

AN ALLERØD FAUNA AT OS, NEAR BERGEN, NORWAY

By

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In the summer 1961 excavations were carried out on the eastern bank of the Os-river at Lundetre about one kilometer north of the village of Os, south of Bergen. (Figs. 1 and 2). The altitude of the site was about 20 m above present sea level. The material which was removed, to give space for buildings, consisted largely of clay, containing a certain amount of shells, mainly of molluscs.

When the author arrived at the site, most of the clay had been removed and dumped at a dumping place at Osøyri, and a rocky head-wall, almost vertical and about 13 m high had been uncovered and exposed. On the flat ground above the cliff, and resting on a rocky surface, was a deposit of till, about 2 m thick which seemed to have covered the removed deposit. (Plate I, fig. 1).

From a distance the rocky wall could be seen to have a whitish tinge, which by close inspection was found to be due to a cover of lime, a few millimetres thick and on the surface consisting mainly of the skeletons of bryozoa. There were also numerous circular basal plates and a number of more or less whole skeletons of barnacles, tests of serpulides, and bivalves. The attached fauna was very well preserved and seems to have escaped destruction by the over-riding glacier due to its particular protected position.

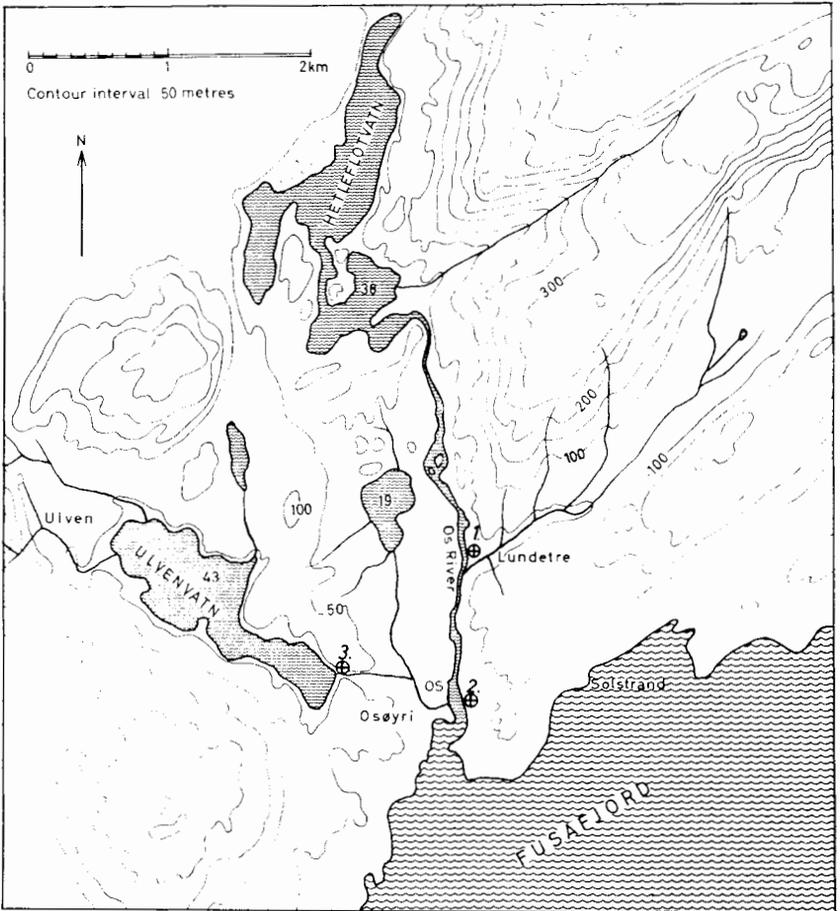


Fig. 1. Map of Os area. Numbers indicating fossil finds.

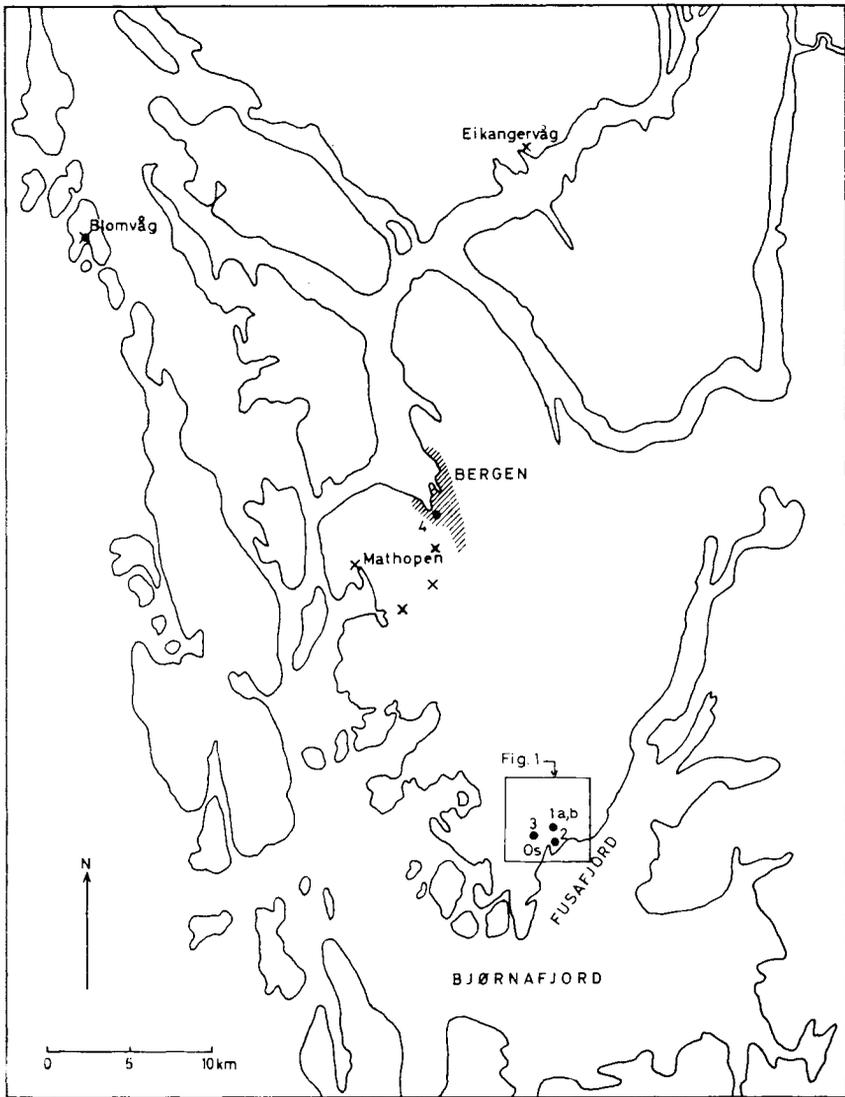


Fig. 2. Map of Bergen—Os area. Circles indicating fossil finds which have been radiocarbon dated. Crosses showing some previously known localities of shelly moraine.

The fossil fauna on cliff

(Plate I, 2, Plate II, 1, 2, Plate III, 1).

The most abundant fossils present on the rock face were bryozoa. These were kindly examined by Dr. J. S. Ryland, Fisheries Laboratory, Lowestoft, who found the following four species:

Cribrilina annulata var. *spitsbergensis* Norman

Microporella arctica Norman

Hemicyclopora polita (Norman)

Escharoides jacksoni (Waters)

The cirripeds were represented by the species *Balanus balanus* Linné and the molluscs by the species *Saxicava arctica*, Linné.

Age of fossils and ecological conditions.

A radiocarbon dating was carried out on the bryozoan lime layer at the Radiological Dating Laboratory, Trondheim (NYDAL, 1962), and the age was found to be 11.700 ± 230 years. Accepting this result the attached fauna lived during the Allerød interval of the Late Glacial period.

With regard to ecological conditions the bryozoa present are similar to those of the High Arctic today.

Cribrilina annulata var. *spitsbergensis* is, according to Nordgaard, (NORDGAARD, 1918), recorded from the White Sea, and is also known from Franz Josef Land, the Kara Sea, Spitsbergen and Greenland, while it has not been obtained from Norwegian waters, but Nordgaard considers it possible that it might be found in the fjords of Finnmark.

Microporella arctica is also an arctic form, in Norway recorded from Tromsø and Havøsund, and from Vadsø (NORMAN, 1903).

Hemicyclopora polita has been obtained at several places on the Norwegian coast, from Boknfjord off Stavanger to Hammerfest in Finnmark. It occurs in the Bergen area today in deep water (Ryland, personal comm.), and is known from Spitsbergen and Greenland.

Escharoides jacksoni is described by Nordgaard from Finnmark at depths ranging from 100 m to 300 m. Outside Norway it is known from Franz Josef Land, King Karl Land, Greenland and the North American Polar Archipelago at depths from ca. 20 m to 350 m. Nordgaard has

also recorded this species in glacial clay at Strandheim in Orkedalen, 10–15 m above present sealevel (NORDGAARD, 1907). With regard to the barnacle *Balanus balanus*, this species is at present very abundant in the northern hemisphere, on the European side of the Atlantic from Franz Josef Land to the British Channel, and is found at depths ranging from a couple of metres to about 300 m (Stephensen, 1933).

The fossils present in clay

The most abundant fossils in the clay were bivalves and of these the most important were the following:

Mya truncata, Lin., *Saxicava arctica*, Lin., *Saxicava pholadis*, Lin., *Macoma calcarea*, Chem., *Lepeta coeca*, Müll. One valve of *Leda pernula*, Müll, not too well preserved, was also found, as well as the cast of the plates of an echinoid, probably *Strongylocentrotus droebachiensis*, (Plate III, 2).

Age and ecological conditions.

A radiocarbon dating was carried out on shell material from the marine clay, (NYDAL, 1962) and the result was 10.050 ± 250 years. This dates the shell material to the Younger Dryas stage, which seems to tally well with the composition of the fauna which is of arctic — boreoarctic character.

Of the species found at Lundetre *Saxicava arctica*, *Macoma calcarea*, *Lepeta coeca* and *Leda pernula* are all important in the Late Glacial Yoldia clay in the Oslo area described by Brøgger (BRØGGER, 1900), and *Saxicava pholadis* is known from the Yoldia clay of the Trondheim area. All species have also been described from the Yoldia clay described by C. F. Kolderup from Vindenes on the east side of Fusa-fjord, Os (KOLDERUP, 1907).

Other radiocarbon-dated deposits in the Bergen—Os area

In Fig. 2 is shown the location of radio-carbon-dated fossiliferous deposits in the Bergen—Os area. Besides the two mentioned samples from Lundetre (number 1 a and b) there are 3 more deposits which have been C^{14} dated:

2. At Osøyri, east of the Os river, along the main road to Hatvik, a clayey till was found to contain fragments of marine shells. Shell-fragments of *Mya truncata*, the most abundant species in the deposit gave an age of 10.150 ± 300 years (NYDAL, 1962).

3. At the south-eastern end of the lake Ulvenvann shell fragments occurring in glacial till, 40 m above present sealevel, were found to have an age of 11.500 ± 300 years (NYDAL, 1960).

4. Shells of *Pecten islandicus* and *Mya truncata*, found in glacial till at the site of the University Buildings, Florida, Bergen, were found to have an age of 11.700 ± 150 years (Nydal, pers. comm.).

It appears that with the exception of the dated samples from Lundetre all the dated shells have been found in glacial till.

Glacial till containing more or less fragmented shells, mainly of molluscs, has long been known from the Bergen area. REKSTAD (1900) describes shells of molluscs in till at Møhlenpris and assumes an Interglacial age. C. F. KOLDERUP (loc. cit., 1907) mentions a number of localities in Bergen and surrounding areas where glacial till containing fragmented shell material has been encountered. The fauna is found to be of arctic-boreoarctic character, and species like *Mya truncata*, *Pecten islandicus*, *Leda pernula*, *Macoma calcarea*, *Lepeta coeca* occur abundantly, while high-arctic species like *Portlandia arctica* and *Arca glacialis* are lacking. Some of the localities described by C. F. Kolderup are shown in Fig. 2, as well as a locality at Mathopen observed by the author. As to the age of the molluscs Kolderup does not regard them as Interglacial owing to their arctic-boreo-arctic character, but simply states that the fauna lived at a time with a considerably colder climate than today and prior to an advance by the inland ice.

Discussion

It can generally be stated that the advance of the glaciers which deposited the till in the Bergen—Os area must be more recent than the age of the shells which are found incorporated in the till. And as the youngest fossils dated from till have an age of 10.500 ± 300 years, the ice advance took place later than this date. The Ra-period or Younger Dryas stage has by varve-counts and C^{14} datings been dated to about 10.000—10.800 years B. P., and the advance by the ice in

the Bergen—Os area is therefore most likely from the latter part of this colder interval.

The other shell material from tills in the area has been dated to 11.500 ± 300 years and 11.700 ± 150 years, and the bryozoan lime-layer at Lundetre to 11.700 ± 230 years. These fossils must therefore be regarded as of Allerød age and the glaciers must have retreated from the Bergen—Os area during this milder interval, — how far can at present not be determined. According to C. F. Kolderup (1907, p. 63) shell-bearing till was found as far east as Eikangervåg in Osterfjorden (Fig. 2). This may suggest that the glaciers had retreated at least this far inside the fjord during the Allerød stage.

The fossil occurrence of Allerød age at Lundetre does also suggest that the ice had retreated quite a distance from that area as the fjord-water presumably must have been fairly clear for a considerable period.

During the Younger Dryas stage the deterioration of the climate resulted in the coastward advance of the glaciers. It was during this advance with the ice front approaching that mud accumulated on the sea bottom at Lundetre eventually filling up the valley and covering the vertical rocky cliff with its attached fauna. The shell material which was dated from this clay deposit had an age of 10.050 ± 250 years, and the fauna must therefore have lived during the latter part of the Younger Dryas stage, which was also the case with the fauna dated from till at Os. The ice advance has therefore occurred very late in this area, and this might again suggest that the ice border during the maximum extent of the ice during the Ra-stage had a position fairly near. (This has been suggested by I. UNDÅS, 1963). Glacial striae present above the cliff and below the till at Lundetre have a direction which corresponds with the direction of the Heggland valley, which again is parallel to the Fusafjord. The glacier which passed above the clay at Lundetre during the Ra-advance was therefore most likely part of a glacier which filled the Fusafjord. As to the actual position of the ice border during the glacial maximum of the Ra-stage in the Bergen—Os area this has not yet been determined with any certainty due to lack of detailed geological mapping. An attempt has, however, been done by UNDÅS, (loc. cit.). What can be said is that all localities where shell-bearing till is found, have most likely been overrun by glaciers during the Younger Dryas stage, and most likely

by the inland ice. This places the ice border west of Os in the southern area and west of Mathopen in the northern area. As to the moraine covering the fossiliferous deposit at Blomvåg further north-west, where the fossils were dated to about 12.500 years, it cannot yet be stated with any certainty if this was deposited by the advance of the Ra-glacier or by an advance connected with the older Dryas stage.

Acknowledgements

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PLATES I—III

(Macrophotographs by E. Irgens)

PLATE I

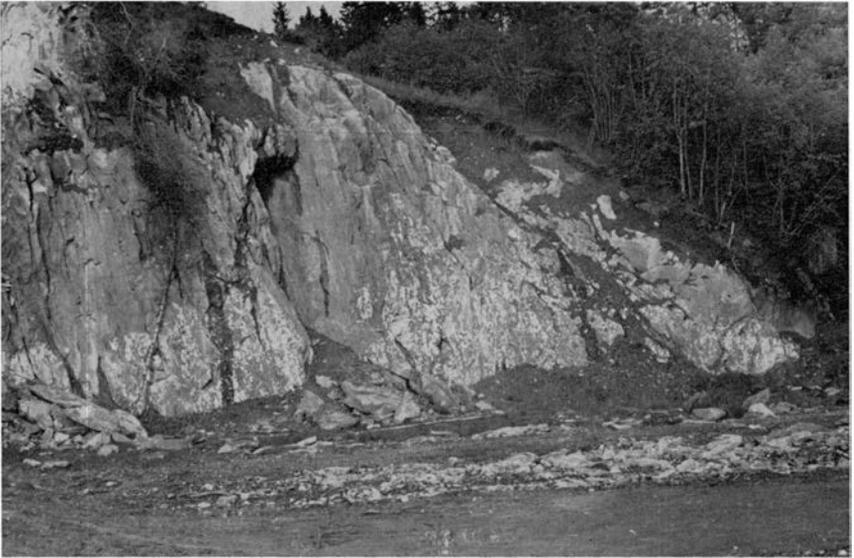


Fig. 1. The exposed vertical rock surface where the attached fossil fauna was found in the lower half. Till on top.

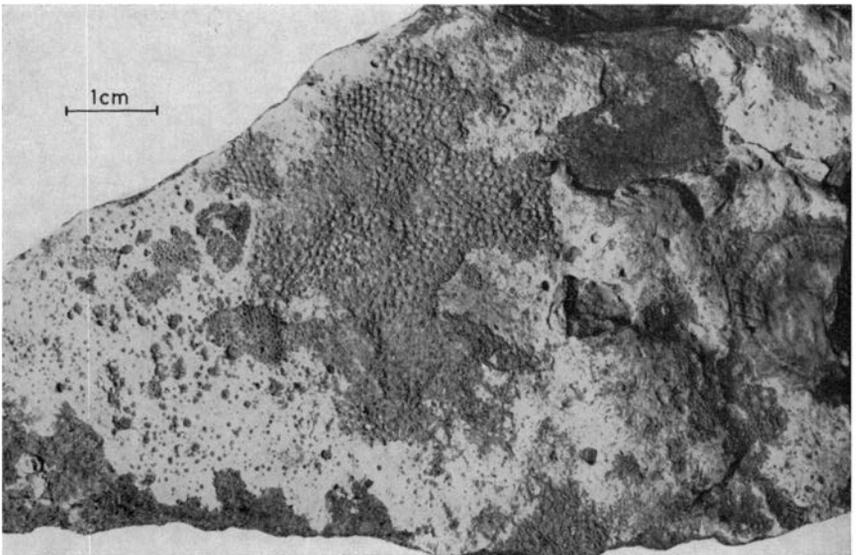


Fig. 2. Bryozoa and basal plate of barnacle (P) on rock surface.

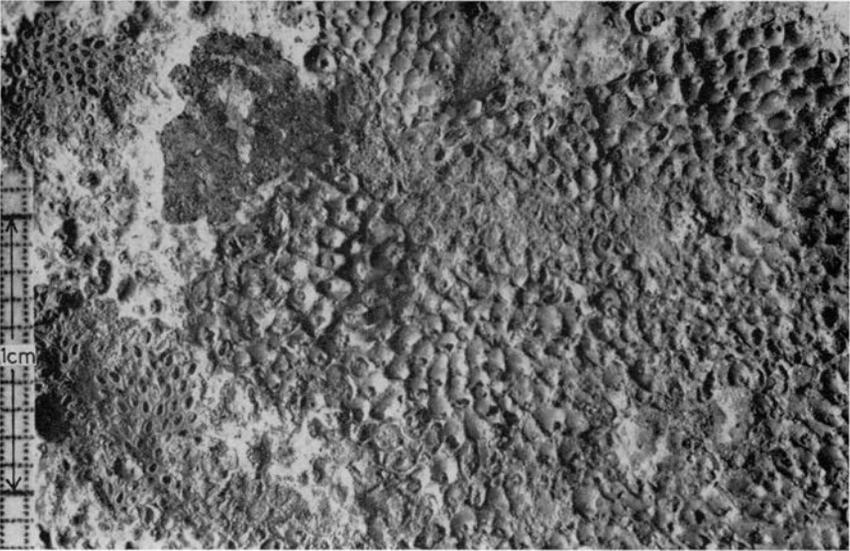


Fig. 1. Bryozoa from rock surface. Detail of Plate I, 2.

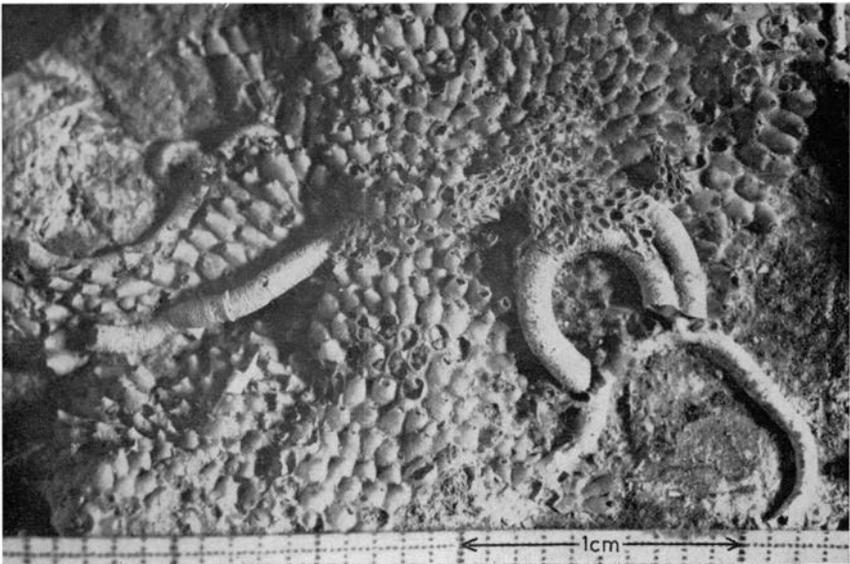


Fig. 2. Bryozoa and serpulid tubes on rock surface.

PLATE III

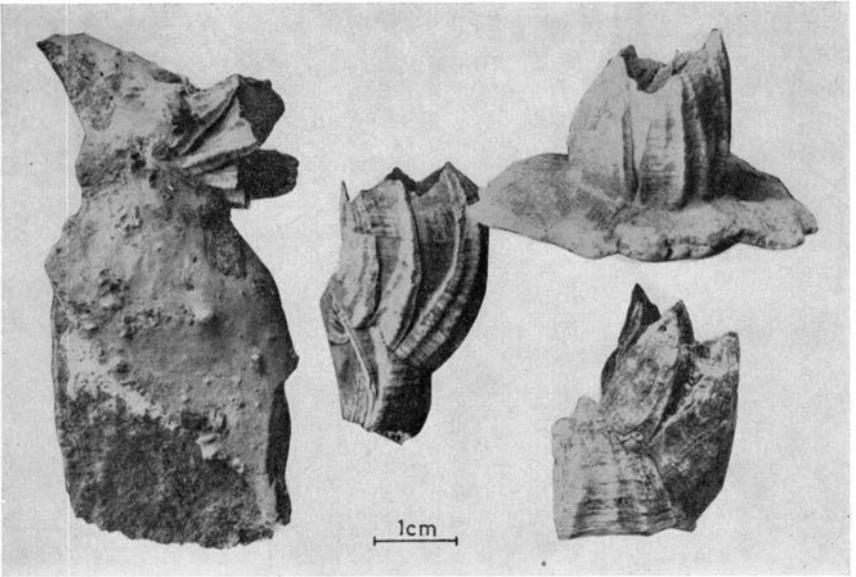


Fig. 1. Barnacles (*Balanus balanus*) from rock surface.

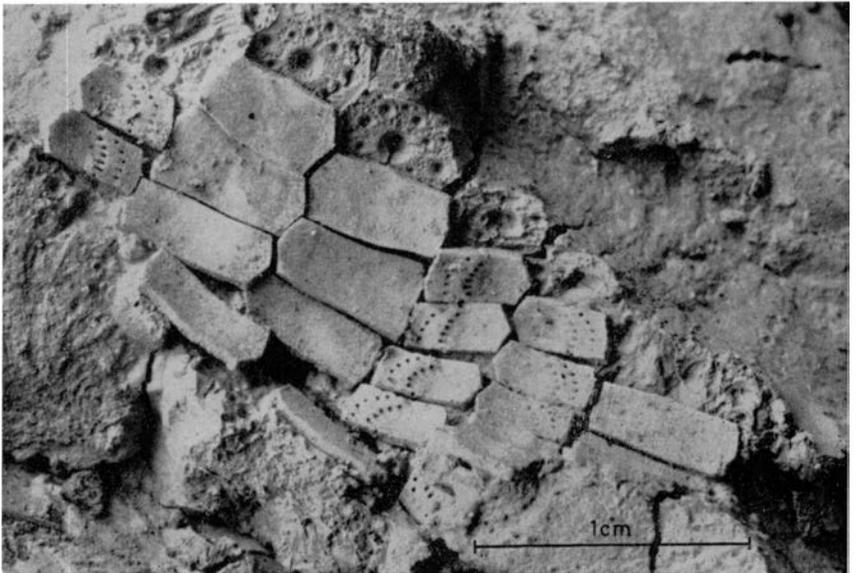


Fig. 2. Cast in clay of *Strongylocentrotus droebachiensis*.