lateral variation both with regard to thickness of the lithologies and degree of


Gislövshammar (Westergård, 1944)
Middle Cambrian
Glaukonitsandsten (0.45m)
(Glauconitic sandstone
Gråvackeskiffer (1.15m)
("Greywacke shale")
Rispebjerg Ss.
m
0
0.50
Brantevik
Middle Cambrian
Glauconite - arenite
Clayey fossiliferous microsparite
Silty biomicrosparite
Clayey biomicrosparrudite
Laminated silt - clay
Fossiliferous silty claystone
Biomicrosparrudite
not exposed in the section measured
Gislövshammar
not exposed in the section measured
Silty biomicrosparrudite
Laminated silt - clay
Clayey biomicrosparrudite
Silty biomicrosparrudite
Fossiliferous silty claystone
Carbonate mudstone
Biomicrosparrudite
Calcareous fossiliferous quartzarenite
Rispebjerg Ss.

consolidation of the clayey sediments within the small area under discussion. Because of the above exposed, it is clear that there is lateral thickness variation of the sedimentary unit. However, as the contact between the Lower and Middle Cambrian at Gislövshammar is not exposed in the studied section, a complete and conclusive correlation between the sections at Brantevik and Gislövshammar is still not possible. Further information, e.g. from additional borings, is needed to attain to a definitive correlation.

As demonstrated in the text of Fig. 8 the uppermost Lower Cambrian south of Simrishamn, Scania, consists of a limestone sequence with intercalated layers of claystone, carbonate mudstone and unconsolidated terrigenous pelitic laminated sediments. This sequence is underlain by the Rispebjerg Sandstone and its basal layer is represented by a calcareous fossiliferous, phosphorite-bearing quartzarenite. This sandstone layer, 5–6 cm thick, changes gradually into the overlying biomicrosparrudite. The calcareous beds overlying this sandstone are chiefly clayey or silty biomicrosparites and biomicrosparrudites, presenting in general a low petrographic fossil diversity. The dominant fossil content in these limestones is trilobite carapaces. Echinoderm fragments are quite frequent in some layers. Chafetz (1978) reported trilobite carapaces, echinoderm fragments, brachiopod shells and, locally, abundant accumulations of sponge megascleres, as the dominant skeletal constituents of biomicrites deposited in a shallow marine environment, probably a subtidal shoal complex.

The limestone beds of this sequence have been extensively bioturbated. The calcareous mud was deposited in a calm, shallow marine environment outside of the influence of strong currents and wave action.

The variation observed in the faunal diversity between different carbonate layers are possibly related to changing conditions of the water circulation (cf. Barwis and Makurath 1978, Smosna and Warshauer 1978b).

The pyrite traces present throughout the sequence indicate slightly reducing conditions. These conditions are found to be most marked within both the claystone and carbonate mudstone layers and the uppermost limestone bed at Brantevik where larger amounts of pyrite are present. There, fenestrae filled by geopetal sediment and/or sparry calcite are common. Various theories have been proposed to explain the origin of the fenestrae and similar structures: decay of algal mats, gas pockets, water droplets, burrowing of organisms and shrinkage of sediments among others. Bird's eye and related structures in carbonate sediments are now almost invariably held to be characteristic of supratidal to shallow lagoonal carbonates (Folk 1973). Mountjoy (1975) considered that although fenestral fabrics

Fig. 8. Diagram showing possible lithostratigraphical correlation in the upper Lower Cambrian between the data from the drilling-core at Gislövshammar (Westergård 1944) and the measured exposed sections 600 m north of Gislövshammar and 1 km south of Brantevik, Scania.

alone are not diagnostic of an intertidal or supratidal environment, their association with definite subaerial features and their occurrence above shallow subtidal facies, clearly indicate that they represent sediments deposited near a shore line.

Baryte and celestite may occur as cement in sandstones or as replacement in limestones (Folk 1974). Baryte and celestite were reported by Hadding (1939). The former mineral was also noted by the same author in 1958. However, neither of these minerals was recorded in the Lower Cambrian strata. Celestite, gypsum, etc, may indicate semiarid climate with development of evaporitic tendencies and restricted circulation (cf. Folk 1974). Development of celestobaryte occurs at the top of the sequence.

The partially phosphatized uppermost limestone bed in the sequence at Brantevik is characterized by a general scarcity of fossil content, by calcite-filled fenestral structures and by a marked increase in the quantities of pyrite and is overlain by a glauconite-arenite deposit, probably a tidal channel-fill sediment. Furthermore, in the 1–2 cm basal layers of this sandstone, which compositionally range from glauconitic limestone to glauconite sandstone, celestobaryte has developed. The combination of the foregoing may suggest that this part of the sequence was deposited in a tidal flat environment with evaporitic tendencies in the last stage of its deposition.

The whole vertical lithological sequence discussed in this paper indicates an accumulation during a transgressive-regressive shift in the depositional environments.

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