KRZYSZTOF BIRKENMAJER, HALINA PUGACZEWSKA and ANDRZEJ WIERZBOWSKI

THE JANUSFJELLET FORMATION (JURASSIC-LOWER CRETACEOUS) AT MYKLEGARDFJELLET, EAST SPITSBERGEN

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Fossiliferous marine strata of the Janusfjellet Formation (Jurassic-Lower Cretaceous) are described from Myklegardfjellet, Agardhbukta area, east Spitsbergen. The invertebrate fauna collected by the first author from these beds in 1977 has been determined by the second author (serpulids, bivalves, belemnites) and by the third author (ammonites). This assemblage allows to distinguish the Upper Callovian, the Kimmeridgian (Lower and Upper) and the Lower Volgian stages in the lower part of the Janusfjellet Formation (Agardhfjellet Member). The upper part of the Janusfjellet Formation (Rurikfjellet Member) yielded poorly preserved fossils of little stratigraphic value.

Key words: Mesozoic, stratigraphy, ammonites, bivalves, belemnites, serpulids, Spitsbergen.

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FORMACJA JANUSFJELLET (JURA — DOLNA KREDA) MYKLEGARDFJELLET, WSCHODNI SPITSBERGEN

Streszczenie. — W pracy przedstawiono wyniki badań nad stratygrafią formacji Janusfjellet (jura-dolna kreda) na Myklegardfjellet (obszar Agardhbukta) na wschodnim Spitsbergenie. Fauna bezkręgowców pochodząca z tych warstw została zebrana przez pierwszego autora podczas kierowanej przez niego polsko-amerykańskiej ekspedycji działającej w 1977 r. na wschodnim Spitsbergenie. Zespół skamieniałości zawierający ogółem 33 gatunki małżów, belemnitów, serpulid (opisanych przez H. PUGACZEWSKĄ) oraz amonitów (opisanych przez A. WIERZBOWSKIEGO) pozwolił na wyróżnienie 20 poziomów faunistycznych. Na ich podstawie w dolnej części formacji (ogniwo Agardhfjellet) stwierdzono górny kelowej, dolny i górny kimeryd oraz dolny wołg. Górna część formacji Janusfjellet (ogniwo Rurikfjellet) zawiera źle zachowaną faunę o małej przydatności stratygraficznej.

INTRODUCTION

The faunas investigated have been collected by the first author from marine Jurassic-Lower Cretaceous strata of the Janusfjellet Formation at Myklegardfjellet, Agardhbukta area (figs. 1, 2) during a Polish-American expedition led by him to east Spitsbergen in 1977.

The serpulids, bivalves and belemnites have been determined by the second author and the ammonites by the third author. The specimens here described are housed in the Institute of Paleobiology, Polish Academy of Sciences, Warsaw (abbreviated as ZPAL).

STRATIGRAPHIC POSITION OF THE JANUSFJELLET FORMATION

by KRZYSZTOF BIRKENMAJER

The Janusfjellet Formation (MAJOR 1964: map — in MAJOR and NAGY 1972; Janusfjellet Subgroup of PARKER 1967) consists of marine strata contained between two continental complexes — a basal one represented by the De Geerdalen Formation (Upper Triassic — ?Hettangian), and a top one — represented by the Helvetiafjellet Formation (BUCHAN *et al.* 1965, PARKER 1967, BIRKENMAJER 1972, 1975, 1977). In central and eastern Spitsbergen the formation is usually subdivided into two units: the lower Agardhfjellet Member (Formation of Parker 1967) and the upper Rurikfjellet Member (Formation of PARKER 1967), separated by a nonsequence about the Jurassic/Cretaceous boundary. A characteristic yellow clay horizon at the base of the Rurikfjellet Formation (PARKER 1967, BJAERKE *et al*, 1976) has been distinguished as the Myklegardfjellet Bed (BIRKENMAJER 1980).

In southern Spitsbergen, mainly in Torell Land, a tripartite subdivision of the Janusfjellet Formation was found useful (RÓŻYCKI 1959, BIRKENMAJER 1972, 1975). The Janusfjellet Formation is there subdivided into the lower Ingebrigtsenbukta Member, the middle Tirolarpasset Member and the upper Ullaberget Member (Table 1). In Torell Land there is either a continuous sedimentation throughout the Janusfjellet Formation, or — in some areas — a break in deposition and intraformational erosion appears at the base of the Tirolarpasset Member. In the latter case, it is marked by arenaceous-conglomeratic rocks of the Polakkfjellet Bed.

A hiatus which covers most of the Lower and Middle Jurassic separates the De Geerdalen Formation from the Janusfjellet Formation. The latter begins as a rule with the Brentskardhaugen Bed (phosphorite conglomerate) which is a very characteristic thin phosphorite-quartz conglomerate or pebbly clay containing reworked marine fauna of several Liassic through Dogger zones, as well as some still older material (see BIRKENMAJER 1975, BIRKENMAJER and PUGACZEWSKA 1975). The conglomeratic bed itself is believed to represent the Lower Callovian or uppermost Bathonian — Lower Callovian.

Lithostratigraphic sections investigated at Myklegardfjellet, which include the De Geerdalen Formation, the Janusfjellet Formation and the Helvetiafjellet Formation, are shown in figs. 3 and 4. A detailed description of strata in these sections is presented elsewhere (BIRKENMAJER 1980).

Agardhfjellet Member

Loose fragments of quartz-phosphatic conglomerate and pebbles of grey fossiliferous phosphorite and white quartz which occur at the foot of Myklegardfjellet scattered over the morphologic ledge formed by the De Geerdalen Formation, indicate the presence of the Brentskardhaugen Bed at the base of the discussed sequence of the Janusfjellet Formation (fig. 4). The basal part of Agardhfjellet Member, some 40 m thick, is very poorly exposed. This part of the member is represented by black shales, possibly with some clay-ironstone and/or siltstone intercalations.

Higher up come black to dark-grey, rather hard shales and papery-shales which in the lower part of the member, up to about 135 m above the bottom of the unit (see fig. 4), contain

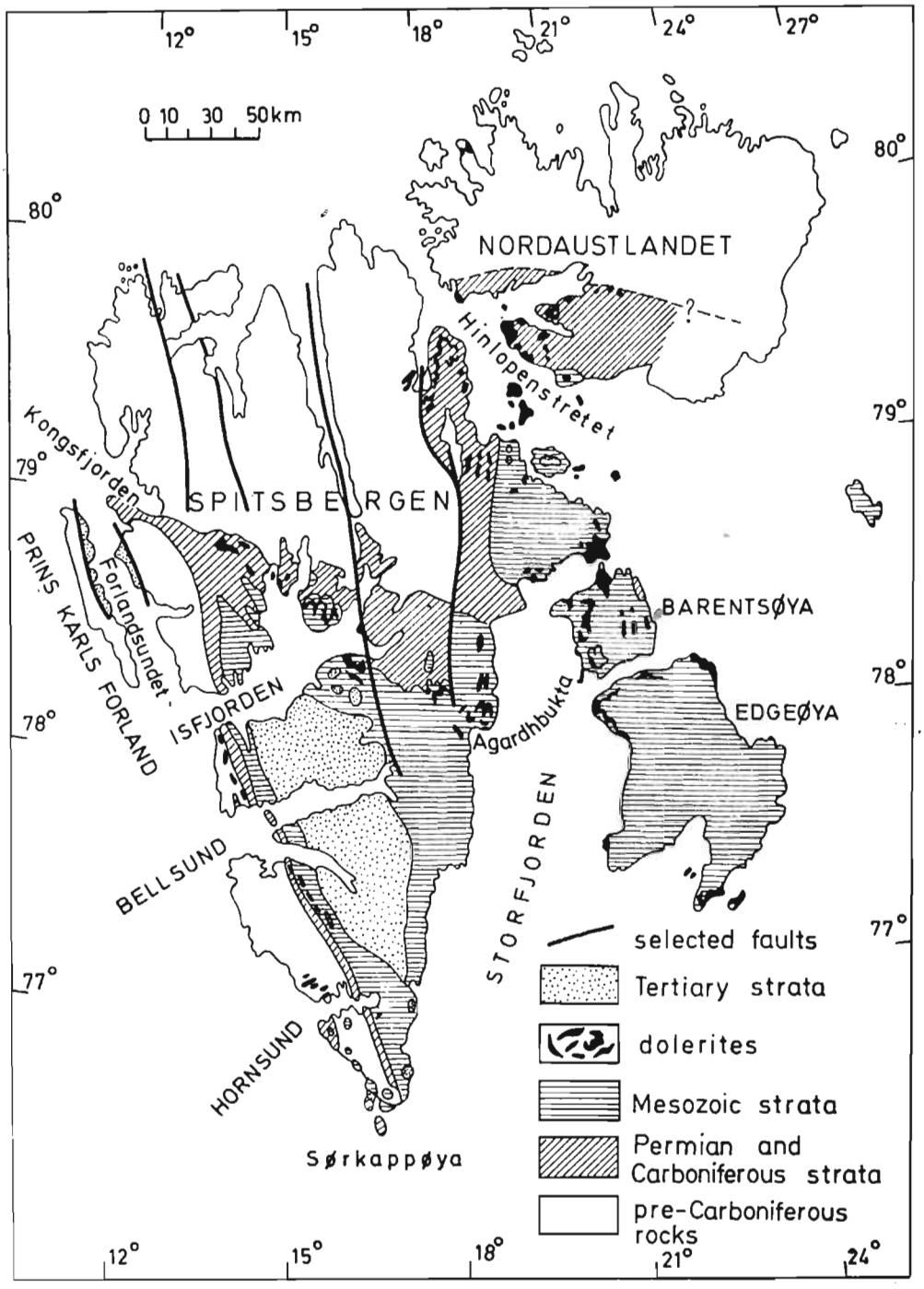


Fig. 1
Position of Agardhbukta against simplified geological map of Svalbard.

thin intercalations of often iron-rich siltstone, fine-grained sandstone and black bituminous shale, subordinately also clay-ironstone layers.

In the upper part of the Agardhfjellet Member, the sandstone and siltstone intercalations disappear, bituminous shales become infrequent, while clay-ironstones (siderites) become a typical feature. The latter form thin intercalations or lenses in a lower portion of the upper part of the Agardhfjellet Member, and zones of discoidal concretions or balls in the uppermost portion of the member.

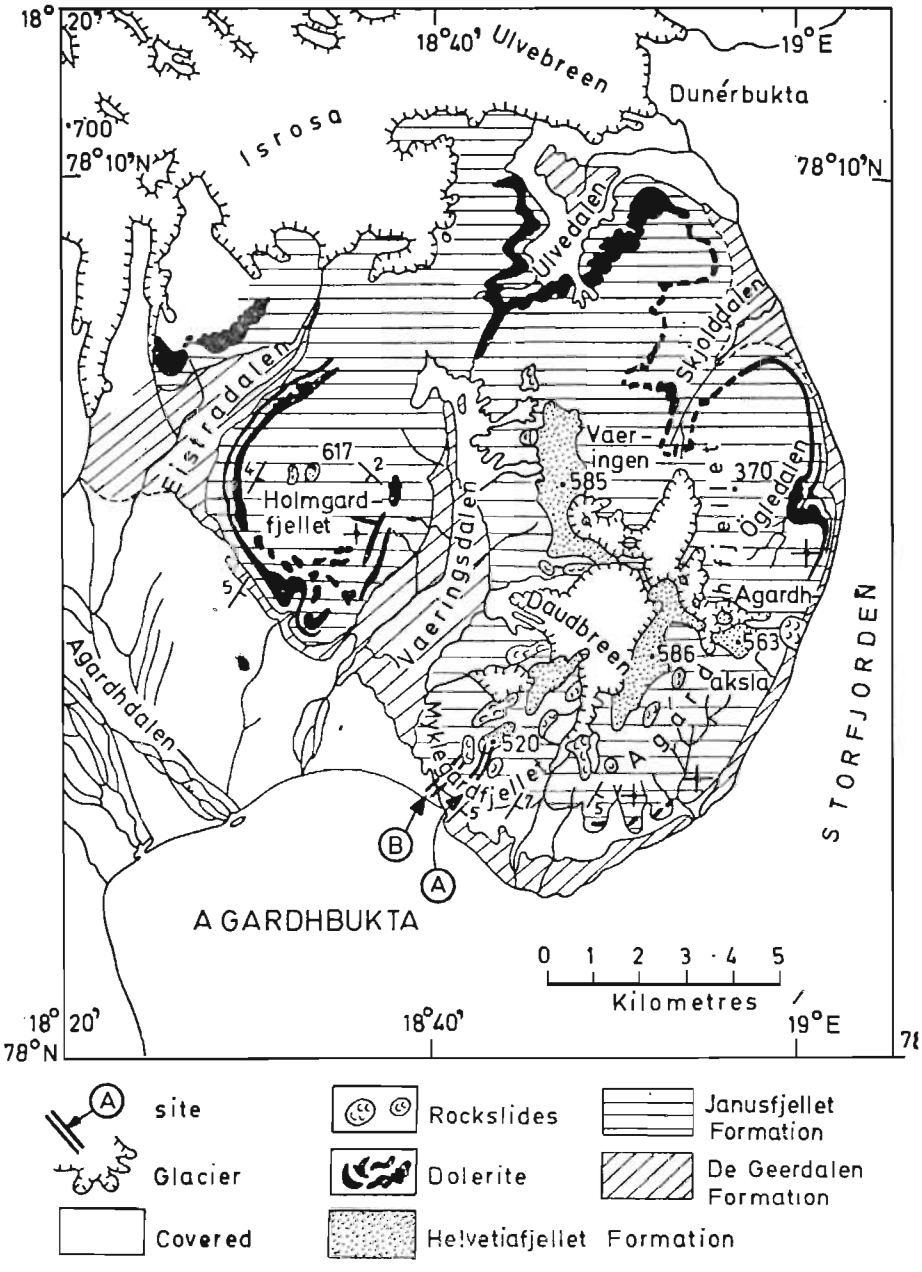


Fig. 2

Geological sketch-map of the Agardhbukta area, with position of stratigraphical sections: A (fig. 3) and B (fig. 4).

About 20 fossiliferous horizons have been recognized in the section of SW Myklegardfjellet (BIRKENMAJER 1980). Eight of these (Faunules 1-8, see below) yielded determinable invertebrate fossils, here listed with age ranges (after determinations by H. PUGACZEWSKA and A. WIERZBOWSKI) and stratigraphical comments.

Faunule 1 (80-81 m)

?*Longaeviceras* sp. This ammonite genus is characteristic of the Upper Callovian.

Faunule 2 (110 m)

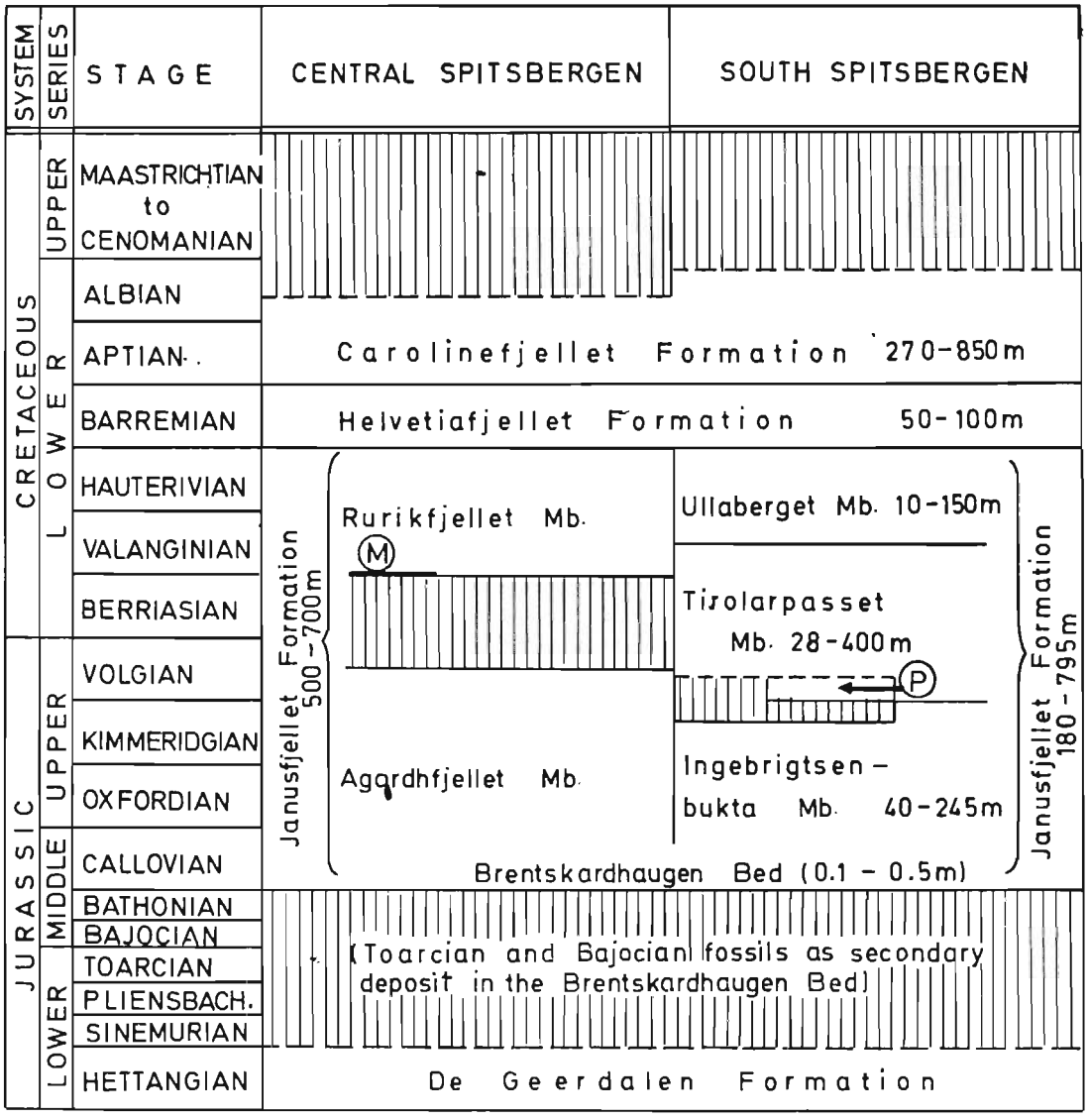
Buchia bronni (LAHUSEN): Oxfordian — Upper Kimmeridgian;

Rasenia (*Zonovia*) *evoluta* SPATH: Lower Kimmeridgian (higher part of *cymodoce* Zone);

Amoeboceras (*Amoebites*) cf. *kitchini* (Salfeld): Lower Kimmeridgian to Upper Kimmeridgian (*mutabilis* Zone);

Table 1

Lithostratigraphic standard for the Jurassic — Lower Cretaceous of Spitsbergen: M — Myklegardfjellet Bed; P — Polakkfjellet Bed.



Amoeboceras (*Amoebites*) sp.

This fauna is clearly of a Lower Kimmeridgian age, as indicated by the presence of *Rasenia* (*Zonovia*) *evoluta*.

Faunule 3 (111-112 m)

Buchia bronni (LAH.) cf. *lata* (TRAUTSCHOLD): Lower Kimmeridgian.

Amoeboceras (*Amoebites*) cf. *salfeldi* SPATH: Lower Kimmeridgian (higher part of *cymodoce* Zone) to lowest Upper Kimmeridgian.

This assemblage is indicative of the Lower/Upper Kimmeridgian boundary.

Faunule 4 (122 m)

Astarte (*Astarte*) cf. *nummus* (SAUVAGE): Oxfordian — Lower Kimmeridgian;

Prorokia cf. *problematica* (BUVIGNIER): Oxfordian — Lower Kimmeridgian.

As this faunule occurs some 10 m above Faunule 3, its Upper Kimmeridgian age seems most probable.

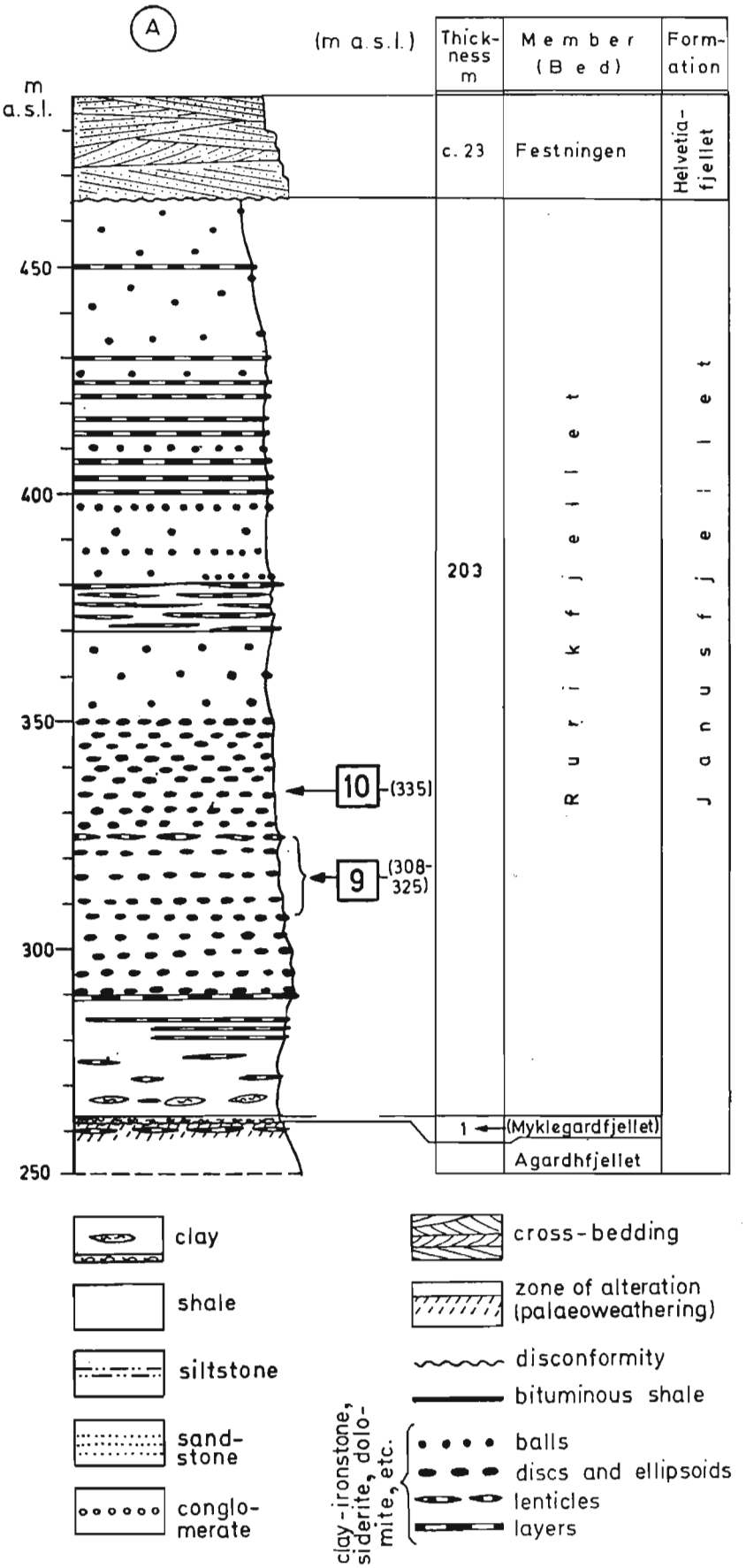


Fig. 3

Position of invertebrate fauna (Faunules 9 and 10) in the Rurikfjellet Member at Myklegardfjellet S.

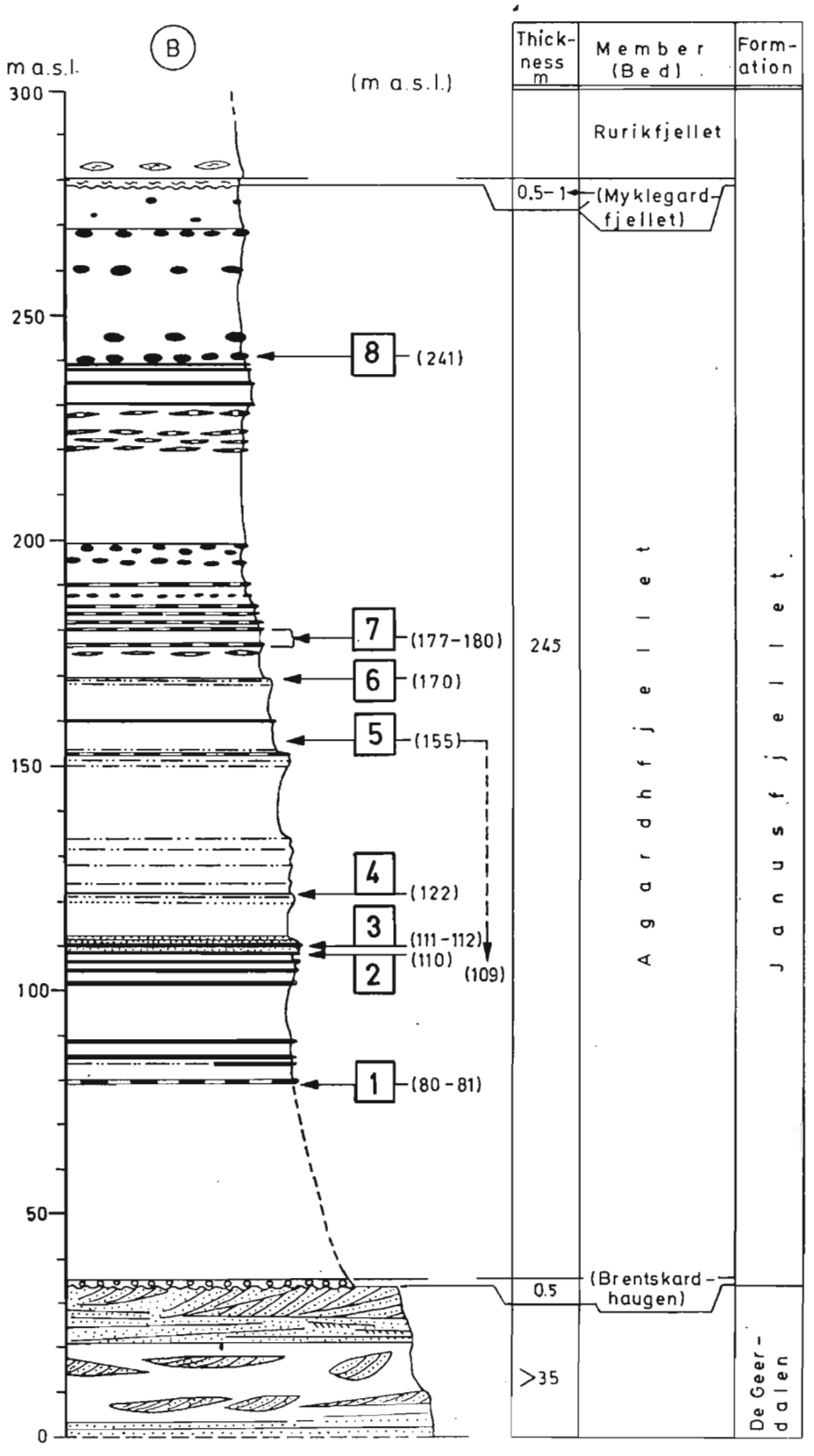


Fig. 4
Position of invertebrate fauna (Faunules 1 through 8) in the Agardhfjellet Member at Myklegardfjellet SW.

Faunule 5 (mainly 155 m, but scattered downslope to 109 m)

Cylindroteuthis (*Cylindroteuthis*) cf. *oweni oweni* (PRATT): Upper Callovian — Upper Kimmeridgian;

Cylindroteuthis (*Cylindroteuthis*) cf. *oweni cuspidata* SAKS: Upper Oxfordian — Kimmeridgian;

Cylindroteuthis (*Holcobeloides*) cf. *beaumonti* (d'ORBIGNY): Callovian — Oxfordian;

Lagonibelus (*Holcobeloides*) cf. *pavlovi* SAKS et NALAEVA: Upper Oxfordian — Lower Kimmeridgian;

Pachyteuthis (*Pachyteuthis*) cf. *cuneata* GUSTOMESOV: Bathonian — Upper Volgian;

Pachyteuthis (*Simobelus*) cf. *breviaxis* (PAVLOV): Oxfordian — Kimmeridgian;

Pachyteuthis (*Simobelus*) cf. *kirghisensis* (d'ORBIGNY): Middle Oxfordian — Kimmeridgian.

Taking into account the upper age-ranges of the belemnite species listed, it seems that Faunule 5 still belongs to the Upper Kimmeridgian rather than to Lower Volgian. Some forms, e. g. *Cylindroteuthis* (*Holcobeloides*) cf. *beaumonti* (Callovian — Oxfordian) could have come from beds older than the Kimmeridgian.

Faunule 6 (170 m)

Serpula (*Cycloserpula*) cf. *subcrispa* PARSCH: Malm gamma to zeta;

Solemya cf. *hoeli* SOKOLOV et BODYLEVSKY: Lower Kimmeridgian — Lower Volgian;

Quenstedtia cf. *subaequilatera* (LYCETT): Bajocian — Lower Volgian;

Quenstedtia cf. *subangulata* (LYCETT): Upper Bathonian — Lower Volgian.

Taking into account the age ranges of the bivalves listed, the Faunule 6 is either Upper Kimmeridgian or Lower Volgian in age.

Faunule 7 (177-180 m)

Serpula sp. indet.

Oxytoma (*Oxytoma*) *inaequivalvis* cf. *expansa* (PHILLIPS): Triassic — Valanginian;

Camptonectes (*Camptochlamys* sp. indet.) cf. *Chlamys* (*Aequipecten*) *arachnoideus* (SOKOLOV et BODYLEVSKY): Lower Volgian;

Unicardium sp. indet.;

Quenstedtia cf. *subangulata* (LYCETT): Bajocian — Lower Volgian;

Buchia pallasi cf. *tenuistriata* (LAHUSEN): Middle Oxfordian — Berriasian.

This faunal assemblage is not very stratigraphically specific. A Lower Volgian age seems probable.

Faunule 8 (241 m)

Serpula sp. indet.

Palaeonucula isfjordica (BODYLEVSKY): Lower Volgian;

Grammatodon (*Grammatodon*) sp. indet;

Goniomya cf. *duboisi* AGASSIZ: Lower Callovian — Lower Volgian;

Isocyprina (*Venericyprina*) sp. indet: Kimmeridgian — Aptian;

Buchia pallasi cf. *tenuistriata* (LAHUSEN): Middle Oxfordian — Berriasian;

Pectinatites (*?Virgatosphinctoides*) sp.: Lower Volgian.

The occurrence of ammonite *Pectinatites* (*?Virgatosphinctoides*) sp. clearly indicates a Lower (resp. Lower-Middle) Volgian age of the assemblage.

The faunas listed indicate the Upper Callovian (Faunule 1) through Lower Volgian (Faunule 8) ages of the Agardhbukta Member at Myklegardfjellet. The age of the lowest 35-m thick part of the member, below Faunule 1, is probably Lower Callovian. Elsewhere in Spitsbergen the base of the Janusfjellet Formation is determined as uppermost Bathonian or Lower Callovian on *Kepplerites* fauna (e. g. PARKER 1967, PČELINA 1967, BIRKENMAJER 1975). The Oxfordian stage has not been recognized on fauna in the Myklegardfjellet section; its position would be between Faunule 1 (81 m) and Faunule 2 (110 m) — see fig. 4.

Rurikfjellet Member

The Rurikfjellet Member is represented at Myklegardfjellet by grey, grey-green to black, rather soft shales, with sideritic and dolomitic intercalations and lenses, and zones of discoidal concretions and balls (often with septarian structure). The balls may also occur at random within the shale (fig. 3). Neither sandstone-siltstone nor bituminous shale intercalations have been found.

In the lowest part of the unit, lenses of yellow clay 5-10 cm thick occur. The Myklegardfjellet Bed (yellow and yellow-green plastic clay — see BIRKENMAJER 1980) forms the base of the Rurikfjellet Member. It seems to be separated by a hiatus from the Agardhfjellet Member whose top part is strongly weathered and resembles a regolith.

Three fossiliferous zones have been recognized, two of these yielded poorly preserved bivalves (Faunules 9 and 10).

Faunule 9 (308-325 m)
Isocyprina (*Venericyprina*) sp. indet: Kimmeridgian — Aptian.

Faunule 10 (335 m)
Isocyprina (*Venericyprina*) sp. indet: Kimmeridgian — Aptian;
Buchia fischeriana (d'ORBIGNY): Lower Volgian — Lower Cretaceous.

This fauna is not very characteristic for age determinations: it could be of a Lower Cretaceous age.

Elsewhere in Spitsbergen, the Rurikfjellet Member represents the Valanginian and Hauterivian stages (PČELINA 1965*a*, *b*, PARKER 1967, BIRKENMAJER 1975).

DESCRIPTIONS

AMMONITES

by ANDRZEJ WIERZBOWSKI

Genus *Longaeviceras* BUCKMAN, 1918
? *Longaeviceras* sp.
(pl. 37:1-2)

Material. — Small specimen (ZPAL Mo. XIII/70) representing a part of a phragmocone; one fragmentary external cast (ZPAL Mo. XIII/71).

Description. — The shell is involute; the umbilical diameter is 23% and the whorl-height is 49% at a shell diameter of 20 mm in the smaller specimen; an approximate umbilical diameter is somewhat below 20% at a diameter of approximately 35 mm in the other specimen. The whorl-section is compressed; the venter is narrow and grades gently into the flanks (specimen ZPAL Mo. XIII/70). The ribs are rather strong and sharp; they coarsen somewhat near the venter, and are bent forward. Most of them are bifurcated with the point of division lying below the mid-height of the whorl; few ribs remain unbranched.

Remarks. — In general appearance the two specimens are very similar to some representatives of the subfamily Quenstedtoceratinae as interpreted recently by MELEDINA (1977). The specimens show sculpture (and some other features) particularly well comparable with *Longaeviceras* but are too poorly preserved for closer identification.

Occurrence. — The specimens were collected 80-81 m above the base of the section. The genus *Longaeviceras* is known from the Upper Callovian in the Arctic, Siberia and NW Europe.

Genus *Amoeboceras* HYATT, 1900

Amoeboceras (*Amoebites*) cf. *salfeldi* SPATH, 1935

(pl. 37:5)

Material. — Incomplete internal cast (ZPAL Mo. XIII/72).

Description. — The outer part of the last half whorl is missing; it seems, however, that the complete shell had attained approximately 60 mm. At the shell diameter of ca. 45 mm, the umbilical diameter is about 30%, and the whorl height is 47%. The umbilicus is shallow with a rather gentle umbilical wall. The whorl sides are flattened; the venter is not visible. The inner whorls are probably sparsely ribbed, but the ornamentation is very poorly preserved. On the outer whorl the ribs are loosely spaced and very coarse; there are about 30 primaries per whorl. The ribs appear to curve slightly on the umbilical wall, then become straight, rectiradiate or slightly prorsiradiate on the flanks. On the ventrolateral side of the whorls the ribs swell somewhat and are united at the strong high clavi.

Remarks. — The robust ornamentation and the development of fully looped ribs with clavi are typical of *Amoeboceras* (*Amoebites*) *salfeldi* Spath (see SPATH 1935, ARKELL and CALLOMON 1963). However, as the specimen is unsatisfactorily preserved, and the inner whorls, venter and whorl-section are practically unknown, no direct identification is warranted.

Occurrence. — The specimen was collected 111-112 m above the base of the section. *Amoeboceras salfeldi* is known from the *borealis* Zone (corresponding approximately to the *cymodoce* Zone of the Lower Kimmeridgian) in Siberia (MESEZHNIKOV and ROMM 1973) and from the *mutabilis* Zone of the Upper Kimmeridgian in Scotland (ARKELL and CALLOMON 1963).

Amoeboceras (*Amoebites*) cf. *kitchini* (SALFELD, 1915)

(pl. 37:3-4)

Material. — Two crushed internal casts (ZPAL Mo. XIII/73-74).

Description. — The maximum diameter is ca. 60 mm. The dimensions of the more complete specimen (pl. 37:3) are as follows: at a shell diameter of 60 mm — the umbilical diameter is 32,5% and the whorl height is 37%; at 44 mm — the umbilical diameter is 30,5% and the whorl height is 41%. The ribbing of the inner whorls is not very dense, but it is too poorly preserved for closer examination. On the outer whorl the ribs are mostly single; they appear to curve slightly on the umbilical wall and are rectiradiate on the flanks. On the last whorl there are about 35 primary ribs which become progressively more loosely spaced with increasing diameter. The ribs swell somewhat above the mid-height of the flanks, then become apparently fainter towards the venter. The ventrolateral tubercles are well developed becoming stronger and more distant with increasing shell size. The relation between the number of primary ribs and the number of ventrolateral tubercles oscillates between 1,2 and 1,5 on the last whorl. The venter is not well preserved but a broad and rather coarsely serrated keel bordered by poorly marked ventral sulci is distinguishable.

Remarks. — The specimens agree with the description and figures of *Amoeboceras kitchini* (SALFELD) given by SHULGINA (1960) and KNIAZEV (1975). However, the state of preservation is too poor for unequivocal identification.

Occurrence. — The specimens were collected 110 m above the base of the section. *Amoeboceras kitchini* is widely distributed in the Arctic, Siberia and NW Europe and it occurs in the Lower Kimmeridgian and in the *mutabilis* Zone of Upper Kimmeridgian (e. g. MESEZHNIKOV and ROMM 1973, SYKES and SURLYK 1976).

Amoeboceras (*Amoebites*) sp.

(pl. 37:6)

Material — One fragmentary external cast (ZPAL Mo. XIII/75).

Description and **remarks.** — The specimen represents only part of the last whorl; no inner whorls are preserved. The umbilicus seems to be rather narrow; the whorl is high. The ribbing is coarse and prorsiradiate; approximation of ribbing observed at the end part of the whorl indicates the proximity of the peristome. The primaries bear small elongated tubercles at about the middle of the flank. After slight weakening, the ribs are pronounced again near the ventral side and, like the innumerous intercalated secondary ribs, form moderately strong ventrolateral tubercles. The keel is coarsely serrated; there are about two teeth per one outer rib.

The fragmentary state of preservation of the specimen precludes detailed comparisons with any known species. There is, however, a certain similarity with *Amoeboceras* (*Amoebites*) *mesezhnikovi* SYKES et SURLYK, 1976 (= *A.* (*A.*) *simplex* MESEZHNIKOV et ROMM, 1973).

Occurrence. — The specimen was collected 110 m above the base of the section.

Genus *Rasenia* SALFELD, 1913

Rasenia (*Zonovia*) *evoluta* SPATH, 1935

(pl. 37:7)

1935. *Rasenia evoluta* SALFELD M. S.; L. F. SPATH; 48.

1978. *Rasenia* (*Zonovia*) *evoluta* SPATH; T. BIRKELUND, B. THUSU and J. VIGRAN; 44-48, 50, pl. 1:4, 5; pl.2:7-10; pl. 3: 1-5; text-figs 5-6.

Material. — One well preserved external cast (ZPAL Mo. XIII/76).

Description. — Maximum diameter is 68 mm. The shell is evolute, the umbilical diameter being 43% and the whorl height — 31% at a shell diameter of 56 mm. There are 23-24 prorsiradiate primaries per whorl, which, starting at the shell diameter of ca. 25 mm, become very strong and bullate. The secondary ribs appear somewhat below the middle of the whorl side; they are strong and rectiradiate and often grouped on the outer whorl in the triplicate sheaves, however, the intercalatory ribs are also present. The secondary to primary rib ratio at 55 mm diameter is 3.0. The constrictions are shallow and rather poorly marked.

Remarks. — The character of ribbing seems typical for the *Rasenia uralensis* group which represents the subgenus *Zonovia* SAZONOV 1960. Of the species placed in that subgenus, undoubteldy the most similar is *Rasenia evoluta* SPATH revived recently by BIRKELUND *et al.* (1978*a*). It should be noted that the character of ventral side of *Zonovia* is not very clear; the type species *Rasenia uralensis* (d'ORB.) shows some weakening of ribbing on the venter, whereas in *Rasenia evoluta* the ribs cross the venter uninterruptedly and without any clear weakening (BIRKELUND *et al.* 1978*a*). Unfortunately, the ventral side of the specimen studied is not preserved.

Occurrence. — The specimen was collected 110 m above the base of the section. *Rasenia evoluta* is known from the higher part of the *cymodoce* Zone of the Lower Kimmeridgian in Great Britain and northern Norway (BIRKELUND *et al.* 1978).

Genus *Pectinatites* BUCKMAN, 1922

Pectinatites (*?Virgatosphinctoides*) sp.

(pl. 37:8)

Material. — Fragmentary, crushed external cast (ZPAL Mo. XIII/77).

Description. — The maximum measured diameter is about 10 cm; by 8 cm diameter the whorl height is greater than diameter of umbilicus. Inner whorls are finely ribbed. On the outer whorl the ribs become more pronounced and are more widely spaced. On the last half-

whorl preserved there are ca. 20 primary ribs. The ribs curve slightly at umbilical slope; for the rest of their length they are straight and prorsiradiate. The biplicate ribs predominate, but occasional simple and polygyrate-triplicate ribs are developed; the intercalatory ribs are rather common. The secondary ribs usually appear about the middle of the whorl side. The secondary to primary rib ratio at 80-90 mm diameter (calculated for 10 primary ribs) equals 2·6.

Remarks. — The ornamentation, especially the presence of the polygyrate ribs and relatively high bifurcation of ribs, is rather typical of the subgenus *Virgatosphinctoides* than of the subgenus *Pectinatites* (see COPE 1967), but the preservation of the specimen is too fragmentary to allow a more precise identification.

Occurrence. — The specimen was collected 241 m above the base of the section. The subgenus *Virgatosphinctoides* is known from the *elegans* to *hudlestoni* Zones of the British succession (COPE 1967, 1974) and some corresponding beds from Greenland (BIRKELUND *et al.* 1978a); these correlate with the Lower Volgian except its uppermost part. However, the closely related subgenus *Pectinatites* is known from the younger beds which are assumed to correspond to the uppermost Lower Volgian — lowermost Middle Volgian (see COPE 1978)

SEDENTARY POLYCHAETE ANNELIDS, BIVALVES, AND BELEMNITES

by HALINA PUGACZEWSKA

SEDENTARY POLYCHAETE ANNELIDS

Family **Serpulidae** BURMEISTER, 1837
Subfamily **Serpulinae** BURMEISTER, 1837
Genus *Serpula* LINNAEUS, 1758
Subgenus *Cycloserpula* PARSCH, 1956

Serpula (*Cycloserpula*) cf. *subcrispa* PARSCH, 1956
(pl. 38:7)

Material. — Several tube fragments and imprints, two of them fairly well preserved. ZPAL A. III/1-2.

Description. — Uncoiled, more or less arcuate tubes 10 to 17 mm in length. The diameter and wall thickness increase in a single specimen from 2 to 3 mm and from 0·33 to 0·5 mm respectively. The tube surface ornamented with fine, concentric striae, up to 10 per 1 mm (pl. 38:7). A shallow and narrow longitudinal furrow covers half the length of a single specimen (pl. 38:7).

Remarks. — The investigated specimens most closely resemble the tubes attributed to *Serpula* (*Cycloserpula*) *subcrispa* PARSCH which show a similar size, shape, and ornamentation (PARSCH 1956:217, pl. 21:3). The only difference is the occurrence of an indistinct longitudinal furrow in the material under study, which may, however, be an artifact of fossilization process.

Occurrence. — 170 m above the section base. *Serpula* (*Cycloserpula*) *subcrispa* PARSCH was described from the Malm Gamma of Beuren-Erkenbrechtsweiler, West Germany, and reported to range in the sponge facies up to the top of Malm Zeta.

Serpula sp. indet.
(pl. 38:8; pl. 43:8)

Material. — Two tubes embedded in rock, with a partly damaged surface. ZPAL A. III/3-4.

Description. — Slightly arcuate tubes circular in cross section, somewhat swollen at variable intervals. Tube length is 13- and 15 mm, diameter approximates 1·25 mm but exceeds 1·5 mm at the swellings; wall thickness is constantly 0·33 mm. Tube wall parabolic in structure (pl. 38:8), with up to 15 alternating thin and thick growth lines per 2 mm. Numerous, irregular, transverse wrinkles on the internal surface of a tube (pl. 43:8).

Remarks. — The investigated tubes resemble in their arcuate outline, circular cross section, and dimensions those identified by SOKOLOV and BODYLEVSKY (1931:30) as *Ditrupa* (*Dentalium*?) sp., but they lack a longitudinal furrow. This difference may be insignificant as the latter authors were unable to reject a possibility that the furrow they observed was merely a damage (op. cit., 30).

Occurrence. — 177-180 and 241 m above the section base. *Ditrupa* (*Dentalium*?) sp. SOKOLOV and BODYLEVSKY 1931, was recorded in the Lower Volgian deposits 1·5 km west of Kapp Delta, Spitsbergen.

BIVALVES

Subclass **Palaeotaxodonta** KOROBKOV, 1954
Order **Nuculoida** DALL, 1889
Superfamily **Nuculacea** GRAY, 1824
Family **Nuculidae** GRAY, 1824
Genus *Palaeonucula* QUENSTEDT, 1830

Palaeonucula isfjordica a (BODYLEVSKY *in* SOKOLOV and BODYLEVSKY, 1931)
(pl. 38:1; pl. 39:5)

1931. *Nucula isfjordica a*; SOKOLOV and BODYLEVSKY, 65, pl. 4:6.

Material. — Two internal moulds with a partly preserved valve. ZPAL Mo. XIII/1-2.

Description.— Valves rhomboidal-oval in outline, with low umbo displaced posteriorly. The better preserved specimen is 15 mm long and 9 mm high. Dorsal margin angular, with its anterior part longer than the posterior one, covered with up to 24 nodiform denticles (pl. 38:1b). Anterior and posterior margins obliquely truncated, parallel to each other. The ventral margin widely arcuate. Mould surface covered with irregularly but rather densely spaced growth lines parallel to the ventral margin (pl. 38:1a). The anterior adductor scar is deeper and larger than the posterior one.

Remarks. — The valve outline, dimensions, and ornamentation are typical of the subspecies *Nucula isfjordica a* (BODYLEVSKY *in* SOKOLOV and BODYLEVSKY 1831). Specimens attributed to *Nucula isfjordica* BODYLEVSKY are more elongate and close to regularly oval in outline, and show less numerous anterior hinge teeth (SOKOLNIKOV and BODYLEVSKY 1931: 64; pl. 4:3-5).

Occurrence. — 241 m above the section base. *Nucula isfjordica a* BODYLEVSKY was originally described from the Lower Volgian horizons 18 and 20 of the Festungsprofil, Spitsbergen (SOKOLOV and BODYLEVSKY 1931; FREBOLD and STOLL 1937).

Subclass **Cryptodonta** NEUMAYR, 1884
Order **Solemyoida** DALL, 1889
Superfamily **Solemyacea** ADAMS and ADAMS, 1857
Family **Solemyidae** ADAMS and ADAMS, 1857
Genus **Solemya** LAMARCK, 1818

Solemya cf. *hoeli* SOKOLOV and BODYLEVSKY, 1931
(pl. 38:5-6; pl. 39:1-3)

Material. — A dozen moulds and imprints, commonly in accumulations. ZPAL Mo. XIII/3-7.

Description. — Elongate valves oval in outline, with rounded posterior and anterior extremities, arcuate dorsal and ventral margins (dorsal margin is close to rectilinear in its median part), 35 to 50 mm in length, and 15 to 22 mm in height. Low, not protruding umbo situated at antero-dorsal margin (pl. 38:5-6; pl. 39:1-3). Valves ornamented with a single main and several lateral ribs, radial striae, and concentric growth lines. Main rib displaced dorsally, in form of a gentle arch reaching the posterior margin (pl. 39:1). Lateral ribs arcuate, running divergently away from the main rib and towards the ventral and dorsal margins (4-8 lateral ribs towards each margin) to which they are perpendicular (pl. 38:5-6; pl. 39:1). Numerous, fine, radial striae along the dorsal and ventral margins (pl. 38:1; pl. 39:2). A very fine net appears postero-ventrally due to the imposition of radial striae onto those running obliquely away from the dorsal margin (pl. 39:2).

Remarks. — The investigated specimens resemble in their dimensions, shape, and ornamentation those identified as *Solenomya* (?) *hoeli* SOKOLOV and BODYLEVSKY, but they differ from the latter in the occurrence of radial, divergent ribs all over a valve instead of exclusively in its posterior part (see SOKOLOV and BODYLEVSKY 1931:76, pl. 4:1). Another difference is that the specimens under study are regularly oval in outline, while a valve is higher posteriorly than anteriorly in *S. hoeli*. However, this may reflect merely an artifact of the poor preservation state of the fauna of Myklegardfjellet.

Occurrence. — 170 m above the section base. *Solenomya* (?) *hoeli* SOKOLOV and BODYLEVSKY 1931, was described from the Lower Kimmeridgian to Lower Volgian horizon 13 of the Festungsprofil, Spitsbergen (SOKOLOV and BODYLEVSKY 1931:110-111).

Subclass **Pteriomorphia** BEURLEN, 1944
Order **Arcoida** STOLICZKA, 1871
Superfamily **Arcacea** LAMARCK, 1809
Family **Parallelodontidae** DALL, 1898
Subfamily **Grammatodontiinae** BRANSON, 1942
Genus *Grammatodon* MEEK and HAYDEN, 1861
Subgenus *Grammatodon* MEEK and HAYDEN, 1861

Grammatodon (*Grammatodon*) sp.
(pl. 40:3)

Material. — Imprint of a valve fragment. ZPAL Mo. XIII/14.

Description. — Posterior part of a valve, 13 mm long and 4 mm high. Valve surface ornamented with growth lines and radial striae. A few conspicuous, angular growth lines (apparent especially in the ventral part of the valve) accompanied by numerous, fine ones bent arcuately in the proximity of umbo (pl. 40:3). Numerous, very fine, radial striae become postero-dorsally thicker and more widely spaced.

Remarks. — The investigated specimen resembles in ornamentation representatives of

the subgenus *Grammatodon* (*Grammatodon*) MEEK and HAYDEN widely distributed in Jurassic to Cretaceous deposits all over the world (NEWELL 1969 in Treatise: N258).

Occurrence. — 241 m above the section base.

Order **Pterioida** NEWELL, 1965
Suborder **Pteriina** NEWELL, 1965
Superfamily **Pectinacea** RAFINESQUE, 1815
Family **Oxytomidae** ICHIKAWA, 1958
Genus *Oxytoma* MEEK, 1864
Subgenus *Oxytoma* MEEK, 1864

Oxytoma (*Oxytoma*) *inaequivalvis* (SOWERBY, 1819) cf. *expansa* (PHILLIPS, 1829)
(pl. 38:2-4; pl. 43:3-4)

Material. — A dozen moulds and imprints with partly preserved valves, five of them fairly well preserved. ZPAL Mo. XIII/8-13.

Description. — Valves variable in outline, obliquely rounded to obliquely oval, with length ranging from 10 to 25 mm, height ranging accordingly from 8 to 23 mm. Umbo most commonly low, a little protruding beyond hinge margin (pl. 43:3-4). Posterior auricle long (5 to 15 mm), with its ventral margin more or less sinusoidal (pl. 38:2-4). Growth lines more numerous and fine in the proximity of umbo than elsewhere. Well developed, radial, primary and secondary ribs with their maximum width (0·5 and 0·2 mm, respectively) attained in the ventral region. Inter-rib spaces fairly wide, up to 1·5 mm for primaries (pl. 38:4).

Remarks. — The investigated specimens most closely resemble those recorded in the Festungsprofil-Lokalität I, Spitsbergen accompanied by *Cardioceras* cf. *kitchini* SALF, and attributed by SOKOLOV and BODYLEVSKY (1931:32, pl. 9:2) to *Oxytoma inaequivalvis* SOVERBY cf. *expansa* PHILLIPS. The difference consists of less numerous radial ribs and more pointed and protruding umbo shown by the specimens under study. This difference may, however, fall within the range of intraspecific variability.

Occurrence. — 177-180 m above the section base. *Oxytoma inaequivalvis* SOWERBY cf. *expansa* PHILLIPS appears widely distributed in Triassic to Valanginian strata of the Arctic regions (FREBOLD and STOLL 1937:47) as well as of Siberia and West Europe (BODYLEVSKY and SULGINA 1958:52).

Family **Pectinidae** RAFINESQUE, 1815
Subfamily **Pectininae** RAFINESQUE, 1815
Genus *Camptonectes* AGASSIZ, 1864
Subgenus *Camptochlamys* ARKELL, 1930

Camptonectes (*Camptochlamys*) sp. indet.
(pl. 39: 4; pl. 40:2)

Material. — Three fragmented moulds. ZPAL Mo. XIII/16-19.

Description. — The investigated specimens are fragments of large-sized forms, as they exceed 50 mm in size. The valve surface is ornamented with concentric folds variable in size and with indistinct growth lines (pl. 40:2). In a single specimen, the umbonal region is ornamented with fine, radial rectilinear striae (up to 20 per 5 mm). Where radial striae cut across growth lines, a fine net appears with slight swellings at the points of intersection (pl. 39:4).

Remarks. — The investigated specimens resemble in valve dimensions and outline those

collected 1·5 km west of Kapp Delta, Spitsbergen, and identified by SOKOLOV and BODYLEVSKY (1931:56) as *Pecten* (*Camptonectes*) sp. *D*. However, the latter forms display bifurcating radial ribs instead of rectilinear ones. Rectilinearity of ribs is actually the criterion for recognition of the subgenus (HERTLEIN 1969 in Treatise, N352).

Occurrence. — 177-180 m above the section base. *Camptonectes* (*Camptochlamys*) ARKELL has been reported from the Bajocian to Volgian. Its type species was described from the Upper Jurassic of West Germany, namely the lower "Coral rag" near Heersum (ROEMER 1839:27, pl. 18:23).

Subfamily **Chlamydinae** KOROBKOV, 1960
Genus *Chlamys* RÖDING, 1798
Subgenus *Aequipecten* FISCHER, 1886

Chlamys (*Aequipecten*) cf. *arachnoideus* (SOKOLOV and BODYLEVSKY, 1931)
(pl. 40:1)

Material. Imprint of a single fragment of the right valve. ZPAL Mo. XIII/15.

Description. — Specimen of 4 mm in length, height close to 4 mm. Well preserved ornamentation consisting of very fine, numerous (up to 13 per 1 mm), radial striae and concentric growth lines. Thicker growth lines occur more or less regularly (pl. 40:1a-b). Minute nodes appear at points of intersection of radial and concentric ornamentation elements.

Remarks. — The ornamentation makes the investigated specimen similar to *Chlamys* (*Aequipecten*) *arachnoideus* (SOKOLOV and BODYLEVSKY 1931) recorded 1·5 km west of Kap Delta, Spitsbergen (SOKOLOV and BODYLEVSKY 1931:61, pl. 4:10-11)). *Chlamys* (*Aequipecten*) cf. *arachnoideus* was also reported from the "Fossilniveau 20", Spitsbergen (FREBOLD and STOLL 1937:34). The type material described by SOKOLOV and BODYLEVSKY (1931) comprises small-sized, isometric (14·25 mm in length, 14 mm in height), rounded in outline forms with up to 150 radial ribs per valve.

Occurrence. — 177-180 m above the section base. *Chlamys* (*Aequipecten*) *arachnoideus* (SOKOLOV and BODYLEVSKY) was recorded in the Lower Volgian of Spitsbergen (SOKOLOV and BODYLEVSKY 1931:61; FREBOLD and STOLL 1937:34, 51, 59).

Family **Buchiidae** COX, 1953
Genus *Buchia* ROUILLIER, 1845
Buchia bronni (LAHUSEN, 1888)
(pl. 40:4-6)

1975. *Buchia bronni* (LAHUSEN, 1888); PUGACZEWSKA, 67, pl. 5:5-8 (see synonymy).

Material. — A dozen considerably flattened moulds and imprints, most commonly in accumulations. ZPAL Mo. XIII/42-44.

Remarks. — Valves with length ranging from 20 to 33 mm, height ranging accordingly from 22 to 36 mm, (pl. 40:4-6) that is larger than those described previously by the present author from the Southwest Torrell Land, Spitsbergen (PUGACZEWSKA 1975:67, pl. 5:5-8). One may suppose that the investigated material includes only adult and gerontic specimens accumulated due to a selection process. Aside of the size, the specimens derived from the two localities are entirely consistent in morphology. It is noteworthy that in the specimens from

Myklegardfjellet the radial striae commonly occur in pairs and undulate a little between every two successive growth lines (pl. 40:4-6).

Because of close similarity in ornamentation, dimensions, and outline, some authors (FREBOLD, MOUNTJOY and REED 1959:28, pl. 8:4-5) consider the name *Buchia bronni* as a junior synonym of *Buchia concentrica* (SOWERBY 1827). The present author is of the opinion that this may indeed be the case.

Occurrence. — 110 m above the section base. *Buchia bronni* (LAHUSEN) is widely distributed in the Upper Jurassic. It was recorded in the Oxfordian to Lower Volgian of Spitsbergen (PUGACZEWSKA 1975); Oxfordian to Upper Kimmeridgian of Symbirsk region, Soviet Union (SOKOLOV and BODYLEVSKY 1931:34); Oxfordian of Rocky River, Carbondale River, southern Alaska, Llama Mountain (along with *Cardioceras* (?) sp. indet.), Shale Banks region, Snake Indian River, and Fiddle River section (FREBOLD, MUONTJOY, and REED 1959:28); Oxfordian to Kimmeridgian of eastern and northeastern Greenland (RAVN 1911:455); Upper Oxfordian to Lower Kimmeridgian of Central Yukon, British Mts, Richardson Mts, and North Alaska (FREBOLD, MOUNTJOY and TEMPELMAN-KLUIT, 1967:10-11).

Buchia bronni (LAH. 1888) cf. *lata* (TRAUTSCHOLD, 1860)
(pl. 41:10-11)

Material. — Two moulds presenting both valves, and a single fragment of a left valve. ZPAL Mo. XIII/20-21.

Description. — Medium-sized specimens. Left valve elongate, obliquely-oval in outline, with a lobe-like widened postero-ventral region, 38 mm in height, 24 mm in length. Conspicuous, curved umbo displaced posteriorly (pl. 41:11). The crest line (*sensu* JELETZKY 1966: 24), that is the axis running through the most elevated points of growth lines and folds is displaced posteriorly in the umbonal region, while situated more or less centrally in the proximity of ventral margin. The right valve is rounded, with height of 24 mm and length of 20 mm (pl. 41:10). Both valves are ornamented with growth lines along and short radial striae with fairly wide and high folds, the latter becoming most prominent in the ventral region.

Remarks. — The investigated specimens closely resemble *Buchia bronni lata* (TRAUTSCHOLD in the outline of the valves and ornamentation. The left valve is not illustrated however (FREBOLD, 1930:22-23, pl. 9:8). The only difference is that the folds on specimen of the right valve under study are larger and more prominent. This difference may actually fall within the range of intraspecific variability. The specific identification appears, however, tentative because of the lack of complete specimens in comparative work (FREBOLD, 1930).

Occurrence. — 111-112 m above the section base. *Buchia bronni* (LAH.) cf. *lata* (TRAUTSCHOLD) was recorded in the Lower Kimmeridgian stratum B of Keilhaufjellet section, Spitsbergen and in the strata with "*Hoplites*" and "*Cardioceras*" *alternans* of the Soviet Union (FREBOLD, 1930:23).

Buchia pallasi cf. *tenuistriata* (LAHUSEN, 1888)
(pl. 40:7; pl. 41:8-9)

Material. — A few moulds and imprints presenting both right and left valves, commonly in accumulations. ZPAL Mo. XIII/22-24.

Description. — Medium-sized specimens. Left valve obliquely oval in outline, with height ranging from 35 to 70 mm, and length ranging accordingly from 24 to 50 mm. The

crest line is a little displaced posteriorly. The right valve is rounded in outline, with height ranging from 33 to 42 mm, and length ranging accordingly from 30 to 36 mm; inconspicuous umbo is situated more or less media ¹y (pl. 40:7; pl. 41:8). Valves are ornamented with distinct growth lines and folds, the latter so times attaining a considerable width, rather regularly, and densely (1-2 mm in space in betwee) spaced in the ventral region (pl. 3:7). Short, radial striae occur in some specimens (pl. 41:9).

Remarks. — The investigated specimens most closely resemble in their ornamentation, dimensions and outline of the right valve those reported from Spitsbergen by FREBOLD (1930, 22, pl. 9:5-7) under the name of *Buchia* cf. *pallasi tenuistriata* (LAHUSEN). The latter forms show however, an arcuate outline of left valve. This difference may be an artifact of the fossilisation process.

Occurrence. — 177-180 and 241 m above the section base. *Buchia* cf. *pallasi tenuistriata* (LAHUSEN) was recorded in the Lower Kimmeridgian stratum B of Keilhaufjellet section, Spitsbergen, and in the strata with "*Hoplites*" and "*Cardioceras*" *alternans* of the Soviet Union (FREBOLD 1939:22, pl. 9:5-7).

Buchia fischeriana (d'ORBIGNY, 1845)

(pl. 41:1-7)

1966. *Buchia fischeriana* (d'ORBIGNY, 1845); JELETZKY, 25, pl. 4:3; pl. 7:2-3; pl. 8:2-6, 8-9.
1969. *Aucella fischeriana* (d'ORBIGNY); GERASIMOV, 57, pl. 7:5, 7 (see synonymy).

Material. — Numerous moulds sometimes along with valves, commonly in mass accumulations; mostly juveniles. ZPAL Mo. XIII/25-32.

Description. — Small to medium-sized specimens, with height ranging from 4·5 to 17 mm, length and valve convexity ranging accordingly from 3 to 13·5 mm, and 2 to 10 mm, respectively. The largest convexity is attained in the dorsal region (pl. 41:3-7). Valves are obliquely oval in outline, with a lobe-like widened postero-ventral part. The left valve is larger than the right one, with small, pointed, arcuate, somewhat prosogyrous umbo not overhanging the right valve (pl. 41:6). The crest line is arcuate, running towards the postero-ventral margin (pl. 41:3*b*, 5*b*, 7*b*). The posterior auricle is small-sized, triangular in outline (pl. 41:5*a*, 5*b*, 7*b*). The right valve is rounded in outline, with the largest convexity attained just below the umbo but sometimes is flattened with a small and blunt umbo (pl. 41:7a). Some valves are obliquely triangular in outline which makes them close to the subspecies *trigonoides* LAHUSEN, 1888 (pl. 41:4). Valves are ornamented with growth lines and numerous, regularly spaced, conspicuous growth folds (more than 20 concentric folds on a juvenile valve 4·5 mm high; (pl. 41:1, 3). Specimens attributed to the subspecies *trigonoides* show also radial striae (pl. 41:4).

Remarks. — The investigated specimens are entirely consistent with *Buchia fischeriana* (d'ORBIGNY, 1845) as described and illustrated in the papers referred to in the synonymy. The only difference is that the specimens under study are smaller which may indicate that these are juvenile individuals.

Occurrence. — 335 m above the section base. *Buchia fischeriana* (d'ORBIGNY) was recorded in the Lower Volgian of Kapp Delta and Jansenhaugen, Spitsbergen (FREBOLD 1930: 39, pl. 14:1-2), and in the Upper Volgian to *Berriasella rjasanensis* Zone, as well as in the so-called "Neokomen Sandstein" of the "Petschora-Land" (SOKOLOV and BODYLEVSKY 1931, 38). In the Arctic region of Canada, *Buchia fischeriana s. l.* appears restricted to the lower Upper Volgian, which permits recognition of a local stratigraphic unit, *Buchia fischeriana* Zone. (JELETZKY, 1966:25, 30). According to GERASIMOV (1969: 58), it ranges from the *Virgatites virgatus* and *Epivirgatites nikitini* Zones up to the *Riasanites rjasanensis* Zone in the Lower Cretaceous of the Russian Platform.

Subclass **Heterodonta** NEUMAYER, 1884
Order **Veneroida** ADAMS and ADAMS, 1856
Superfamily **Lucinacea** FLEMING, 1828
Family **Mactromyidae** COX, 1929
Genus *Unicardium* d'ORBIGNY, 1850
Unicardium sp. indet.
(pl. 42:1, 6*a*)

Material. — Numerous, more or less deformed moulds. ZPAL Mo. XIII/33, 33A.

Description. — Medium-sized valves, rounded oval in outline, a little protruding anterodorsally, with height of 20 to 23 mm, and length of 25 to 30 mm. The umbo wide, submedial, a little displaced anteriorly (pl. 42: 1, 6*a*). The dorsal margin a little depressed anteriorly to umbo. The posterior margin narrow. The valve surface is ornamented with irregularly spaced, concentric striae variable in width, and fine growth lines. The valve outline remains unchanged in ontogeny.

Remarks. — The specimens under study resemble in valve outline, dimensions, and ornamentation those assigned by MORRIS and LYCETT (1855:73, pl. 8:7-8) to *Unicardium varicosum* (SOWERBY, 1819) but the latter forms are less rounded in outline and more convex. From those identified by SOKOLOV and BODYLEVSKY (1931:74) as *Unicardium* sp., the investigated specimens differ in having less elongate valves and greater height.

Occurrence. — 177-180 m above the section base. *Unicardium varicosum* (SOWERBY) was described from the "Great Oolite" of South England (MORRIS and LYCETT 1853, pl. 8: 7, 7*a*, *b*). *Unicardium* sp. was collected in the Lower to Upper Kimmeridgian horizons 7-8 and 13 of the Festungsprofil, Spitsbergen (SOKOLOV and BODYLEVSKY 1931: 74, 110; FREBOLD and STOLL 1937:17, pl. 1:4).

Superfamily **Crassatellacea** FÉRUSSAC, 1822
Family **Astartidae** d'ORBIGNY, 1844
Subfamily **Astartinae** d'ORBIGNY, 1844
Genus *Astarte* SOWERBY, 1816

Astarte (*Astarte*) cf. *nummus* SAUVAGE, 1871
(pl. 43:1)

Material. — A single left valve with somewhat damaged anterior part, and numerous crushed moulds. ZPAL Mo. XIII/38-39.

Description. — Medium-sized, suboval valve approximately 10 mm in height, 12 mm in length, and 4 mm in convexity (the largest convexity attained just below the umbo). Umbo inconspicuous, a little protruding, prosogyrous (pl. 43:1a-c). Dorsal margin declining obliquely towards the anterior extremity, while close to rectilinear posteriorly. Anterior margin narrower and more elongate than the posterior one (pl. 43:1a). Fairly shallow and wide lunule with a length of some 3 mm and width of 1 mm. Valve surface ornamented with 26 concentric ribs and numerous, fine growth lines. The ventral side of the ribs adheres to the valve surface, while the dorsal side stands out a little (pl. 43: 1a-b). A slight convexity runs from the posterodorsal margin towards the postero-ventral one, where ribs are bent in the form of a deep sinus (pl. 43:1a-b). Ribs become irregular, commonly anastomosing in the posterior region. The hinge with slightly damaged cardinal teeth is preserved at the internal surface (pl. 43:1c).

Remarks. — The above described valve most closely resembles in its outline and dimensions those attributed by ARKELL (1934:241, pl. 31:4; pl. 34:37) to *Astarte* (*Astarte*) *nummus* SAUVAGE, 1871. It differs, however, from the latter in the occurrence of anastomosing ribs in its posterior region. This difference may actually fall within the range of intraspecific varia-

bility, which appears indeed very wide in the species under discussion (ARKELL 1934). Several "species" (*Astarte depressioides* LAHUSEN, 1883, and *A. depressioides* ILOVAISKY, 1904, among others) have been included by ARKELL (1934:242) to *Astarte* (*A.*) *nummus* SAUVAGE.

Occurrence. — 122 m above the section base. *Astarte* (*Astarte*) *nummus* SAUVAGE was described from the Upper Oxfordian *Clavellata* Beds of England (ARKELL 1934:241). Its junior synonym *Astarte depressioides* was recorded in the Oxfordian to Lower Kimmeridgian of Moskva and Riasan area, Soviet Union, and in the equivalent horizons 4 to 7 of the Festungsprofil, Spitsbergen (SOKOLOV and BODYLEVSKY 1931:73; FREBOLD and STOLL 1937:15).

Genus *Prorokia* BÖHM, 1893

Prorokia cf. *problematica* (BUVIGNIER, 1852)

(pl. 43:2)

Material. — A single right valve and a fragment of ventral margin of another specimen. ZPAL Mo. XIII/41, 41A.

Description. — Medium-sized valve subrectangular in outline, with length of about 13·5 mm, height of about 9 mm, and convexity approximately 5 mm (the largest convexity attained at mid-height; pl. 43:2b). The umbo low and wide, prosogryous, not protruding displaced anteriorly. The dorsal margin declining obliquely both anteriorly and posteriorly. The anterior margin narrow, the posterior margin wide, and the ventral one close to rectilinear. The hinge margin is long and straight, a little depressed anteriorly to umbo (pl. 43:2b). No lunule or nympha. Wide, elongate elevation extends from the umbo towards the postero-ventral margin. The valve surface is ornamented with 18 wide and high ribs, still widened and bent in form of a sinus at the elevation (pl. 6:2a). The inter-rib spaces are wider than the ribs themselves, except for the elevation where the situation is reverse. Both ribs and interrib spaces are covered with growth lines. Angular inflection at mid-height of the valve results in the formation of a limbus with a maximum width of some 4 mm but wedging out laterally. The limbus is ornamented exclusively with growth lines (pl. 43:2a). The internal side of the ventral margin is minutely denticulated (pl. 43:2c). No hinge is preserved.

Remarks. — The investigated specimens resemble *Prorokia problematica* (BUVIGNIER) in their dimensions and asymmetrically situated elevation. They differ from the latter in less numerous, wider, and higher ribs and the occurrence of a limbus (see ARKELL 1934:254, pl. 33:11-13). These differences may, however, fall within the wide range of intraspecific variability.

Occurrence. — 122 m above the section base. *Prorokia problematica* (BUVIGNIER) was described from the Upper Oxfordian *Clavellata* Beds and Osmington Oolite of Dorset, Steeple Ashton, Wilts, and Osmington, England. It was also recorded in the Upper Oxfordian strata at Tonnerre, France (LORIOL 1893:109, pl. 8:8-9); and in the Lower Kimmeridgian deposits at Nattheim, West Germany (QUENSTEDT 1858:763, pl. 93:25-26, 33). This species has insofar not been reported from Spitsbergen.

Superfamily **Tellinacea** de BLAINVILLE, 1814

Family **Quenstedtiidae** COX, 1929

Genus *Quenstedtia* MORRIS and LYCETT, 1855

Quenstedtia cf. *subaequilatera* (LYCETT, 1863)

(pl. 42:4, 6b)

Material. — Imprints and moulds, mostly flattened and damaged, two of them fairly well preserved. ZPAL Mo. XIII/36, 36A.

Description. — Medium-sized left valve is obliquely oval in outline, with length exceeding 20 mm, height approximately 17 mm. Umbo low, not protruding, displaced anteriorly. The

dorsal margin declines obliquely both anteriorly and posteriorly. The anterior margin is narrow, shorter than the posterior one; the latter widely rounded. The valve surface is ornamented with indistinct growth lines parallel to valve outline (pl. 42:4, 6b).

Remarks. — The specimens under study most closely resemble in their dimensions, size, and ornamentation the species *Quenstedtia subaequilatera* (LYCETT) but they differ from the latter in their less elongate outline and weaker development of the posterior angle (LYCETT 1863:69, pl. 35:12). These differences may, however, be artifacts of fossilization process.

Occurrence. — 170 and 177-180 m above the section base. *Quenstedtia subaequilatera* (LYCETT) was described from the Inferior Oolite of Radborough Hill near Stroud, Cornbrash of Scarborough, both localities in South England, and from the time equivalent strata of Leckhampton Hill (LYCETT 1863:69, pl. 35:12). *Corbicella* sp., which is actually a junior synonym of the generic name *Quenstedtia* MORRIS and LYCETT, was recorded in the Lower Volgian horizons 16, 18 and 20 of the Festungsprofil, Spitsbergen (FREBOLD and STOLL 1937:18, pl. 1:6).

Quenstedtia cf. *subangulata* (LYCETT, 1863)

(pl. 42:5)

Material. — A dozen imprints and moulds, commonly crushed, one of the moulds fairly well preserved. ZPAL Mo. XIII/37.

Description. — Medium-sized valve oval in outline, 23 mm long, 12 mm high. The umbo low, somewhat protruding, displaced anteriorly. The dorsal margin declines obliquely and is slightly depressed anteriorly to umbo; a wide inconspicuous keel runs from the postero-dorsal margin towards the postero-ventral one (pl. 42: 5). Growth lines are indistinct except for the ventral region where they become more apparent.

Remarks. — The specimens under study most closely resemble *Quenstedtia subangulata* (LYCETT) but their poor preservation permits merely a tentative identification (see LYCETT 1863:70, pl. 40:9).

Occurrence. — 170 m above the section base. *Quenstedtia subangulata* (LYCETT) was described from the Forest Marble Laycock, England (LYCETT 1863). It was also recorded in the uppermost Kimmeridgian to Lower Volgian horizons 9 and 16 of the Festungsprofil, Spitsbergen (FREBOLD and STOLL 1937: 18, 48, pl. 1:5).

Superfamily **Arcticacea** NEWTON, 1891

Family **Arcticidae** NEWTON, 1891

Genus *Isocyprina* ROEDER, 1882

Subgenus *Venericyprina* CASEY, 1952

Isocyprina (*Venericyprina*) sp. indet.

(pl. 42:2-3; pl. 43:6)

Material. — A dozen moulds and imprints, a few of them fairly well preserved. ZPAL Mo. XIII/34, 34A, 35.

Description. — Medium-sized valve obliquely triangular in outline, 22 to 25 mm high, 21 to 23 mm long. The umbo is low, rounded, not protruding, submedially situated. The dorsal margin is widely arcuate. The ventral margin reaches the posterior one at a more or less obtuse angle (pl. 42:3). The anterior margin is rounded, convex. An indistinct keel running from postero-dorsal margin towards the postero-ventral one separates the posterior flat region of the valve from the anterior, convex one (pl. 42:2-3; pl. 43: 6). The valve outline remains unchanged in ontogeny, as indicated by growth lines with a posterior angle.

Remarks. — The investigated specimens most closely resemble in their dimensions, valve outline, and ornamentation those assigned by FREBOLD and STOLL (1937:21) to *Isocyprina*

sp. Because of their angular, somewhat truncated, sometimes rostrum-like elongate postero-ventral extremity, the latter forms were recognized by CASEY (1952:136) as a distinct subgenus *Venericyprina*. Therefore, the specimens under study are also attributed to this subgenus even though more precise identification is impossible because of their poor preservation.

Occurrence. — 241, 318-325, and 355 m above the section base. The subgenus *Isocyprina* (*Venericyprina*) CASEY is widely distributed in the Kimmeridgian to Aptian strata of Europe (MYRA KEEN and CASEY 1969 in Treatise N648). *Isocyprina* (*Venericyprina*) sp. (FREBOLD and STOLL) was described from the Lower Volgian horizon 20 of the Festungsprofil, Spitsbergen (FREBOLD and STOLL 1937:21, 50, pl. 1:7). It was also recorded in the Kimmeridgian to Aptian of Europe (CASEY 1952:136; MYRA KEEN and CASEY 1969 in Treatise N648).

Subclass **Anomalodesmata** DALL, 1889
Order **Pholadomyoida** NEWELL, 1965
Superfamily **Pholadomyacea** GRAY, 1847
Family **Pholadomyidae** GRAY, 1847
Genus *Goniomya* AGASSIZ, 1841
Subgenus *Goniomya* AGASSIZ, 1841

Goniomya cf. *dubois* AGASSIZ, 1842
(pl. 43:5)

Material. — Imprint of a single fragment of a valve. ZPAL Mo. XIII/40.

Description. — The investigated fragment is 30 mm high and 15 mm long. Ornamented with V-shaped ribs interconnected on the subumbonal part of the specimen with short transverse ribs, while on the ventral part of the specimen contacting directly with one another at an angle close to 90°. In the posterior region of the specimen, lateral ribs cut the transversal ones at a larger angle (ca 140°) than in the anterior one. The posterior ribs are arcuate, while the anterior ones rectilinear (pl. 43:5). In the median part of the valve fragment, ribs increase from 0·5 to 1·5 mm in width, and inter-rib spaces increase from 1 to 3 mm in width through ontogeny.

Remarks. — The investigated specimen closely resembles in ornamentation those assigned by GERASIMOV (1955: 83, pl. 19:1-2) to *Goniomya dubois* AGASSIZ, 1842, attaining up to 50 mm in length. The lack of a complete specimens makes this assignment tentative.

Occurrence. — 241 m above the section base. *Goniomya dubois* AGASSIZ was described from the Lower to Middle Callovian and Lower Volgian of Moskva and Riasan area, Soviet Union, and from the Callovian (?) of Switzerland. The species *Goniomya elegantula* TULLBERG, 1881, included recently by GERASIMOV (1969:81) into the synonymy of *G.* cf. *dubois*, was recorded in the Volgian deposits 1·5 km west of Kapp Delta, Spitsbergen (SOKOLOV and BODYLEWSKI 1931:76).

BELEMNITES

Family **Cylindroteuthididae** STOLLEY, 1919
Subfamily **Cylindroteuthidinae** STOLLEY, 1919
Genus *Cylindroteuthis* BAYLE and ZEILLER, 1878

Cylindroteuthis (*Cylindroteuthis*) *oweni* cf. *oweni* (PRATT, 1844)
(pl. 45:7-8; pl. 46:5-8)

Material. — Ten fragments of rostra at variable developmental stages. ZPAL Mo. XIII/46-51.

Description. — Medium-sized, subcylindrical rostra rounded to oval in cross section, with the dorso-ventral diameter a little larger than the lateral one. Lateral sides flat and wide

extending along the rostrum somewhat obliquely, closer to the dorsal side than to the ventral one (pl. 46:6c, 8c). The dorsal side is convex, the ventral side flattened (pl. 45: 7c-d; pl. 46: 6c, 8c). The apical part narrows very slowly, passing finally to a more or less blunt apex. Several radial striae appear on a well preserved apex (pl. 46:5). The apical furrow is fairly narrow and shallow (pl. 45; 8a; pl. 46:7a), but sometimes widens up to 4 mm (pl. 45: 7a).

The investigated specimens are more or less fragmentary. Their dorso-ventral and lateral diameters range from 4 to 5 mm at about 5 mm above the apex; their maximum dorso-ventral diameter ranges from 9 to 18 mm, while the maximum lateral diameter ranges from 10 to 17·5 mm. Juvenile rostra are elongate, slender, circular in cross section, with a narrow, shallow, and long (half the length of a rostrum) apical furrow, and the apical line displaced a little ventrally (pl. 45:8a-c).

The change occurring during ontogeny concerns the ralative increase in rostrum length *versus* diameter, the change from circular to oval cross section, widening of lateral sides and their displacement towards the dorsal side (pl. 45:7-8; pl. 46:5-8).

Intraspecific variability concerns mostly the cross section of the rostrum, elongation and slenderness of its apical part, and the dimensions of the apical furrow (wide and very short to narrow and long).

Remarks. — The investigated rostra most closely resemble those attributed by SAKS and NALNAEVA (1964:45, pl. 1:5-6; pl. 2:1) to *Cylindroteuthis* (*Cylindroteuthis*) *oweni oweni* (PRATT, 1844), as well as the species *Cylindroteuthis* (*Cylindroteuthis*) *puzosi* GUSTOMESOV as described by GUSTOMESOV (1964:119, pl. 1:1-2). *Cylindroteuthis* (*C.*) *puzosi* was considered by SAKS and NALNAEVA (1964) as a junior synonym of *Cylindroteuthis* (*C.*) *oweni oweni* (PRATT). Rostra of this species attain up to 220 mm in length, 22·7 mm in dorso-ventral diameter, and 19·8 mm in lateral diameter.

Occurrence. — 109-155 m above the section base. *Cylindroteuthis* (*C.*) *oweni oweni* (PRATT) was recorded in the Upper Callovian to Oxfordian of the European part of the Soviet Union, Callovian of West Canada, Upper Oxfordian of Greenland (IVANOVA 1959:369, pl. 17:1-2); Middle Callovian to Kimmeridgian of the Russian Platform, Oxfordian of France (GUSTOMESOV 1964:119, pl. 1:1-2); and Kimmeridgian of Taimyr, North Siberia (SAKS and NALNAEVA 1964:45, pl. 1:5-6; pl. 2:1). *Cylindroteuthis* (*C.*) *puzosi* GUSTOMESOV was reported from the Oxfordian to Upper Kimmeridgian horizon 9 of the Festungsprofil, Spitsbergen (SOKOLOV and BODYLEVSKY 1931:104).

Cylindroteuthis (*Cylindroteuthis*) *oweni* cf. *cuspidata* SAKS and NALNAEVA, 1964

(pl. 44:1-4; pl. 46:4)

Material. — A dozen fragments of rostra at variable development stages. ZPAL Mo. XIII/52-56.

Description. — Medium to large-sized rostra, subconical in their apical part (pl. 46: 4*a-b*), subcylindrical adapically. The rostra oval in cross section, with the dorso-ventral diameter larger than the lateral one (pl. 44:1*b-f*, 2*c*), except for their apical part rounded in cross section (pl. 44:1*c*). Lateral sides flat and wide; displaced dorsally in adult specimens (pl. 44: 1*d-f*, 2*c*), located symmetrically, narrower and delimited by ventrally depressed lateral furrows in juveniles (pl. 44:1*d-e*). Ventral and dorsal sides are considerably convex, the latter being a little wider than the former. Lateral sides are more or less flattened. The apical part is long, decreasing gradually in diameter down to a more or less pointed apex. The apical furrow is narrow and shallow sometimes very short (pl. 44:4*a-b*; pl. 46: 4*a-b*).

The largest investigated specimen is 130 mm long, with the maximum dorso-ventral diameter of 30 mm, and maximum lateral diameter of 26 mm (pl. 44:1*a-b*, 1*f*). The smallest specimen is 58 mm long, with diameters equal (7 mm) at the apical part but very different at the adalveolar part where dorso-ventral diameter attains 14 mm, while the lateral one is merely 11·5 mm (pl. 44:4).

The siphonal tube is preserved within the alveole of a single specimen; its diameter approximates 0·5 mm, whereas that of the alveole is 5 mm in that place (pl. 44:2*c*). The apical line is commonly displaced towards the ventral side, but located almost centrally at the apical part of a rostrum (pl. 44:1*c-e*).

The change occurring during ontogeny concerns mostly the change from circular to oval cross section, dorsal displacement of lateral sides, the change from subconical to subcylindrical outline of rostrum, and shallowing of apical furrow.

Remarks. — The investigated specimens most closely resemble those assigned by SAKS and NALNAEVA (1964:47, pl. 3:1-8; fig. 7) to *Cylindroteuthis* (*Cylindroteuthis*) *oweni cuspidata* SAKS and NALNAEVA, 1964. The type material of the subspecies ranges up to 132·7 mm in length, 22·5 mm in dorso-ventral diameter, and 20·8 mm in lateral diameter.

Occurrence. — 109-155 m above the section base. *Cylindroteuthis* (*C.*) *oweni cuspidata* SAKS and NALNAEVA was recorded in the Upper Oxfordian to Kimmeridgian of the Petschora basin, northern Russia, and the Cheta basin, Northwest Siberia; and in the Kimmeridgian of England and France (SAKS and NALNAEVA 1964:47, pl. 3:1-8; fig. 7).

Genus *Lagonibelus* GUSTOMESOV, 1956
Subgenus *Holcobeloides* GUSTOMESOV, 1956
Lagonibelus (*Holcobeloides*) cf. *beaumonti* (d'ORBIGNY, 1842)

(pl. 45:1-4)

Material. — A few eroded fragments of rostra. ZPAL Mo. XIII/60-63.

Description. — Medium-sized, subcylindrical rostra irregularly oval in cross section, with the lateral diameter larger than the dorso-ventral one (pl. 45:1*b*, 3*b-d*, 4*b*). The lateral and dorsal sides are rounded, the ventral side has a furrow up to 9 mm in width. The ventral furrow is distinct all over the rostrum in length, changing from V- to U-shaped in ontogeny (pl. 45:1*b*, 2*b*, 3*a-d*, 4*b*). A secondary fissure commonly occurs at the bottom of a furrow, formed through erosion of growth lamellae. Lateral furrows are weakly developed, discernible merely in cross section.

The largest investigated fragment is 95 mm long, with the dorso-ventral diameter ranging up to 19 mm and the lateral one up to 21 mm (pl. 45:3*a*).

Juvenile rostra are circular in cross section, with a deep, V-shaped apical furrow persistent up to the mid-length of rostra (pl. 45:1*b*, *2b*).

Large intraspecific variability concerns all the morphological characteristics, especially the depth and width of the ventral furrow.

Remarks. — The investigated specimens most closely resemble those of *Lagonibelus* (*Holcobeloides*) *beaumonti* (d'ORBIGNY, 1842) which attain up to 118 mm in length, 16 mm in the dorso-ventral diameter, and 17·5 mm in the lateral diameter (GUSTOMESOV 1964:148, pl. 9:1-7); the latter show, however, a more regular cross section and narrower apical furrow. These differences may be due to the poor preservation state of the material under study.

Occurrence. — 109-155 m above the section base. *Lagonibelus* (*Holcobeloides*) *beaumonti* (d'ORBIGNY) was reported from the Callovian of France, and Middle Callovian to Oxfordian of the Russian Platform, West Siberia, and England (GUSTOMESOV 1964: 148; SAKS and NALNAEVA 1964:109).

Lagonibelus (*Holcobeloides*) cf. *pavlovi* SAKS and NALNAEVA, 1964

(pl. 45:5; 6)

Material. — Two fragments of juvenile rostra. ZPAL Mo. XIII/58-59.

Description. — Small to medium-sized, subcylindrical rostra subcircular in cross section, with rounded dorsal and lateral sides, flattened ventral side (pl. 45:5-6). A very shallow

apical furrow entirely covers the ventral side of the investigated specimens (pl. 45: 5*a-c*; 6*a-c*).

The larger specimen presents the median part of a rostrum. It is 38 mm long, with the dorso-ventral diameter ranging up to 7·5 mm, the lateral one up to 9·5 mm (pl. 45: 6*a-c*). The apical line is situated very close to the ventral side (pl. 45:5*c*, 6*c*).

Remarks — The investigated specimens resemble *Lagonibelus* (*Holcobeloides*) *pavlovi* SAKS and NALNAEVA, 1964 in their subcylindrical outline and characteristically wide and flat apical furrow. The only difference is in their small dimensions, as the type material ranges up to 137 mm in length, up to 13·6 mm in dorso-ventral diameter, and up to 15·5 mm in lateral diameter (SAKS and NALNAEVA 1964:116, pl. 27:1-3; fig. 34).

Occurrence. — 109-155 m above the section base. *Lagonibelus* (*Holcobeloides*) *pavlovi* SAKS and NALNAEVA was recorded in the Upper Oxfordian (*Amoeboceras alternans* Zone) to Lower Kimmeridgian of Pachsa Peninsule, North Siberia; and in the Kimmeridgian of Timan Peninsule, northern Russia, and England.

Genus *Pachyteuthis* BAYLE and ZEILLER, 1878
Pachyteuthis (*Pachyteuthis*) cf. *cuneata* GUSTOMESOV, 1960
(pl. 46:9)

Material. — A single slightly damaged rostrum. ZPAL Mo.XIII/57.

Description. — Medium-sized rostrum with length of 112 mm, dorso-ventral diameter of 18 mm, and lateral diameter of 22 mm. The cross section is oval in outline, with obliquely oriented, dorsally displaced lateral sides (pl. 46; 9*c*). The rostrum outline is conical in lateral view, cylindrical in ventral view (pl. 46:9*a-b*). The apical furrow is short, wide, fairly deep owing to erosion of external growth lamellae; it covers a quarter of the length of the rostrum (pl. 46:9*a*). Early developmental stages are more trapezoidal in cross section.

Remarks. — The investigated specimen in its short apical furrow, trapezoidal juvenile cross section, and oval adult cross section resembles *Pachyteuthis* (*Pachyteuthis*) *cuneata* GUSTOMESOV, 1960. It differs from the latter in its wider and deeper apical furrow and more blunt apex but these differences may fall within the range of intraspecific variability.

Occurrence. — 109-155 m above the section base. *Pachyteuthis* (*Pachyteuthis*) *cuneata* GUSTOMESOV was described from the Lower Callovian to Upper Volgian of the European part of the Soviet Union and north Trans-Uralia (GUSTOMESOV 1960: 201, pl. 48:3-4). It was also recorded in the Bathonian to Callovian of Siberia, and Volgian of England (GUSTOMESOV 1964:166, pl. 13:1-6).

Subgenus *Simobelus* GUSTOMESOV, 1956
Pachyteuthis (*Simobelus*) cf. *breviaxis* (PAVLOV, 1892)
(pl. 46:2, 3)

Material. — Two rostra with a slightly damaged alveolar part. ZPAL Mo. XIII/65-66.

Description. — Medium-sized, subconical rostra with rounded, close to subsquare cross section (pl. 46:2*c*). The larger specimen is 65 mm long, with dorso-ventral and lateral diameters ranging up to 20 and 21 mm, respectively (pl. 46:2*a-b*). The ventral side is slightly convex, dorsal side widely arcuate. The apical part of the rostrum is short and swollen. The apex is blunt, ventrally directed (pl. 46:2*b*). The apical furrow extends along the entire length of the rostrum; in the proximity of the alveole, it attains up to 4 mm in width. The apical line is displaced ventrally (pl. 46:3).

Remarks. — The investigated specimens resemble *Pachyteuthis* (*Simobelus*) *breviaxis* (PAVLOV) in their short and swollen apical part, subsquare cross section, location and form

of the apical furrow. They show a slightly more rounded cross section, more convex dorsal side, narrower and longer apical furrow than the latter form but all these differences may fall within the range of intraspecific variability (GUSTOMESOV 1964:174, pl. 16: 2-4).

Occurrence. — 109-155 m above the section base. *Pachyteuthis* (*Simobelus*) *breviaxis* (PAVLOV) was recorded in the Oxfordian to Kimmeridgian of North Siberia, Moskva region, and the Izhma basin; and Upper Jurassic of Boulogne-sur-Mer, France (GUSTOMESOV 1964: 174, pl. 16: 2-4). It was also reported from the Lower Kimmeridgian of Pachsa Peninsule, North Siberia (SAKS and NALNAEVA 1966: 65, pl. 14:5-6; pl. 15:1; pl. 19:4; fig. 20).

Pachyteuthis (*Simobelus*) cf. *kirghisensis* (d'ORBIGNY, 1845)

(pl. 46:1)

Material. — Adalveolar part of a single rostrum. ZPAL Mo. XIII/64.

Description. — Medium-sized, subcylindrical rostrum with transverse oval adapical cross section (pl. 46:1*c*), and subsquare adalveolar cross section with indistinct but discernible traces of lateral lines (pl. 46: 1*d-e*). Fairly narrow lateral flats are located dorsally to lateral lines (pl. 46:1*b*). The lateral and dorsal sides are convex, the ventral side is slightly flattened (pl. 46:1*c*). The investigated specimen is 25 cm long, with adapical dorso-ventral and lateral diameters of 9 and 9·5 mm, respectively; within the alveole, both the diameters are 9·5 mm.

Remarks. — The specimen under study resembles in its subcylindrical shape, subsquare cross section, and lateral flats *Pachyteuthis* (*Simobelus*) *kirghisensis* (d'ORBIGNY, 1845) as illustrated by GUSTOMESOV (1964: 181, pl. 19:1-3) and PAVLOV (1965: 29, pl. 5:1). It has however, much smaller dimensions, a more rounded cross section, and no apical furrow. The investigated rostrum may be a juvenile, while the morphological characteristics of the species may appear later on in ontogeny. One may also suppose that the above mentioned differences fall within the range of intraspecific variability which is indeed fairly wide in the considered species (GUSTOMESOV 1964).

Occurrence. — 109-155 m above the section base. *Pachyteuthis* (*Simobelus*) *kirghisensis* (d'ORBIGNY) was described from the Oxfordian to Kimmeridgian of Kostroma, Ivanovsk, and Orenburg regions, Russian Platform (GUSTOMESOV 1964:181, pl. 19:1-3; PAVLOV 1965, 29; pl. 5:1).

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EXPLANATIONS OF THE PLATES 37-46

All specimens are from the Janusfjellet Formation, (Jurassic-Lower Cretaceous), Myklegardfjellet section. The positions of specimens above the base of the section (see figs. 3-4) are given in meters:

PLATE 37

?Longaeviceras sp.
80-81 m

1. External cast; ZPAL Mo. XIII/71.
2. Part of phragmocone, internal cast; ZPAL Mo. XIII/70.

Amoeboceras (*Amoebites*) cf. *kitchini* (SALFELD, 1915)
110 m

3. Internal cast; ZPAL Mo. XIII/73.
4. Internal cast; ZPAL Mo. XIII/74.

Amoeboceras (*Amoebites*) cf. *salfeldi* SPATH, 1935
111-112 m

5. Internal cast; ZPAL Mo. XIII/72.

Amoeboceras (*Amoebites*) sp.
110 m

6. Last part of body chamber, external cast; ZPAL Mo. XIII/75.

Rasenia (*Zonovia*) *evoluta* SPATH, 1935
110 m

7. External cast; ZPAL Mo. XIII/76

Pectinatites (*?Virgatosphinctoides*) sp.
241 m

8. External cast; ZPAL Mo. XIII/77.

All photographs × 1

Photo: S. Kolanowski

PLATE 38

Palaeonucula isfjordica (BODYLEVSKY *in* SOKOLOV and BODYLEVSKY)
241 m

1. Mould of a left valve; *a* valve surface, × 3, *b* taxodont hinge, × 5; ZPAL Mo. XIII/1.

Oxytoma (*Oxytoma*) *inaequivalvis* (SOWERBY) cf. *expansa* (PHILLIPS)
177-180 m

2. Left valve: *a* imprint, *b* plasticine cast, × 3; ZPAL Mo. XIII/9.
3. Left valve: *a* imprint, *b* plasticine cast, × 2; ZPAL Mo. XIII/11.
4. Mould of a left valve showing large posterior auricle with a deep sinus, × 2; ZPAL Mo. XIII/12.

Solemya cf. *hoeli* SOKOLOV and BODYLEVSKY

170 m

5. Mould of a right valve showing imprints of radial striae along the ventral margin, × 1·5; ZPAL Mo. XIII/3.
6. Mould of a right valve with arcuate striae × 1·5; ZPAL Mo. XIII/4.

Serpula (*Cycloserpula*) cf. *subcrispa* PARSCH

170 m

7. Two tubes, × 5; ZPAL A. III/1-2.

Serpula sp. indet.

177-180 m

8. Longitudinal section showing parabolic form of growth lines and lamellae, × 20; ZPAL A. III/3.

PLATE 39

Solemya cf. *hoeli* SOKOLOV and BODYLEVSKY

170 m

1. Mould of a left valve showing traces of a main rib and divergent, lateral ribs, × 5; ZPAL Mo. XIII/5.
2. Imprint of a right valve showing traces of radial striae along the dorsal margin and indistinct net at its posterior extremity, × 2; ZPAL Mo. XIII/6.
3. Mould showing traces of divergent ribs, × 1; ZPAL Mo. XIII/7.

Camptonectes (*Camptochlamys*) sp. indet.

177-180 m

4. Umbonal part of a valve showing reticulate ornamentation, × 5; ZPAL Mo. XIII/16.

Species-diverse coquinite

241 m

5. Bivalve and serpule-bearing rock sample, × 2; ZPAL Mo. XIII/1.

PLATE 40

Chlamys (*Aequipecten*) cf. *arachnoideus* (SOKOLOV and BODYLEVSKY)

177-180 m

1. Fragment of a valve: *a* imprint, × 4; *b* plasticine cast, × 6; ZPAL Mo. XIII/15.

Camptonectes (*Camptochlamys*) sp. indet.

177-180 m

2. Fragment of a valve, × 1; ZPAL Mo. XIII/16.

Grammatodon (*Grammatodon*) sp.

241 m

3. Fragment of a valve showing angulate growth lines and several fine, radial striae, × 3; ZPAL Mo. XIII/14.

Buchia bronni (LAHUSEN)

110 m

4. Moulds of left valves with undulate, radial striae, × 2; ZPAL Mo. XIII/42.
5. Imprint and moulds with distinct radial ornamentation, × 2; ZPAL Mo. XIII/43.
6. Rock sample crowded with moulds. × 1; ZPAL Mo. XIII/44.

Buchia pallasi cf. *tenuistriata* (LAHUSEN)

241 m

7. Mould of a right valve, note the wide, concentric folds, × 2; ZPAL Mo. XIII/23.

Species-diverse coquinite

241 m

8. Rock sample with *Buchia* aff. *volgensis* (LAHUSEN), and *Serpula* sp. indet., × 2; ZPAL Mo. XIII/25.

PLATE 41

Buchia fischeriana (d'ORBIGNY)

335 m

1. Coquinite showing moulds of juvenile shells grouped in a disorderly manner, × 1·5; ZPAL Mo. XIII/29.
2. Coquinite showing moulds of juvenile shells grouped in an orderly manner, × 5; ZPAL Mo. XIII/31.
3. Mould: *a* right valve, *b* left valve, *c* lateral view, × 5; ZPAL Mo. XIII/26.
4. Mould: note the unusual triangular outline, × 3; ZPAL Mo. XIII/28.
5. Mould of a juvenile shell: *a* right valve, *b* left valve, × 3; ZPAL Mo. XIII/27.
6. Mould of a juvenile shell: *a* antero-lateral view, *b* postero-lateral view, *c* postero-dorsal view; note the bent but not overhanging umbo, × 3; ZPAL Mo. XIII/30.
7. Mould of an adult shell: *a* right valve, *b* left valve, × 3; ZPAL Mo. XIII/32.

Buchia pallasi cf. *tenuistriata* (LAHUSEN)

241 m

8. Mould of a right valve. × 1; ZPAL Mo. XIII/22.
9. Mould of a left valve with low, concentric folds, × 1; ZPAL Mo. XIII/24.

Buchia bronni (LAHUSEN) cf. *lata* (TRAUTSCHOLD)

111-112 m

10. Mould of a right valve, note several wide and convex, concentric folds, × 1·5; ZPAL Mo. XIII/20.
11. Mould of a left valve, × 1·5; ZPAL Mo. XIII/21.

PLATE 42

Unicardium sp. indet.
177-180 m

1. Mould, × 2; ZPAL Mo. XIII/33.

Isocyprina (*Venericyprina*) sp. indet.
318-325 m; 335 m

2. Mould of a left valve with the postero-ventral margin slightly rostrate, × 1·5; ZPAL Mo. XIII/35.
3. Mould, note the angular inflection of growth lines in the proximity of the ventral margin, × 2; Mo. XIII/34.

Quenstedtia cf. *subaequilatera* (LYCETT)
170 m

4. Mould, × 2; ZPAL Mo. XIII/36.

Quenstedtia cf. *subangulata* (LYCETT)
170 m

5. Monospecific coquinite showing disorderly orientation of moulds, × 1; ZPAL Mo. XIII/37.

Species-diverse coquinite
177-180 m

Is of: *a Unicardium* sp. indet., *b Quenstedtia* cf. *subaequilatera*, *c Oxytoma* (*Oxytoma*) *inaequivalvis* cf. *expansa*, × 2; ZPAL Mo. XIII/38.

PLATE 43

Astarte (*Astarte*) cf. *nummus* SAUVAGE
122 m

1. Left valve: *a* fine, anastomosing posterior ribs, × 3; *b* wide, separated from one another anterior to median ribs, × 3; *c* partly preserved hinge, × 5; ZPAL Mo. XIII/39.

Prorokia cf. *problematica* (BUVIGNIER)
122 m

2. Right valve: *a* angularly inflected ventral region, × 5; *b* dorsal view, note the apparent variability in convexity of the valve, × 3·5; *c* denticulated ventral margin, × 5; ZPAL Mo. XIII/41.

Oxytoma (*Oxytoma*) *inaequivalvis* (SOWERBY) cf. *expansa* (PHILLIPS)
177-180 m

3. Left valve: *a* imprint, *b* plasticine cast, × 1·5; ZPAL Mo. XIII/8.
4. Valve with rounded outline, convex umbo, well preserved primary and secondary ribs, × 3; ZPAL Mo. XIII/10.

Goniomya cf. *dubois* AGASSIZ

241 m

5. Fragment of a valve, × 1·5; ZPAL Mo. XIII/40.

Isocyprina (*Venericyprina*) sp. indet.

241 m

6. Imprint, × 1; ZPAL Mo. XIII/34A.

Buchia sp.

241 m

7. Imprint of a valve with convex umbo and a furrow below it, × 2; ZPAL Mo. XIII/45.

Serpula sp. indet.

241 m

8. Partly destroyed tube, × 5; ZPAL A.III/4.

PLATE 44

155 m (scattered down to 109 m)

Cylindroteuthis (*Cylindroteuthis*) *oweni* cf. *cuspidata* SAKS and NALNAEVA

1. Adult rostrum: *a* ventral view, × 1; *b* lateral view, × 1; *c* cross section through the apical part, × 1·5; d-*e* successive cross sections through the median part, × 1·5; *f* cross section through the alveole, × 1·5; ZPAL Mo. XIII/52.
2. Juvenile rostrum: *a* ventral view, × 1; *b* lateral view, × 1; *c* cross section through the alveole, note the siphonal tube high in the phragmocone, × 3; ZPAL Mo. XIII/54.
3. Juvenile rostrum: *a* ventral view, × 1; *b* lateral view, × 1; *c* cross section at the base of the alveole, × 1·5; ZPAL Mo. XIII/55.
4. Apical part of a juvenile rostrum: *a* ventral view, indistinct apical furrow, × 1; *b* lateral view, × 1; *c* cross section at the base of the alveole, × 1·5; ZPAL Mo. XIII/53.

PLATE 45

155 m (scattered down to 109 m)

Lagonibelus (*Holcobeloides*) cf. *beaumonti* (d'ORBIGNY)

1. Anterior part of a rostrum with narrow and deep furrow: *a* ventral view, × 1; *b* cross section, × 1·5; ZPAL Mo. XIII/60.
2. Median part of a rostrum with a wide and shallow furrow: *a* ventral view, × 1; *b* cross section, × 1·5; ZPAL Mo. XIII/61.

3. Adult rostrum: *a* ventral view, note the wide and shallow furrow, × 1; *b-d* successive cross sections with furrow changing gradually from V- to U-shaped outline, × 1·5; ZPAL Mo. XIII/62.
4. Anterior part of a rostrum: *a* ventral view, note the furrow widened by erosion, × 1; *b* cross section, × 1·5; ZPAL Mo. XIII/63.

Lagonibelus (*Holcobeloides*) cf. *pavlovi* SAKS and NALNAEVA

5. Juvenile rostrum: *a* ventral view, × 1; *b* lateral view, × 1; *c* cross section with flat ventral side, × 1·5; ZPAL Mo. XIII/58.
6. Juvenile rostrum: *a* ventral view, note the very wide and shallow furrow, × 1; *b* lateral view, × 1; *c* cross section, note the slightly concave ventral side, × 1·5; ZPAL Mo. XIII/59.

Cylindroteuthis (*Cylindroteuthis*) *oweni* cf. *oweni* (PRATT)

7. Median fragment of a rostrum: *a* ventral view, note the wide and shallow furrow, × 1; *b* lateral view, × 1; *c-d* cross sections at successive early developmental stages, note the flattened ventral side and considerably convex dorsal side, × 3; ZPAL Mo. XIII/46.
8. Juvenile rostrum: *a* ventral view, note the narrow and shallow furrow, × 1; *b* apical part in dorsal view, × 2; *c-d* successive cross sections, × 1·5; ZPAL Mo. XIII/47.

PLATE 46

155 m (scattered down to 109 m)

Pachyteuthis (*Simobelus*) cf. *kirghisensis* (d'ORBIGNY)

1. Fragment of a juvenile rostrum: *a* ventral view, × 1; *b* lateral view, × 1; *c* cross section below the alveole, × 1·5; *d* cross section through the alveole, × 1·5; *e* enlarged cross section through the alveole, note the subsquare outline and incised lateral lines, × 3; ZPAL Mo. XIII/64.

Pachyteuthis (*Simobelus*) cf. *breviaxis* (PAVLOV)

2. Adult rostrum: *a* ventral view, × 1; *b* lateral view, note the convex dorsal side, × 1; *c* cross section, × 1·5; ZPAL Mo. XIII/65.
3. Longitudinal section through a rostrum, × 1; ZPAL Mo. XIII/66.

Cylindroteuthis (*Cylindroteuthis*) *oweni* cf. *cuspidata* SAKS and NALNAEVA

4. Apical part of a rostrum: *a* ventral view, note the narrow and shallow furrow, × 1; *b* lateral view, × 1; *c* cross section, × 1·5; ZPAL Mo. XIII/56.

Cylindroteuthis (*Cylindroteuthis*) *oweni* cf. *oweni* (PRATT)

5. Apical part of a juvenile rostrum covered with longitudinal furrows, × 2; ZPAL Mo. XIII/48.
6. Apical part of an adult rostrum: *a* ventral view, note the short and shallow furrow, × 1; *b* lateral view, × 1; *c* cross section, × 1·5; ZPAL Mo. XIII/49.
7. Apical part of an adult rostrum: *a* ventral view, note the narrow furrow, × 1; *b* lateral view, × 1; ZPAL Mo. XIII/50.
8. Median part of a rostrum: *a* ventral view, × 1; *b* lateral view, × 1; *c* cross section, × 1·5; ZPAL Mo. XIII/51.

Pachyteuthis (*Pachyteuthis*) cf. *cuneata* GUSTOMESOV

9. Adult rostrum: *a* ventral view, note the short and wide apical furrow, × 1; *b* lateral view, × 1; *c* cross section at mid-length, × 1·5; ZPAL Mo. XIII/57.

Pls. 38-46 photo: S. Woźniak
E. Wyrzykowska


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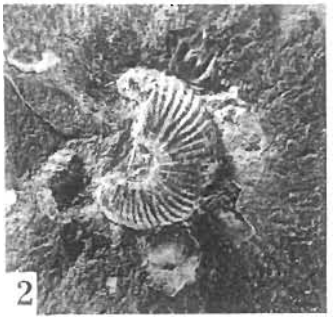
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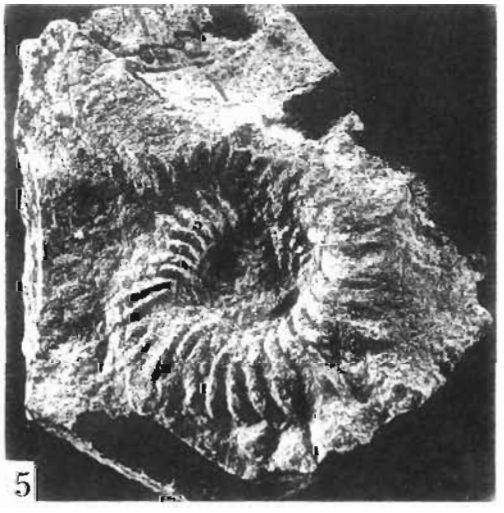
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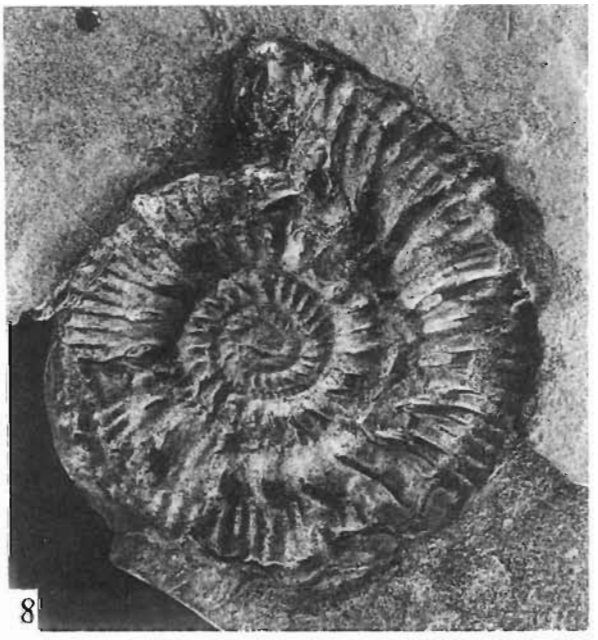
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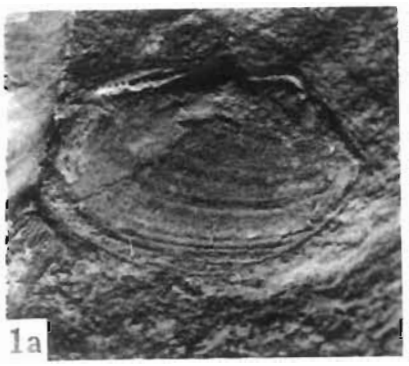
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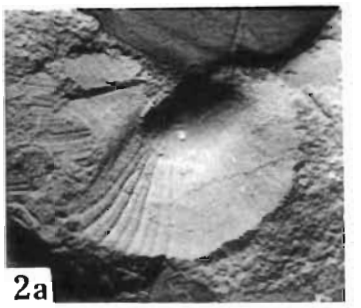
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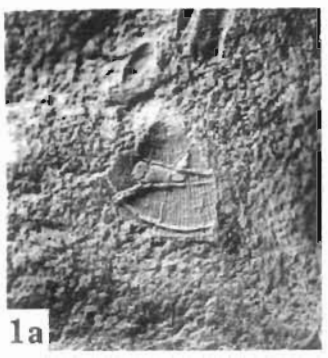
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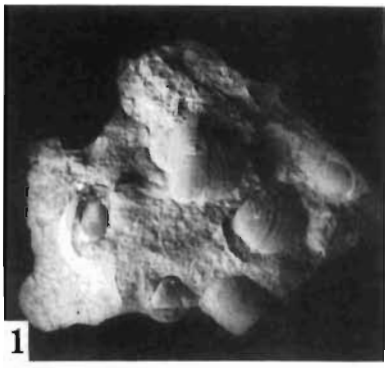
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6c


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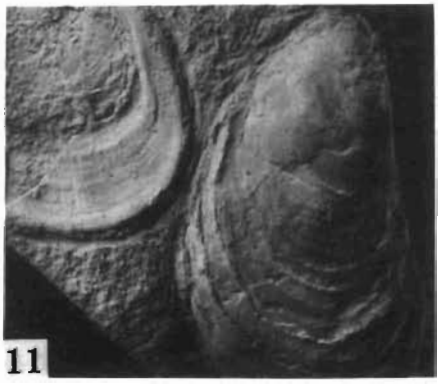
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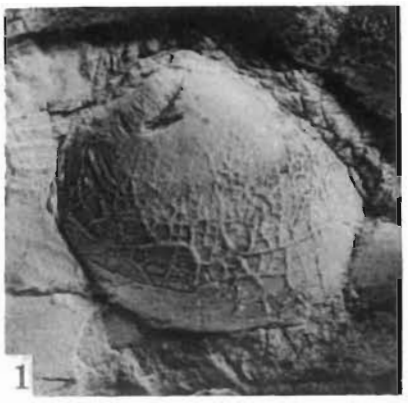
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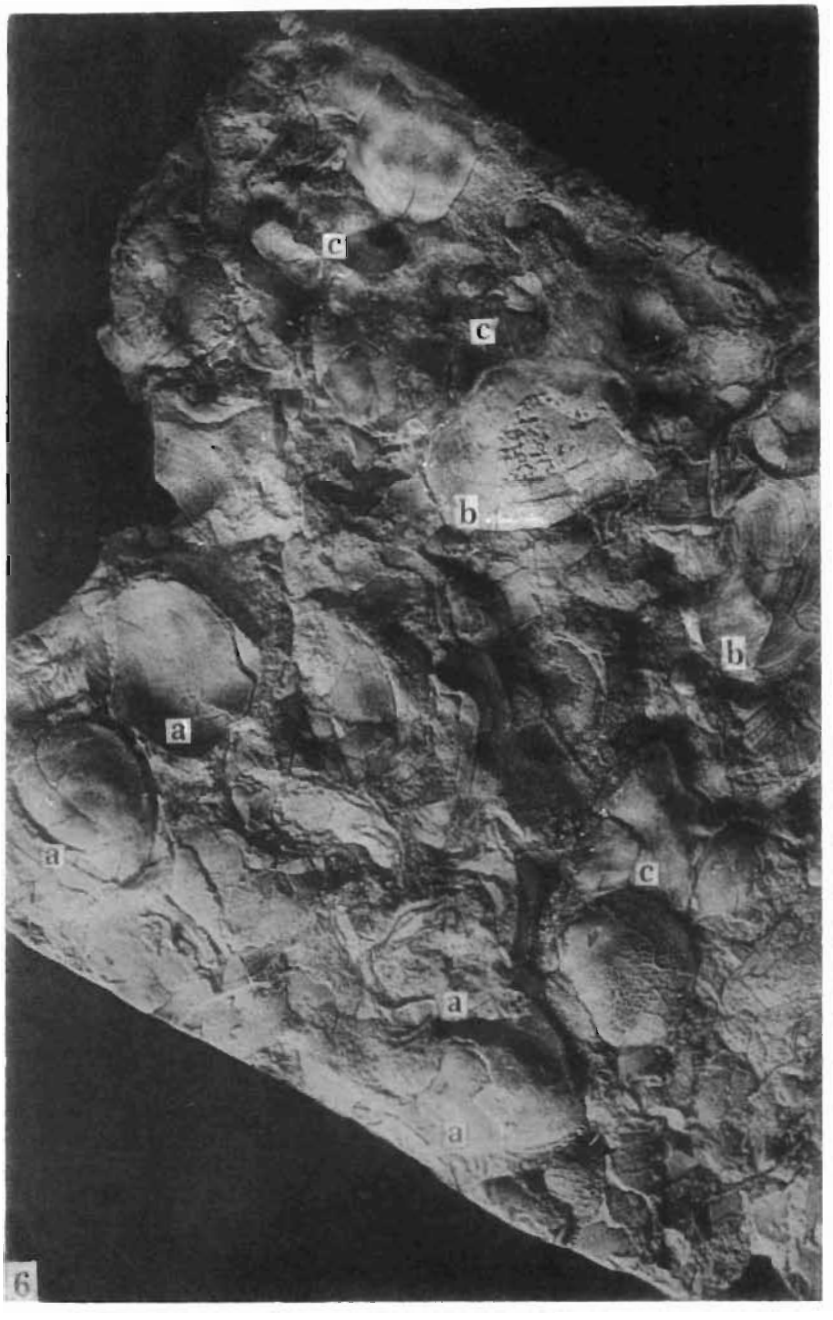

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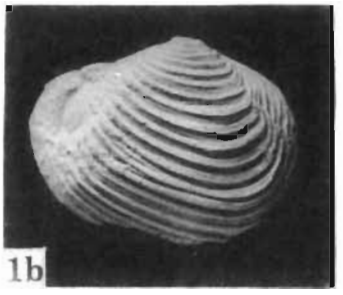
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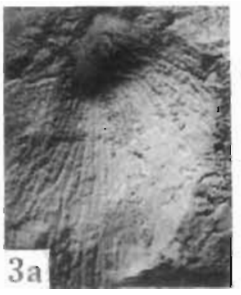
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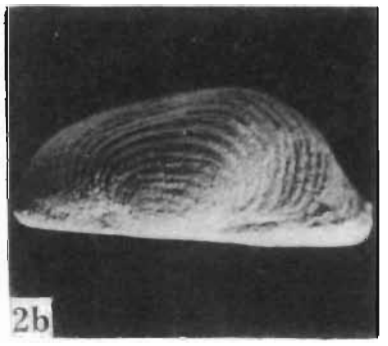
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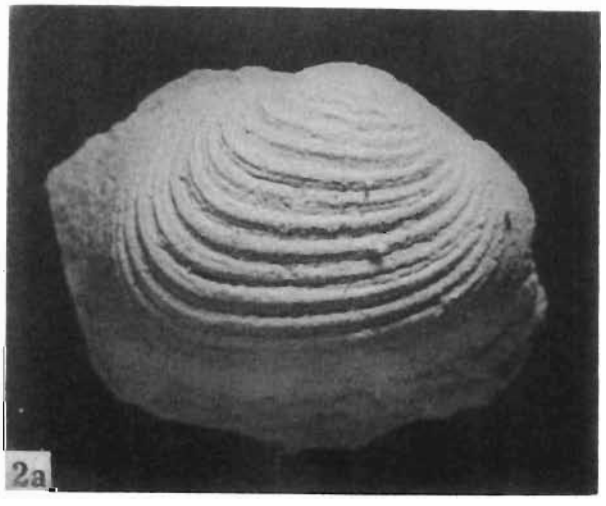
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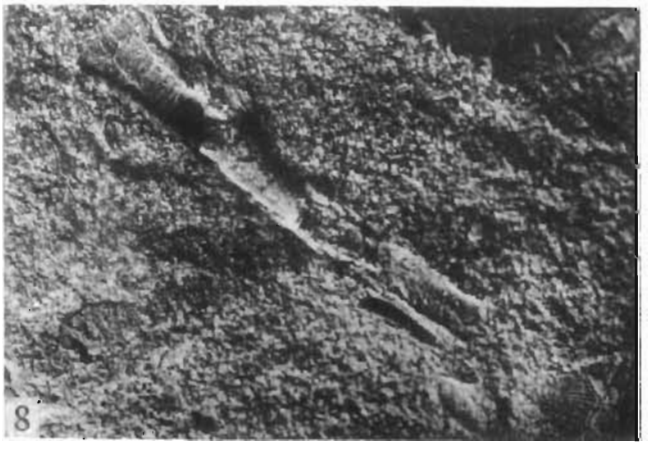
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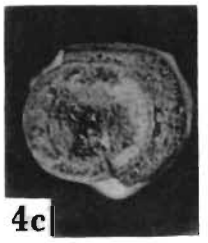
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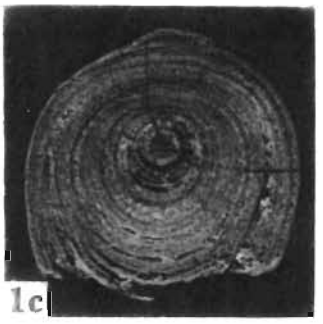
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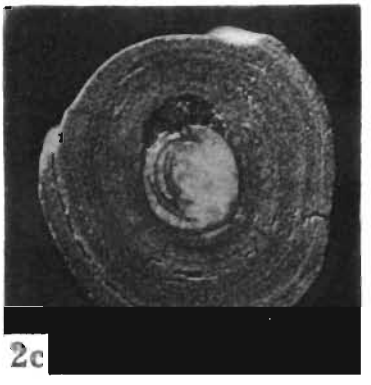
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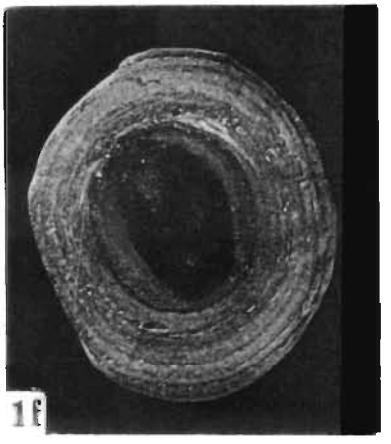
1f


2a


2b


3a


3b


3b
1b
7c
7d
3c
2b
7a
7b
1a
3d
2a
5a
5b
8c
6c
5c
4b
6b
3a
4a
8a
8b
6a


5
1c
1d
3
7a
7b
6a
1b
1a
9c
6b
1e
8c
6c
4c
8a
2a
2c
9a
9b
2b
4a
4b
8b