THE MIDDLE ORDOVICIAN OF THE OSLO REGION, NORWAY 24. STAGE 4b AT LUNNER, HADELAND

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The paper deals with the Middle Ordovician stage 4b in the drift covered area around Lunner railway station. The sequence studied has a thickness of more than 170 m, and almost 160 m of this belongs to stage 4b. Lithologically it consists of alternating beds of biomicrite and silty shale. The percentages of the two rock types differ from level to level, and the biomicrite beds show a highly variable development. The beds are generally poorly fossiliferous, and few index fossils have been found. Faunal and lithological comparisons with the Oslo-Asker district (type district of the Oslo Region stages) is difficult because of the local development of the facies. The only lithological comparison possible is with substage 4bδ, where the similarity to the Oslo-Asker district is clear.

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This paper is one of several published by different authors on the Middle Ordovician of the Oslo Region. The fieldwork was carried out during the summers 1967–1969.

The Lunner area (as defined here) is a roughly 5×8 km large area transected by the railway line from Oslo to Gjøvik, and is part of the Cambro-Silurian district of Hadeland (cf. Størmer 1953). As the area is drift covered, stratigraphical work in the bedrock is usually only possible in road and railway sections.

The Precambrian peneplane dips westward below the Cambro-Silurian sedimentary beds in the NNE of the district. Further south, along the eastern and southern boundary, the sedimentary beds are in contact with Permian syenites and granites. The western boundary of the district is marked by the N-S Randsfjord fault of Permian age.

Several geologists have undertaken stratigraphical work in Hadeland. Much of the earlier modern work was done by Holtedahl, who (1912) described limestones of economic importance. Thereafter the map sheet of Gran appeared (Holtedahl & Schetelig 1923), and a description of the Middle and Upper Ordovician Series was given, based mainly on sections in the northwestern and southeastern parts of the district. A distinct difference in facies was noticed in the Middle and Upper Ordovician successions between the SE and the NW parts of the area, and it was this facies difference that Kiær (1926) studied.

Størmer (1943) dealt with both stratigraphy and tectonics, and later (1945) he published stratigraphical and palaeontological results from the same area. In this latter paper, Størmer discussed the facies problems, and introduced the term 'The Northern' and 'The Southern Development'.

More recently the Silurian rocks of the area have been discussed by Major (1946) and Hagemann (1957, 1966). The latest summary of the Ordovician stratigraphy is to be found in Størmer (1953).

Description of sections

Because of the thick glacial drift in the area, suitable stratigraphic sections are restricted to the railway cutting near Lunner station, and to a roadcut south of the station. In 1967, as a result of house building, some temporary exposures were available on the hill 300 m southwest of the station.

The railway section at Lunner

This section was briefly described by Størmer in 1945 (pp. 382–384), but it has since been greatly enlarged. Here a section on both sides of the railway, approximately 350 m south of the station, presents a 39.52 m thick profile through the Upper Chasmops Limestone (4bδ) and the lower part of the succeeding Tretaspis Shale (4cα) (Fig. 1).

No sharp boundary between the two substages is visible, there being a gradual transition from nodular limestones, through isolated limestone lenses, to shales. This is in contrast to the Oslo-Asker district (type district of the Oslo Region stages), where a sharp lithological boundary separates the Upper Chasmops Limestone and the Tretaspis Shale (Størmer 1953, pp. 65–69).

In describing the Lunner profile, Størmer mentions the possibility of a fault occurring in the section, but rejects it. However, it is obvious that a fault is present at 17.20 m above the base of the section (Fig. 2), and causes a repetition of about 10 m of the beds. Associated with the fault there is a Permian dyke which displaces the dip of the beds on either side of it. Between 7.90 m and 9.00 m in the profile, three distinctive beds with large ellipsoidal limestone nodules (30–70 cm in diameter) occur followed by a double limestone bed. These marker beds can be distinguished south of the fault between levels 17.95 m and 19.00 m, and can also be recognized elsewhere in the area.

Also present in the section on both sides of the fault, there is an intraformational conglomerate (3–5 cm thick) best exposed south of the fault above the 25.88 m level.

Fig. 3 shows the distribution of the fossils encountered. The lithology shown in the column to the left is based on the detailed sections.

Thus on lithological observations there is evidence of a repetition, but unfortunately there is no definite faunal evidence except for the presence of an *Echinosphaerites* sp. This occurs north of the fault from 9.95 m to 14.30

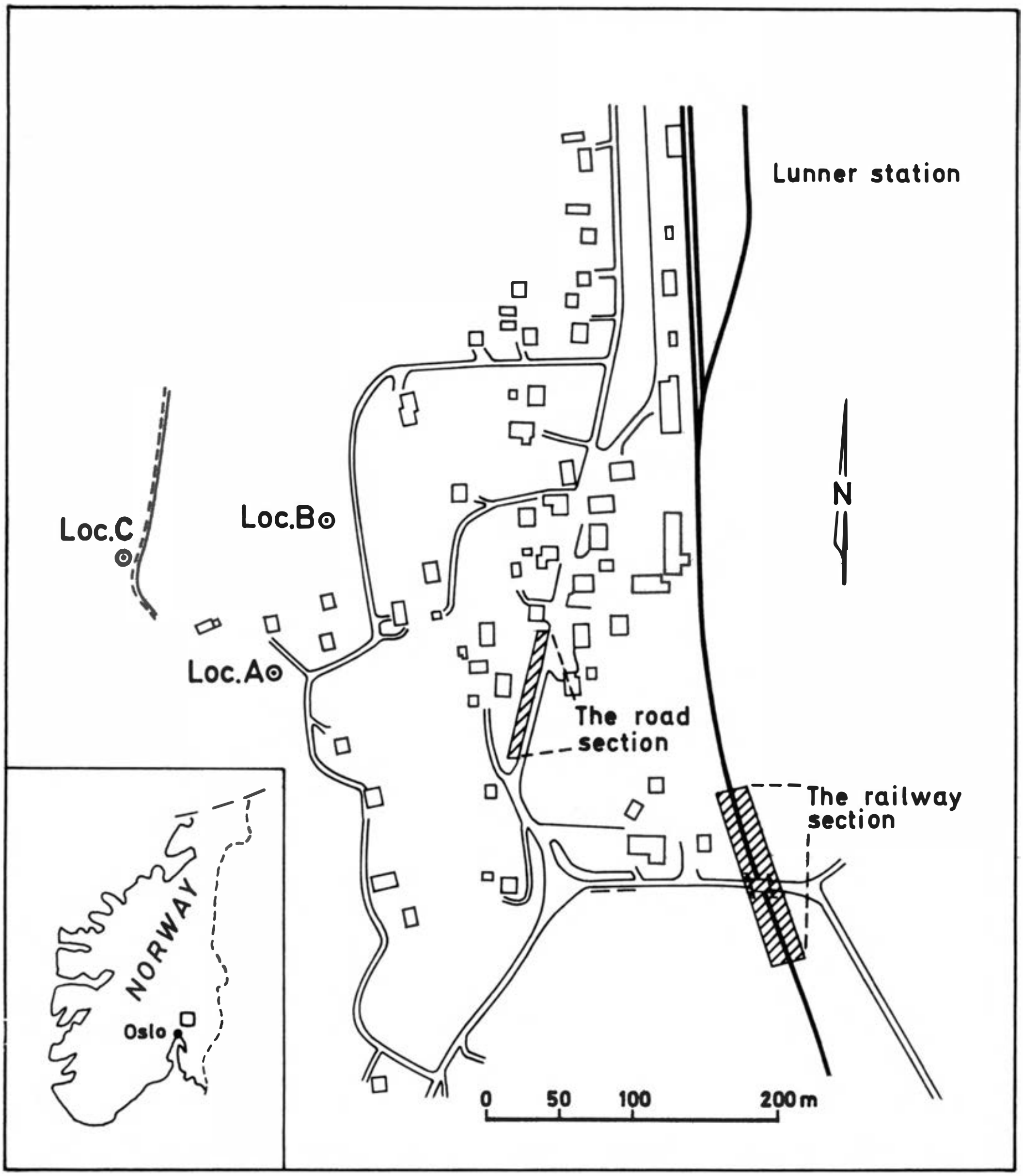

Fig. 1. Map showing the area around Lunner railway station at Hadeland, with the localities described herein.

m and south from 19.83 m to 23.25 m, and in the same position relative to the mentioned marker horizons. This suggests a repetition of approximately 10 m of beds belonging to the Upper Chasmops Limestone.

The boundary between 4bδ and 4cα is difficult to distinguish on faunal evidence, but Størmer (1945, p. 384) suggested that it is about 20 m above the base of the section. He listed *Tretaspis seticornis* as being found about

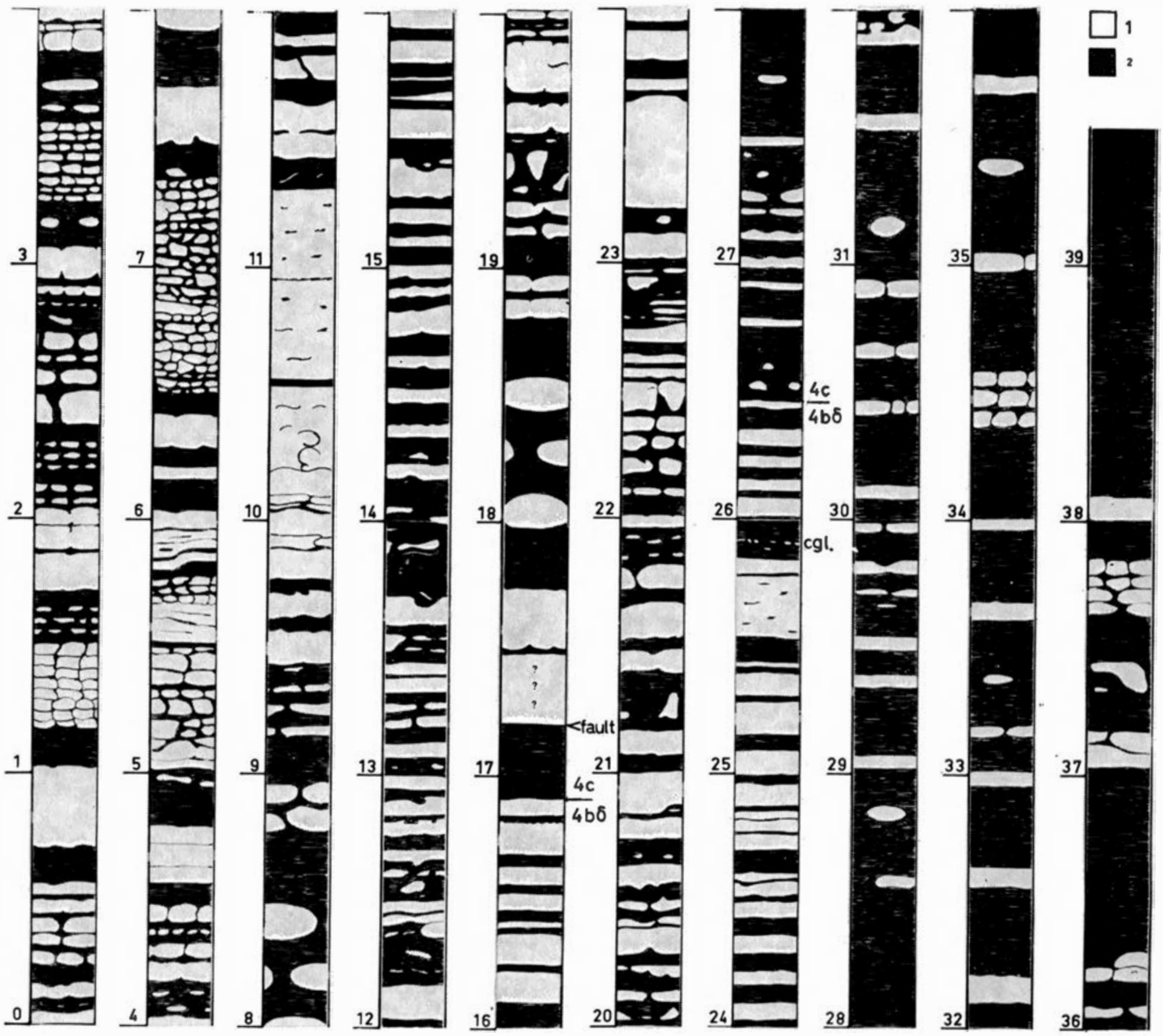

Fig. 2. Railway section south of Lunner station. Diagrammatic representation of the sedimentary structures in the section. Legend: 1. biomicrite; 2. silty shale. Numbers refer to height in metres above base.

22 m above the base of the section, but after examining his field notes and discussing this with him, it would appear that he found it at 34 m and not at 22 m above the base. This supports my collection of *Tretaspis seticornis* from level 35.70 m. Kiær (1926, p. 3) lists *Diplograptus* sp., *Dicellograptus* sp. (=*D. pumilus;* see Størmer 1945, p. 384) and *Leptograptus flaccidus* from the lowest part of the shale south of Lunner station. I have found poorly preserved species of *Dicellograptus* from level 38.67 m above the base of the section.

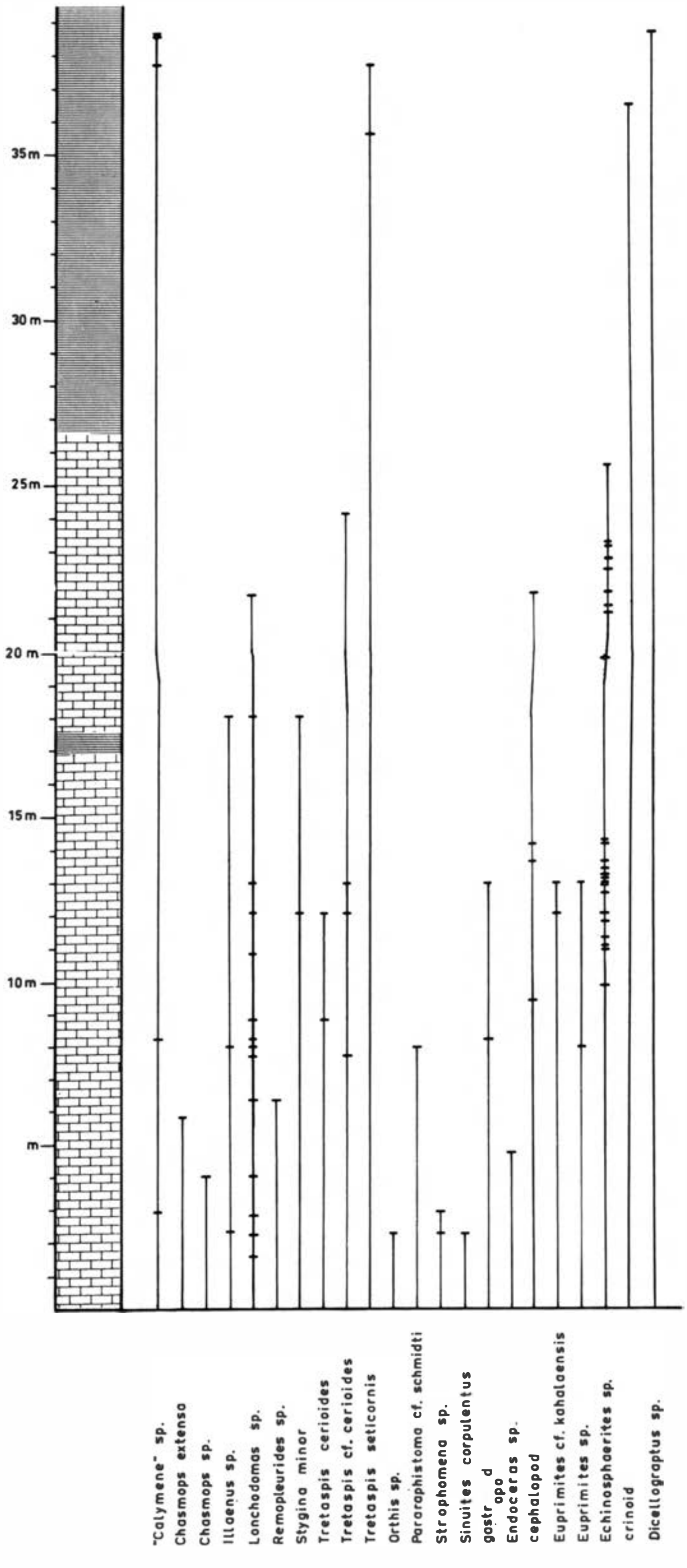

Fig. 3. Railway section south of Lunner station. Diagram showing fossil distribution in the section. The small black, horizontal lines show where the different fossils were collected.

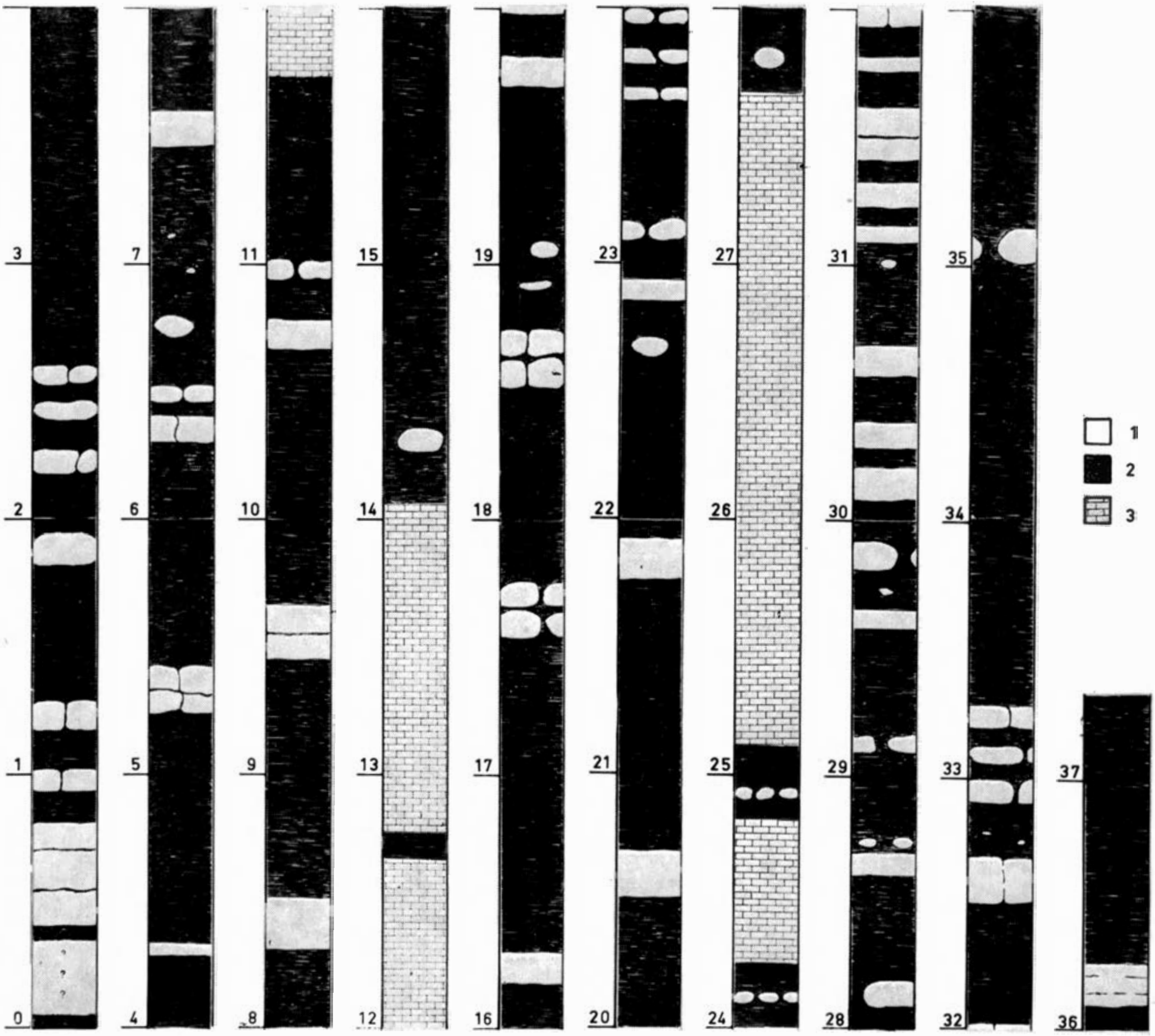

Fig. 4. Road section south of Lunner station. Diagrammatic representation of the sedimentary structures in the section. Legend: 1. biomicrite; 2. silty shale; 3. nodular limestone (biomicrite and silty shale, but the structures cannot be studied). Numbers refer to height in metres above base.

Thus both graptolites and *Tretaspis seticornis* only indicate that from 35.70–38.67 m we have characteristic 4c faunal elements. On lithological evidence the boundary can be placed even lower.

North of the fault a change in lithology between predominant limestone with subordinate shale below, and dominant shale above, occurs at 16.90 m (Fig. 2). South of the fault the increase in shale relative to limestone is seen at 26.47 m (Fig. 2). The transition south of the fault starts 0.43 m lower than north of the fault, the reason perhaps being the result of differences in com-

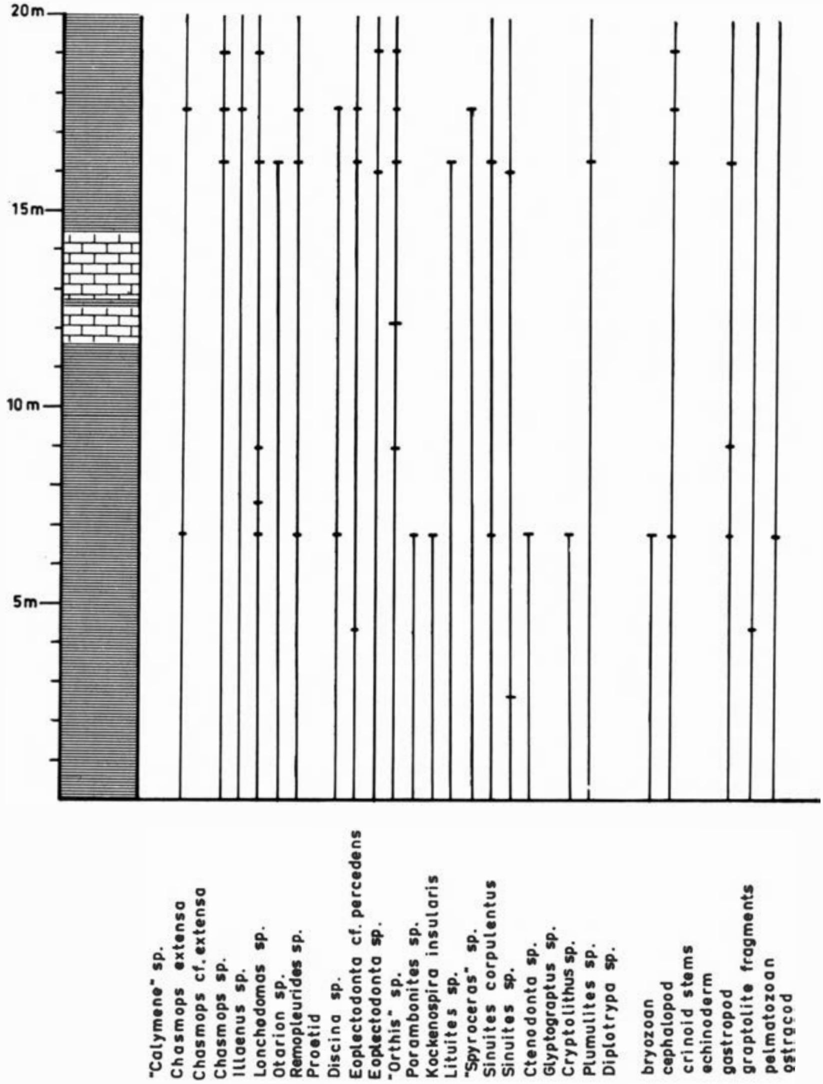

Fig. 5. Road section south of Lunner station. Diagram showing fossil distribution in the lowermost 20 m of the section. The small black, horizontal lines show where the different fossils were collected. Continued on Fig. 6.

pression or that the limestone beds thin out laterally. The lithology suggests a boundary at 16.90 m (26.47 m). However, the conglomerate at 25.88 m must also be taken into account. This horizon represents a break in sedimentation, and could be interpreted as a result of the orogenic disturbances which Vogt (1928, p. 107, 1945, p. 522) called the 'Ekne disturbance'. This disturbance is also mentioned from several other localities in the Oslo Region, and Størmer (1967, p. 204) suggests the influence of this disturbance throughout the Oslo Region. In my opinion, the intraformational conglomerate would have been a suitable boundary if it had not been overlain by lime-

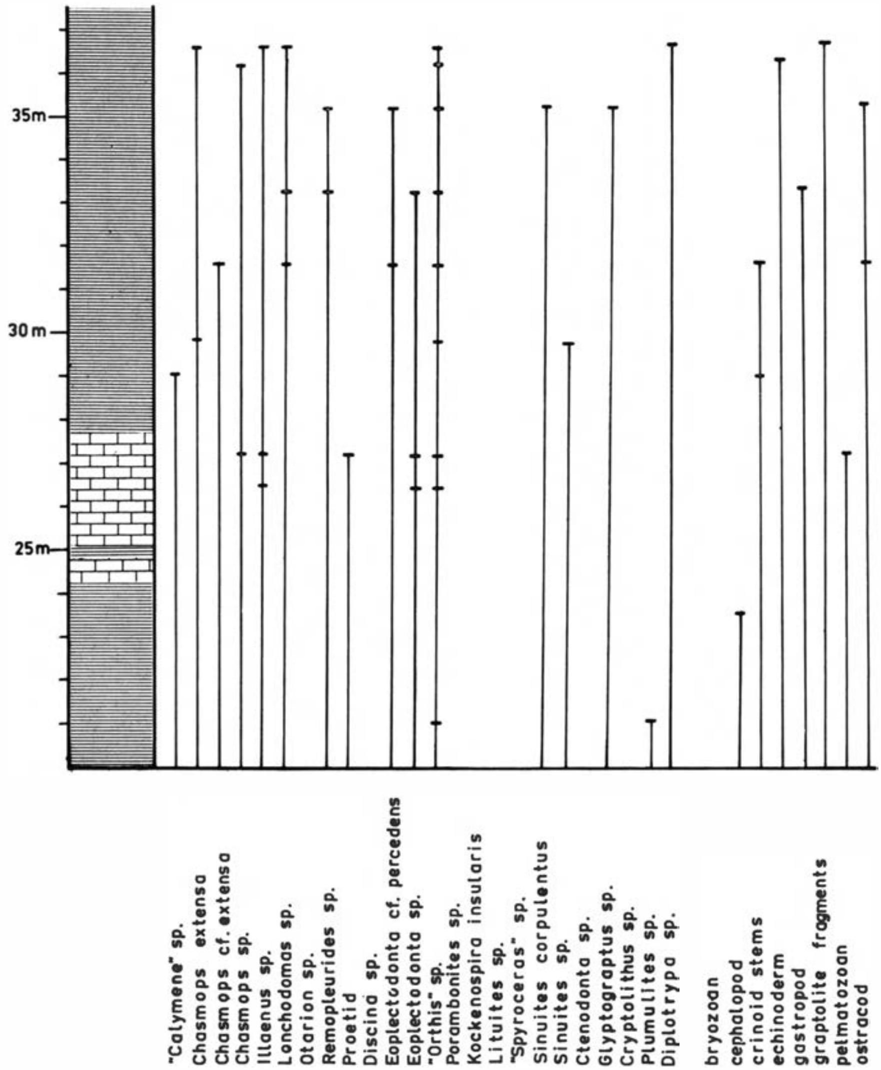

Fig. 6. Road section south of Lunner station. Diagram showing fossil distribution in the section between 20 and 37.32 m. Continued from Fig. 5.

stone, but since there is a lithological boundary at 16.90 m, the boundary between 4bδ and 4cα should be placed at this level.

The actual base of 4bδ is missing in the section, but is exposed in a small section about 100 m to the west. Here the boundary with the shale below is very sharp, and the total thickness of 4bδ, with the upper boundary as suggested here, is approximately 17.5 m.

The road section at Lunner

A partly overgrown section is located on the west side of the main road to the south of Lunner railway station (Fig. 1). This section provides the best information on the sequence below that already described. Two 'gaps' occur in the section where it is overgrown and cannot be studied in detail. The gaps comprise nodular limestones similar to those already described in the railway section. Each gap also contains a shaly intercalation (Fig. 4).

In this section, 37.32 m of Middle Ordovician beds are exposed. There is a minor fault in the section at 28.05 m above base, but no repetition of the beds occurs. Silty shale with limestone beds and nodules dominate, and the two gaps mentioned above are both located on the same side of the fault.

The faunas (Figs. 5 and 6) are insufficient for an exact stratigraphical correlation, but some information is provided. *Eoplectodonta* cf. *percedens,* not earlier recorded from Hadeland, occurs at several horizons in the section. Spjeldnæs (1957, p. 103) lists it from the districts of Oslo-Asker, Ringerike and Skien-Langesund, and states that it is common in 4bα and 4bβ, although it also occurs in the lower part of 4bγ.

According to Yochelson (1963, p. 157), *Sinuites corpulentus* occurs in Hadeland in 4bα and 4bβ. In Asker it also occurs in 4bγ (I have found *S. corpulentus* in 4bδ in Hadeland). *Kockenospira insularis* is recorded by Yochelson (1963, p. 171) from 4aα at Bygdøy, and from stage 4c in Hadeland. *Chasmops extensa* occurs throughout the whole section, indicating that the beds may be correlated with 4bγ or 4bδ in the Oslo-Asker district.

Minor localities

In addition to the two sections already described, there are also some minor exposures in the area. They are located on the hillside SW and W of Lunner station (Fig. 1).

In the three localities described here, silty shale is the dominant rock type, but biomicrite is also present both as nodules and continuous beds. In two of the localities (A and B), houses were under construction and fossils were collected from the excavated material.

Locality A. Fossils were taken from heaps of excavated rock material composing both silty shale and biomicrite. The following were found: *Chasmops extensa, Chasmops* aff. *extensa, Chasmops* sp., *Illaenus* cf. *glaber, Illaenus* sp., *Lonchodomas* sp., *Remopleurides* sp., *'Calymene'* sp., *Strophomena (Gunnarella)* cf. *rigida, Rafinesquina* cf. *ungula, Diplotrypa* sp., *Lituites* sp., a crinoid *(Pentagonocyclicus),* cephalopod, gastropod and a pelecypod.

Chasmops extensa is the only trilobite in this locality of any stratigraphical value, suggesting the presence of 4bγ or 4bδ. According to Spjeldnæs (1957, pp. 133, 203) *Rafinesquina (Hedstroemina) ungula* occurs in 4bα, 4bβ and 4bγ in the Ringerike district, and *Strophomena (Gunnarella)* cf. *rigida* in 4bδ_2 in the same district.

Locality B. This was also a construction site and the fossils collected included: *Chasmops* aff. *extensa, Chasmops* sp., *Illaenus* sp., *Lonchodomas*

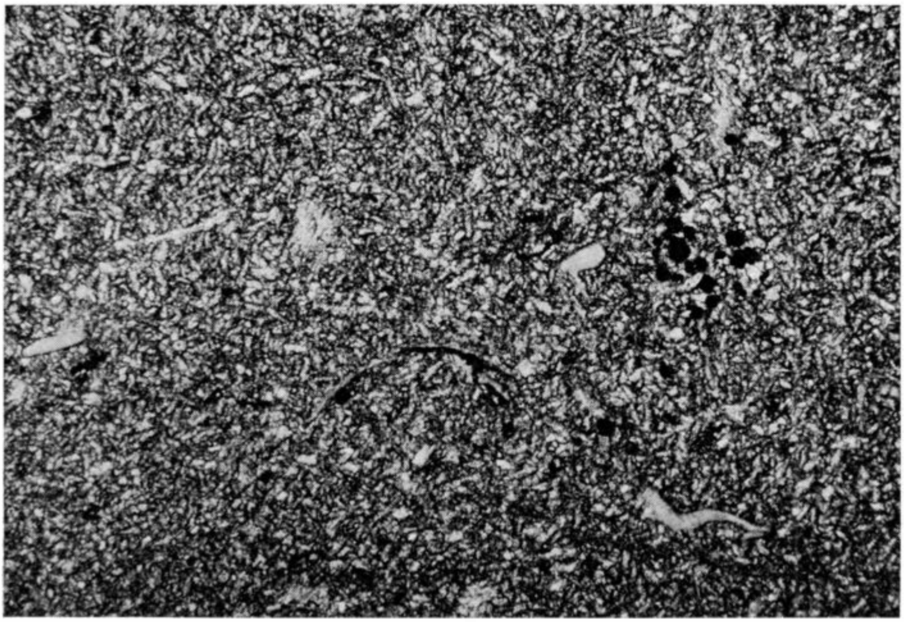

Fig. 7. Typical biomicrite from stage 4b in the Lunner area. Both fossil fragments and pyrite crystals are present. × 36.

sp., *'Calymene'* sp., *Kjerulfina* cf., *foliovalve, Leptaena* cf. *strandi, 'Orthis'* sp., *Diplotrypa* sp., *Sinuites corpulentus,* a crinoid, gastropod and a pelecypod.

Again, with the exception of *Chasmops* aff. *extensa,* the trilobites give little stratigraphical information. According to Spjeldnæs (1957, p. 156), *Kjerulfina foliovalve* occurs in 4bγ in the Oslo-Asker district, but specimens described by Spjeldnæs from Hadeland and Ringerike were too fragmentary to be referred to this species with absolute certainty. *Leptaena strandi* also occurs in the same horizon (4bγ) in the Asker district, but is found in 4bα in Ringerike.

Locality C. This locality is an exposure beside a footpath on the hillside SW of Lunner railway station. The exposure comprises a 1 m thick section of horizontally bedded silty shales with nodules of biomicrite. The beds are more fossiliferous than elsewhere in the area, and the following fossils were found: *Chasmops* aff. *extensa, Chasmops* sp., *Lonchodomas* sp., *Remopleurides* sp., *'Calymene'* sp., *Ptychoglyptus* cf. *valdari, Rafinesquina* cf. *ungula, Strophomena (Gunnarella)* sp., *'Orthis'* sp., *Lituites* sp., *Endoceras* sp., *Ctenodonta* sp., *Sinuites corpulentus, Sinuites* cf. *corpulentus, Pararaphistoma* sp., echinoderm fragment, a gastropod, ostracod and a pelecypod.

The trilobites again provide little information on the age of these beds, and one must rely on the brachiopods. Spjeldnæs (1957, p. 61) states that

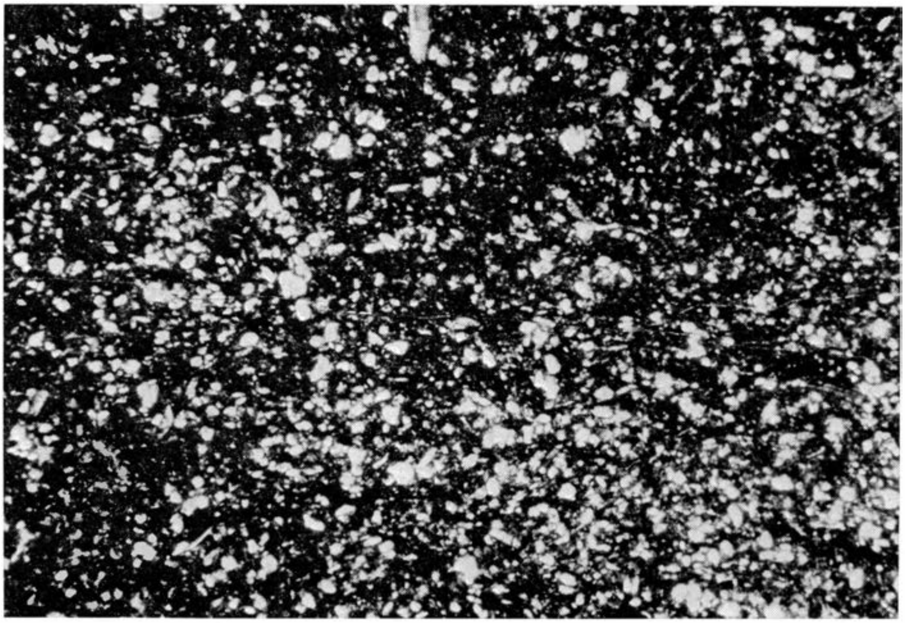

Fig. 8. Typical thin section of a silty shale from stage 4b. × 36.

Ptycoglyptus valdari is common in the upper part of 4bα in the Oslo-Asker district, and in Ringerike and Hadeland some large specimens occur in the same zone. *Rafinesquina (Hedstroemina) ungula* occurs in 4bα, 4bβ and 4bγ of the Ringerike district.

Lithology

Limestones

Samples were taken at 1 m intervals throughout the railway section. Soluble carbonate was determined according to a method described by Ellingboe & Wilson (1964). All samples contained between 55 % and 86 % $CaCO_3$.

Samples for thin section studies were taken throughout the sections described, and all thin sections studied consist of fine-grained micritic carbonate. The larger calcite grains all consist of fossil material (Fig. 7), some of them partly recrystallized. Quartz grains are seen in all the thin sections, but quartz does not constitute more than 1–5 % of the total rock. All quartz grains are of silt size (Wentworth 1922). Pyrite is also seen in all the samples, but as a secondary mineral with well-defined crystals of highly variable size; in total, pyrite constitutes less than 1 % of the rock. The three minerals mentioned above can easily be detected in microscope, but the matrix is too fine-grained for microscope study. Samples were therefore investigated with an X-ray diffractometer, and besides the minerals already mentioned, dolomite, illite and chlorite are present, the latter only in small amounts.

Shales

Samples for carbonate determination were sampled in the railway section, and treated as described for the limestone above. The shales contained from 8 % to 38 % $CaCO_3$.

In thin sections one can see that the shales are composed of two components – grains and matrix. Although the grains are easily identified in microscope, the matrix is too fine-grained for thin section study (Fig. 8). The grains are mainly quartz, but secondary pyrite also occurs. Fossil fragments are considerably larger than the mineral grains, and they often occur parallel to the lamination. Their size is highly variable, and fragments up to about 2 cm are not uncommon. The quartz grains are all of silt size.

The X-ray diffractometer studies show that, besides the minerals already mentioned, illite and chlorite are present in the matrix. At the top of the railway section, smaller amounts of feldspar were detected. Pointcounting of a sample from the 27.10 m level of the railway section, whose composition is typical for the silty shale, gave the following results:

Matrix	70 %
Quartz grains	24 %
Fossil fragments	4 %
Pyrite	2 %
Total	100 %

Intraformational conglomerate

Study of the conglomerate in the Lunner railway section shows that the pebbles consist of biomicrite, while the matrix is a silty shale. The larger pebbles have a maximum diameter of about 2 cm. The conglomerate is evidently intraformational (Fig. 9).

Stratigraphy

The development of stage 4b in the exposures around Lunner railway station is shown in Fig. 10. The total thickness of the sequence studied is about 170 m, but only the upper part of the succession (in the railway and road sections) can be correlated with other districts with any accuracy.

Starting with the railway section, and working downwards in the sequence, there is a lithological resemblence to the 4bδ beds in the Oslo-Asker. The thickness is almost the same in both districts (Oslo-Asker, 10–12 m and 17 m; Hadeland, 17.5 m). Below the nodular limestone of 4bδ in Hadeland, there is a marked lithological change to silty shale (Fig. 10 about 140 m

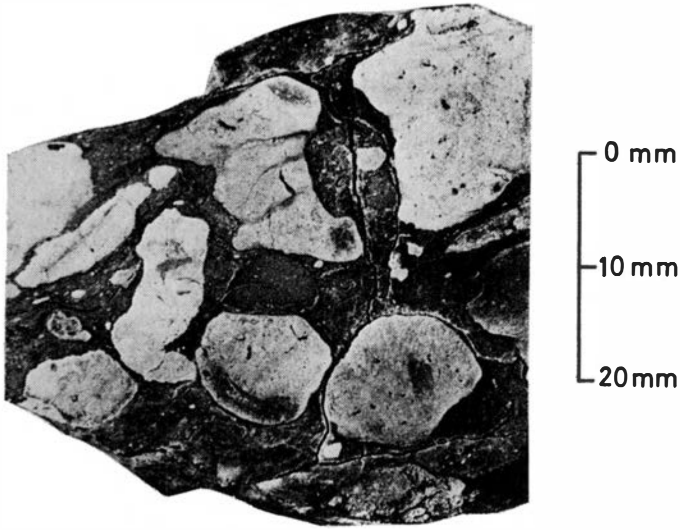

Fig. 9. Intraformational conglomerate, consisting of biomicrite pebbles in a matrix of silty shale. Rock surface etched with HCl.

above base). The shales are 7.60 m thick and are underlain in the succession by a 4.95 m thick nodular limestone. The junction between these beds and those of the road section is not exposed, and beds below those in the road section are only exposed in the localities A, B, and C. A minor fault is seen in the road section, but there is no repetition of beds. The thickness measured here (37.32 m) is a minimum, because beds might be missing.

While there are good indications of substage 4bδ and stage 4c in the faunas of the railway section, it is more difficult to correlate the beds below. Some fossils indicate 4bγ or lower beds. There is a break in the exposed succession between the road section and the section at Locality A, but loose fragments of silty shale are common. The fossil list of Locality A shows that the faunas here are represented by fossils common throughout stage 4b, and few of them are good index fossils. The rather similar faunas of Locality B and C barely suggest different stratigraphical levels. The nodular limestone horizon of 8.5 m between the Locality A and B sections (Fig. 10 about 50 m above base), represents a poorly exposed locality in a footpath, where no fossils were found.

The investigations show that the facies of 4b in the Lunner area is to a great extent local; thus the nodular limestone of 4bβ found in other districts seems to be missing. The faunas are distinctly Middle Ordovician, but none of the substages in the Oslo-Asker district can be recognized in the silty shales below substage 4bδ. This is probably the result of uniform sedimentation throughout the major part of 4b, with stable bottom conditions. Both the biomicrite and the silty shale contain quartz grains of the same size (silt), and even if the amount differs, this might indicate similar sedimentation

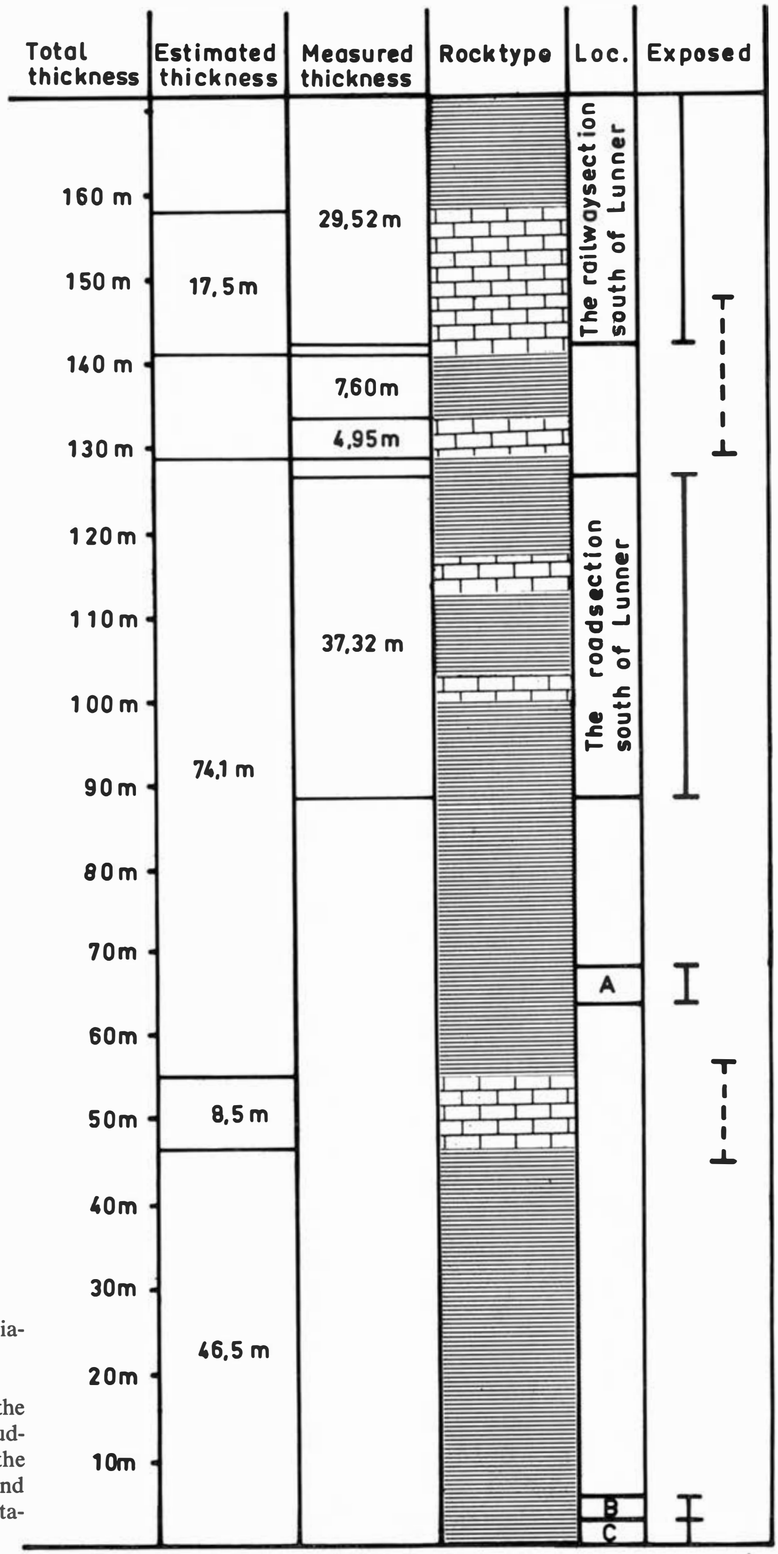

Fig. 10. Diagrammatic representation of the sections studied in the area around Lunner station.

conditions for both rock types. No signs of current or wave activity were seen in the sediments, and one must therefore look upon them as deposited below wave base. The stable bottom conditions favoured the fauna already existing, and no faunal change resulted.

If no unobserved faults exist in the sequence, the complete thickness of 4b in the Lunner area amounts to at least 159 m (lower boundary not known). Of this the upper 17.5 m belongs to 4bδ, while the rest, 141.5 m, represents one or more zones which cannot be distinguished in the area.

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REFERENCES

Ellingboe, J. & Wilson, J. 1964: A quantitative separation of non-carbonate minerals from carbonate minerals. *Jour. Sedimentary Petrology 34,* 412–418.

Hagemann, F. 1957: On the petrography of the Silurian shales from Hadeland, Norway. *Norsk geol. tidsskr. 37,* 229–246.

Hagemann, F. 1966: Silurian Bentonites in the Oslo Region. *Norges geol. undersøkelse 242,* 44–61.

Holtedahl, O. 1912: Kalkstensforekomster i Kristianiafeltet. *Norges geol. undersøkelse 63.*

Holtedahl, O. & Schetelig, J. 1923: Kartbladet Gran. *Norges geol. undersøkelse 97.*

Kiær, J. 1926: Sphaeronidkalken paa Hadeland. *Norsk geol. tidsskr. 9,* 1–22.

Major, H. 1946: Noen profiler fra eldste silur i Oslofeltets nordlige del. *Norsk geol. tidsskr. 26,* 59–142.

Spjeldnæs, N. 1957: The Middle Ordovician of the Oslo Region, Norway. 8. Brachiopods of the Suborder Strophomenida. *Norsk geol. tidsskr. 37,* 1–214.

Størmer, L. 1943: Kaledonsk dekke-tektonikk på Hadeland? *Norsk geol. tidsskr. 22,* 74–91.

Størmer, L. 1945: Remarks on the Tretaspis (Trinucleus) shales of Hadeland. *Norsk geol. tidsskr. 25,* 379–426.

Størmer, L. 1953: The Middle Ordovician of the Oslo Region, Norway. 1. Introduction to stratigraphy. *Norsk geol. tidsskr. 31,* 37–141.

Størmer, L. 1967: Some aspects of the Caledonian geosyncline and foreland west of the Baltic Shield. *Quart. Jour. geol. Soc. London 123,* 183–214.

Vogt, Th. 1928: Den norske fjellkjedes revolusjonshistorie. *Norsk geol. tidsskr. 10,* 97–115.

Vogt, Th. 1945: The geology of part of Hølonda-Horg District, a type area in the Trondheim Region. *Norsk geol. tidsskr. 25,* 449–528.

Wentworth, C. K. 1922: A scale of grade and class terms for clastic sediments. *Jour. Geology 30,* 377–392.

Yochelson, E. L. 1963: The Middle Ordovician of the Oslo Region, Norway. 15. Monoplacophora and Gastropoda. *Norsk geol. tidsskr. 43,* 133–213.

The Middle Ordovician of the Oslo Region, Norway

All published in Norsk Geologisk Tidsskrift (N.G.T.).

No.

1. L. Størmer: Introduction to Stratigraphy. N.G.T. 31, pp. 37–141. Bergen 1953.
2. D. Hill: Some Rugose and Tabulate Corals. N.G.T. 31, pp. 143–168, pls. 1–5. Bergen 1953.
3. N. Spjeldnæs: Graptolites dating the Beds below the Middle Ordovician. N.G.T. 31, pp. 171–184, pl. 1. Bergen 1953.
4. G. Henningsmoen: Ostracoda. N.G.T. 32, pp. 35–56, pls. 1–5. Bergen 1953.
5. S. Skjeseth: The Trilobite Family Styginidae. N.G.T. 35, pp. 9–28, pls. 1–5. Bergen 1955.
6. F. Hagemann & N. Spjeldnæs: Notes on Bentonites (K-bentonites) from the Oslo-Asker District. N.G.T. 35, pp. 29–52. Bergen 1955.
7. F. Nikolaisen: Trilobites of the Suborder Cheirurina. N.G.T. 41, parts 2–4, pls. 1–4. Bergen 1961.
8. N. Spjeldnæs: Brachiopods of the Suborder Strophomenida. N. G. T. 37, h. 1, pp. 1–214, pls. 1–14. Bergen 1957.
9. N. Spjeldnæs: Brachiopods of the Family Porambonitidae. N.G.T. 37, h. 2, pp. 215–228, pl. 1. Bergen 1957.
10. W. C. Sweet: Nautiloid Cephalopods. N.G.T. 38, h. 1, pp. 1–178, pls. 1–21. Bergen 1958.
11. H. & T. Soot-Ryen: Pelecypoda. N.G.T. 40, part 2, pp. 81–122, pls. 1–4. Bergen 1960.
12. H. Soot-Ryen: Notostraca and Conchostraca. N.G.T. 40, part 2, pp. 123–132, pl. 1. Bergen 1960.
13. G. Henningsmoen: Trilobites of the Family Asaphidae. N.G.T. 40, parts 3–4, pp. 203–257, pls. 1–14. Bergen 1960.
14. F. Nikolaisen: The Trilobite Family Telephinidae. N.G.T. 43, part 3, pp. 345–399, pls. 1–4. Bergen 1963.
15. E. L. Yochelson: Monoplacophora and Gastropoda. N.G.T. 43, part 2, pp. 133–213, pls. 1–8. Bergen 1963.
16. W. B. N. Berry: Graptolites of the Ogygiocaris Series. N.G.T. 44, part 1, pp. 61–170, pls. 1–16. Bergen 1964.
17. G. Hamar: Conodonts from the Lower Middle Ordovician of Ringerike. N.G.T. 44, part 2, pp. 243–292, pls. 1–6. Bergen 1964.
18. F. Nikolaisen: Rare Trilobites of the Families Olenidae, Harpidae, Ityophoridae and Cheiruridae. N.G.T. 45, part 2, pp. 231–248, pls. 1–4. Oslo 1965.
19. D. L. Bruton: The Trilobite Family Odontopleuridae. N.G.T. 45, part 3, pp. 339–356, pls. 1–3. Oslo 1965.
20. K. Bjørlykke: The Geochemistry and Mineralogy of some Shales from the Oslo Region. N.G.T. 45, pp. 435–456. Oslo 1965.
21. H. Soot-Ryen: A New Pelecypod of the Genus Palaeosolen, Hall, 1885. N.G.T. 46, part 1, pp. 21–26, pl. 1. Oslo 1966.
22. G. Hamar: Preliminary Report on Conodonts from the Oslo-Asker and Ringerike Districts. N.G.T. 46, part 1, pp. 27–83, pls. 1–7. Oslo 1966.
23. R. M. Owens: The Trilobite Family Proetidae. N.G.T. 50, No. 4, pp. 309–332, 4 pls. Oslo 1970.
24. Ø. Lauritzen: Stage 4b at Lunner, Hadeland. N.G.T. 53, no. 1, pp. 25–40. Oslo 1973.