# New Kimmeridgian ammonite fauna from East Spitsbergen and its phyletic significance

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A rich Kimmeridgian ammonite fauna is described from the Janusfjellet Subgroup at Holmgardfjellet, Agardhbukta, East Spitsbergen. The fauna collected from a narrow stratigraphic interval represents a single ammonite assemblage showing a wide but continuous range of variability, with end-forms strongly resembling *Amoeboceras* (*Hoplocardioceras*) *decipiens* Spath and *A.* (*Amoebites*) *elegans* Spath, respectively. Accepting a horizontal classification in ammonite taxonomy, the assemblage may easily be placed into a single species for which the name *Amoeboceras* (*Amoebites*) *uralense* Mesezhnikov, 1973, is available, as this form corresponds to the intermediate and the most common morphotype. The fauna with *A. uralense* is possibly directly below that with *A. elegans* and *A. decipiens*, but above that with *A. kochi*. Close phyletic relations are suggested between the *A. elegans* – *A. uralense* group (traditionally placed in the subgenus *Amoebites*) and the subgenera *Hoplocardioceras* (type species *A. decipiens*), and *Euprionoceras* (type species *A. kochi*).

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## Geological setting (*K. Birkenmajer*)

The ammonite fauna here described was collected in 1977 by K. Birkenmajer during a Polish–American palaeomagnetic expedition to Agardhbukta, East Spitsbergen (Birkenmajer 1978; Vincenz *et al.* 1984). It comes from a site located at 184–185 m a.s.l. in the southern part of Holmgardfjellet, above Vaeringsdalen (Fig. 1). There, between two horizontal Lower Cretaceous dolerite sills, each about 1 m thick (see Birkenmajer 1979, fig. 2, site 1; fig. 3A), black to grey, slightly-baked silty or sandy shales crop out, with a 1–1.5 m thick interval containing numerous flattened ammonite and bivalve (*Buchia* spp.) impressions. The fossils are particularly frequent in a 10–20 cm thick zone of slightly backed and bleached (grey) shale at the contact with the upper sill (Birkenmajer 1980, p. 44, Vaeringsdalen-Holmgardfjellet section). They are scattered over the entire surface of the outcrop due to solifluction processes.

The shales in question belong to the Agardhfjellet Formation (Upper Bathonian–Ryazanian) of the Janusfjellet Subgroup (Fig. 2) which is widespread in the area (Fig. 1), being typically exposed at Myklegardfjellet and Agardhfjellet to the east of Vaeringsdalen. There, the shales are predominantly black, often bituminous, with clay-ironstone, siltstone, and fine-grained sandstone intercalations. They are fossiliferous at several horizons, indicating the presence of Late Callovian through Early (or Early-Middle) Volgian at Myklegardfjellet. The Kimmeridgian Stage, as recognized by ammonites, belemnites and bivalves, is about 45 m thick at Myklegardfjellet (Birkenmajer 1980; Birkenmajer et al. 1982, Faunules 2–5).

## The ammonite fauna (*A. Wierzbowski*)

### *Taxonomic description*

The collection studied consists of 144 specimens housed at the Museum of the Geological Faculty, Warsaw University (Collection No: IGPUW/A 26/1–144). Some are fragmentary (48 specimens), but a considerable number of better preserved and more complete specimens are suitable for measurements. All are flattened, being preserved as external casts, so original whorl-thicknesses cannot be measured. The suture lines are not preserved.

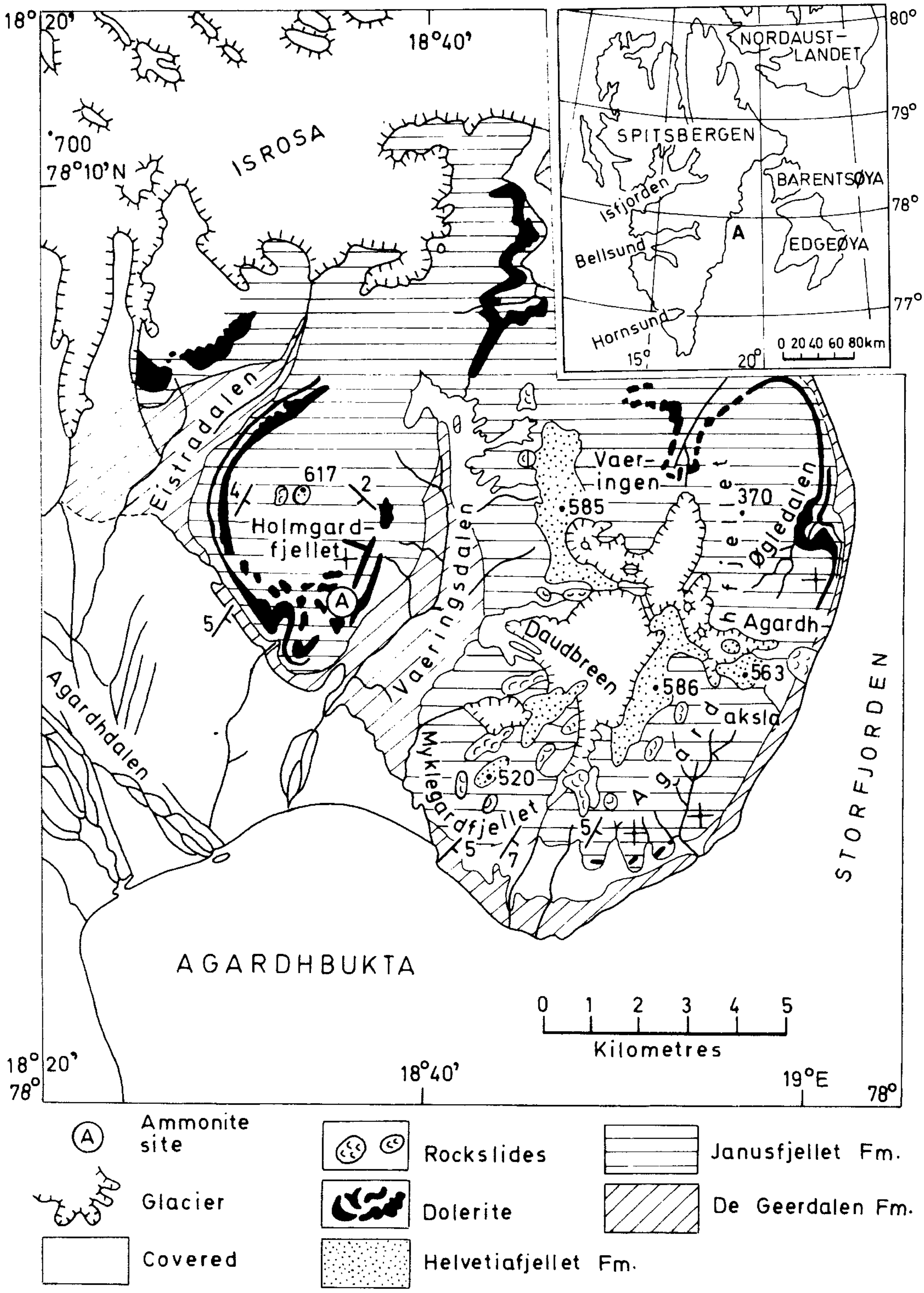

*Fig. 1.* Geological sketch-map of the Agardhbukta area (after Birkenmajer 1980) with position of Kimmeridgian ammonite fauna at Holmgardfjellet. Inset shows position of Agardhbukta (A) in Spitsbergen.

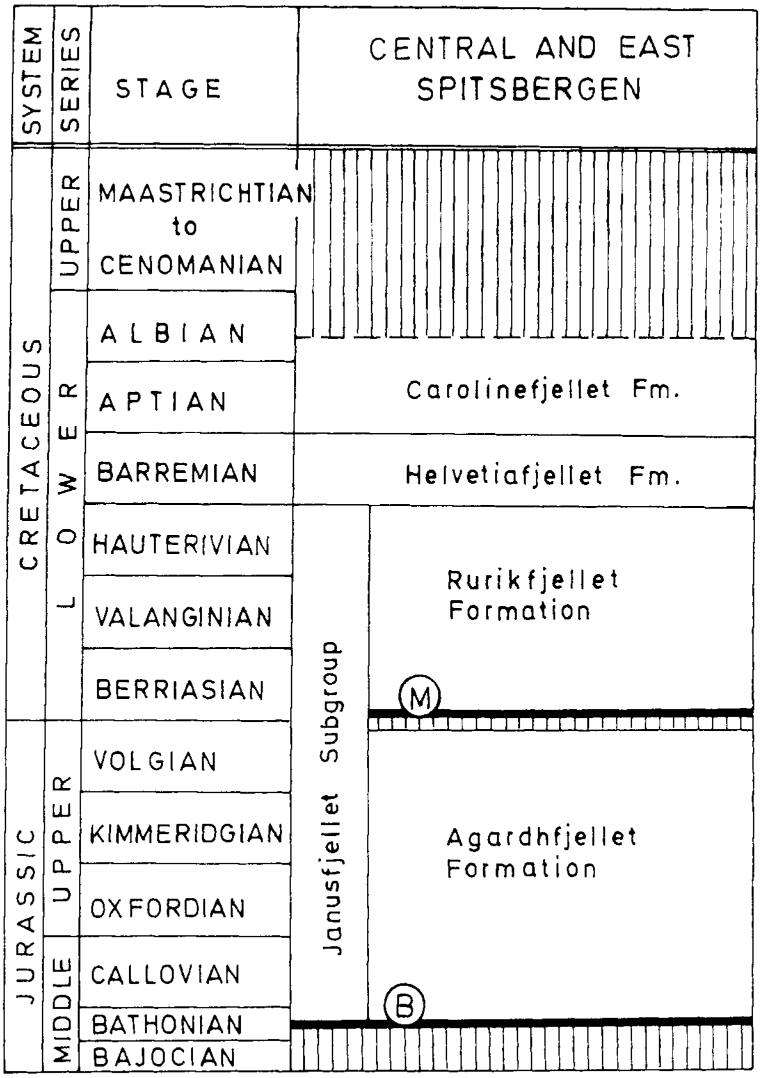

*Fig. 2.* Lithostratigraphic standard for the Jurassic and Lower Cretaceous deposits of Central-East Spitsbergen. B. Brentskardhaugen Bed: M. Myklegardfjellet Bed.

The majority of the specimens (89 better preserved and, possibly, all the fragmentary ones) show a wide but nevertheless continuous variation of their characters (Figs. 3, 4, and 5). The specimens are commonly either between 20 and 60 mm or between 75 and 105 mm in diameter. Usually they are incomplete, but uncoiling of the whorls observed at 40–60 mm diameter (Fig. 3) and weakening of the ornamentation on body-chambers exceeding 70–80 mm in diameter suggest that at least two groups of fully grown ammonite shells (micro- and macroconchs) occur in this collection. The shells, in their normally coiled parts, are moderately involute: the umbilical diameter (Ud) ranges from 25 to 33% of the shell diameter (D), whereas the whorl height (Wh) is between 36 and 45% of D (the mean values are 29–31% and 40–42% respectively).

The ornamentation of specimens shows a wide variation (Figs. 6–10). The ribbing oscillates between sparse and fairly dense: there occur from about 20 to 40 primary ribs per whorl at 20 to 60 mm diameters; at larger diameters, the ribbing becomes more dense, and the number of primaries may rise even to 45–50 per whorl (Fig. 4). The primary ribs on the inner whorls are thin, sometimes accentuated at the umbilicus, being as a rule stronger at the two-thirds of the whorl

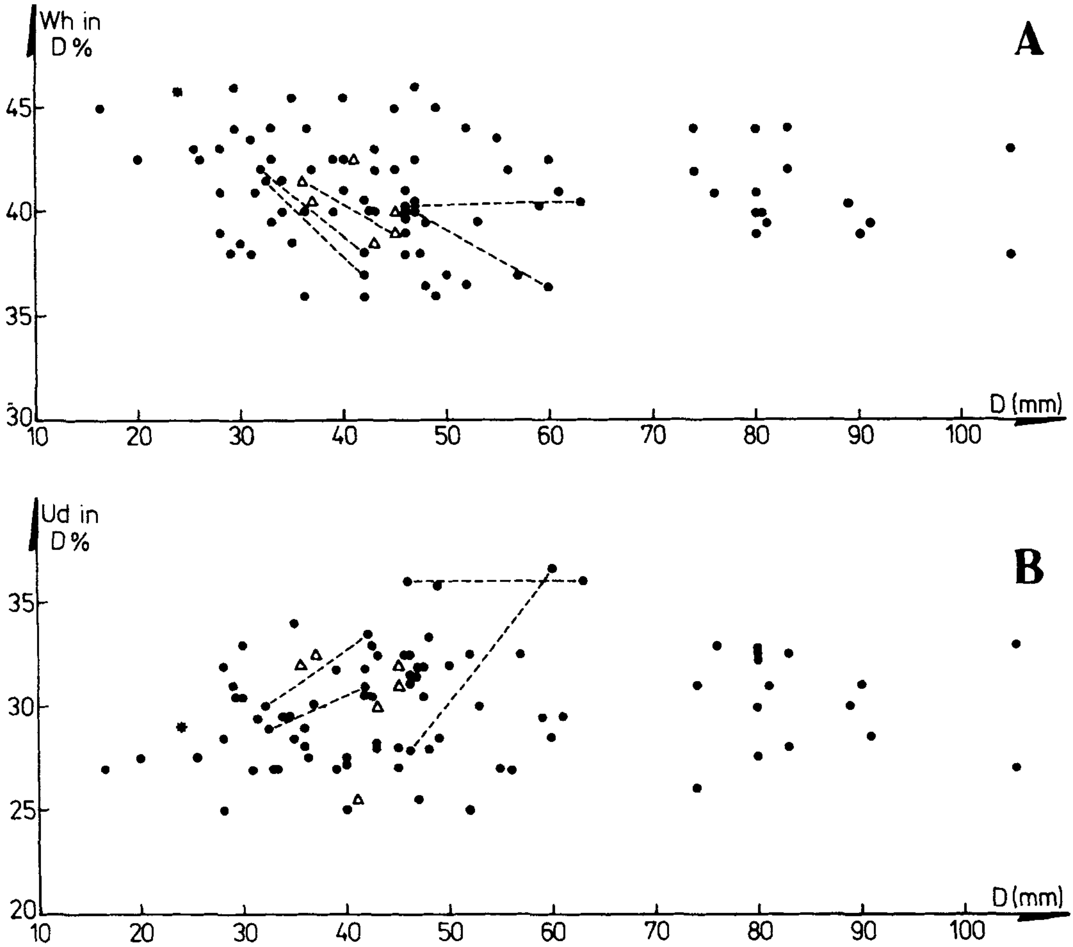

*Fig. 3.* Diagrams showing relations between (A) whorl height (Wh) in percentage of shell diameter against shell diameter (D), and (B) umbilicus diameter (Ud) in percentage of shell diameter and shell diameter (D). Black circles (holotype = asterisk) = *Amoeboceras uralense* Mesezh. White trangles = *Amoeboceras elegans* Spath. Stippling connects measurements on same specimens.

height; the secondary ribs appear high on the whorl and are more or less swollen or even transformed into small tubercles (Fig. 6). The ratio of secondary ribs (or corresponding tubercles) to primary ribs at 15–40 mm diameters is rather high, varying between 1.5 and 2.1. Then, at larger diameters of 40 to 80 mm, this ratio decreases to about 0.8–1.5 (Fig. 5).

Some specimens show a marked development of three rows of tubercles/nodes: at the umbilicus, at two-thirds of the whorl height, and at the ventro-lateral part of the whorl (Figs. 6J, 7F–G, 9C–D). The three-row pattern may appear already with a diameter of about 20 mm, but in other specimens it appears at larger diameters, from about 30 mm up to 50–60 mm. Whereas the outer tubercles are mostly wholly separated, the middle and inner ones are always connected by ribs. The specimens show a strong resemblance to *Amoeboceras* (*Hoplocardioceras*) *decipiens* Spath, differing from it in a generally weaker development of the tubercles, their weaker differentiation being a result of persistence of primary ribs in all stages of the sculpture development and in a somewhat higher position of the middle row of tubercles on the whorl flank. It should be remembered, however, that these differences are mostly statistic in character, and some extremely strongly ornamented specimens from this collection (Fig. 7F, G) do not essentially

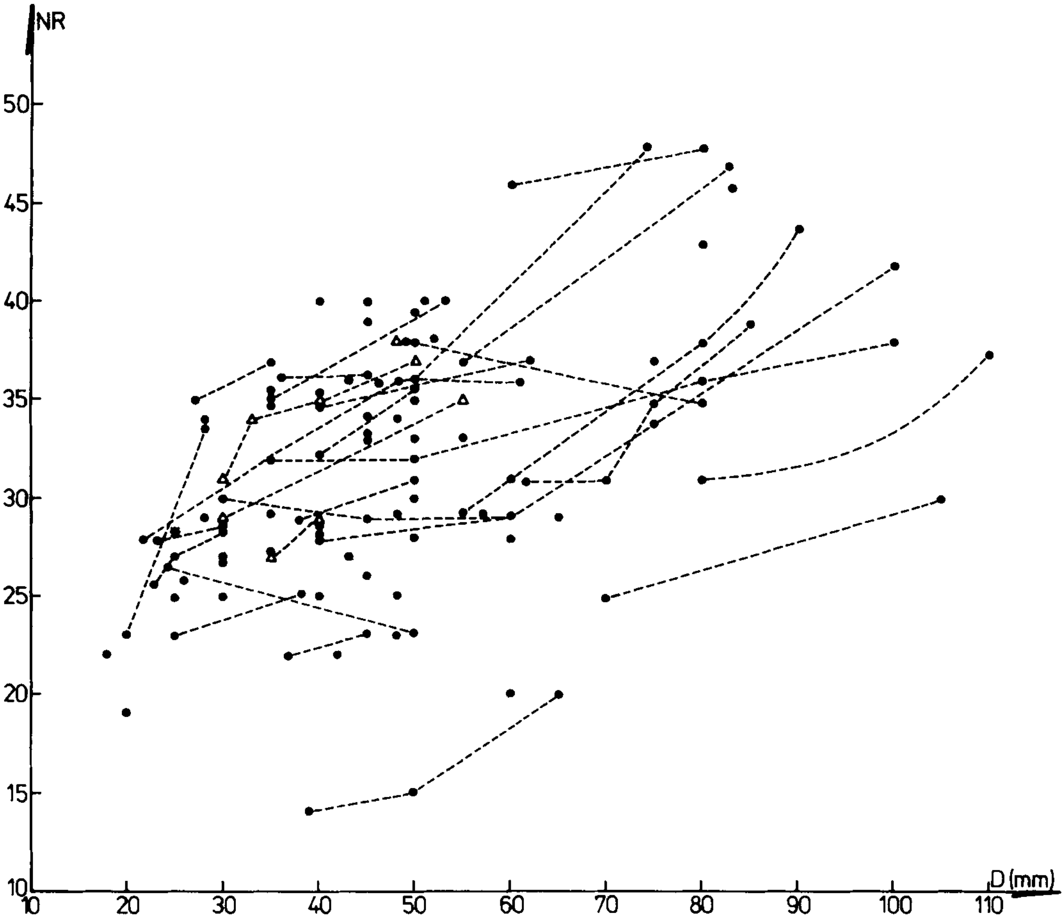

*Fig. 4.* Diagram showing relation between number of primary ribs per whorl (NR) and shell diameter (D); other explanations as in Fig. 3.

differ from those of *A. decipiens* illustrated by Spath (1935), Birkelund & Callomon (1985), and Wierzbowski (1989).

Other, more numerous specimens in this collection do not have such strongly developed tubercles. There may occur only a single, well-developed outer row of the tubercles or often also a middle one, while the ribs in the periumbilical part of the whorl remain either only slightly thickened or do not swell at all. The specimens showing weaker development of the middle tubercles are markedly similar to *Amoeboceras* (*Amoebites*) *elegans* Spath, as amply illustrated by Spath (1935), Birkelund & Callomon (1985), and Wierzbowski (1989). The main difference lies in more numerous secondary ribs on the inner whorls in our specimens (Fig. 7A–C and 8B–D). As the secondary ribs are more common in *Amoeboceras* (*Euprionoceras*) *kochi* Spath, some of our poorly tuberculated specimens (Fig. 7A, B) resemble the latter species. In contrast, the dominant specimens of this group, showing somewhat stronger development of the tubercles (Figs. 6A–H, 7D–E, 8A, and 9A, B), seem to be closer to *Amoeboceras* (*Amoebites*) *uralense* Mesezhnikov. The holotype and only illustrated specimen of this species (Mesezhnikov & Romm 1973, pl. 3, fig. 6) is small, attaining only 25 mm in diameter and incomplete. It nevertheless seems quite distinctive, enabling the species to be safely identified. In our collection, important features of the holotype such as the numerous secondary ribs that become

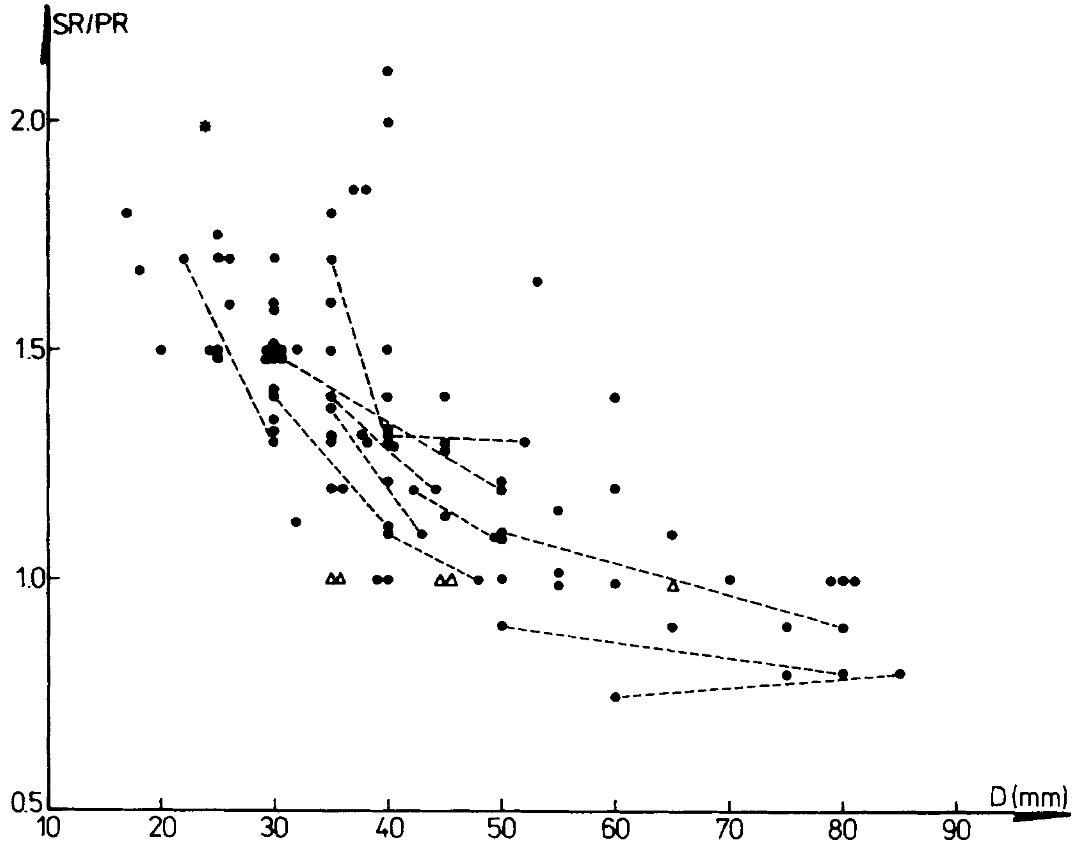

*Fig. 5.* Diagram showing relation between the ratio of secondary to primary ribs (SR/PR) and shell diameter (D); other explanations as in Fig. 3.

transformed into elongated tubercles, thickening of primary ribs on the whorl flank, and rather dense ribbing are clearly recognizable.

Apart from the character of their tubercles, all our specimens show a marked weakening of ornamentation at larger dimensions, usually starting at 70–80 mm diameter. The ribbing becomes simultaneously denser and simpler, while the keel keeps its marked crenulation.

## Remarks

The classification of our specimens is somewhat troublesome and depends on the approach chosen. As shown above, a few specimens can be compared with the species *A.* (*Hoplocardioceras*) *decipiens* Spath and *A.* (*Amoebites*) *elegans* Spath, while the majority bear a close resemblance to *A.* (*Amoebites*) *uralense* Mesezhnikov. Thus, following a traditional "vertical" classification (see Callomon 1985), at least three morphospecies (as well as related forms prefixed by "aff.") might be distinguished here. However, the continuous variability observed in our specimens, and their occurrence in the same, narrow stratigraphic horizon, favour instead a "horizontal" classification, suggesting their affiliation as an assemblage of variants of a single biospecies. It should be recalled that monospecific assemblages of Cardioceratidae, whose evolution was with minor exceptions monophyletic (Callomon 1985), were a common feature of that family independent of stratigraphic level and geographic location. From the specific names already available, that of *Amoeboceras* (*Amoebites*) *uralense* Mesezhnikov seems the most appropriate for our collection.

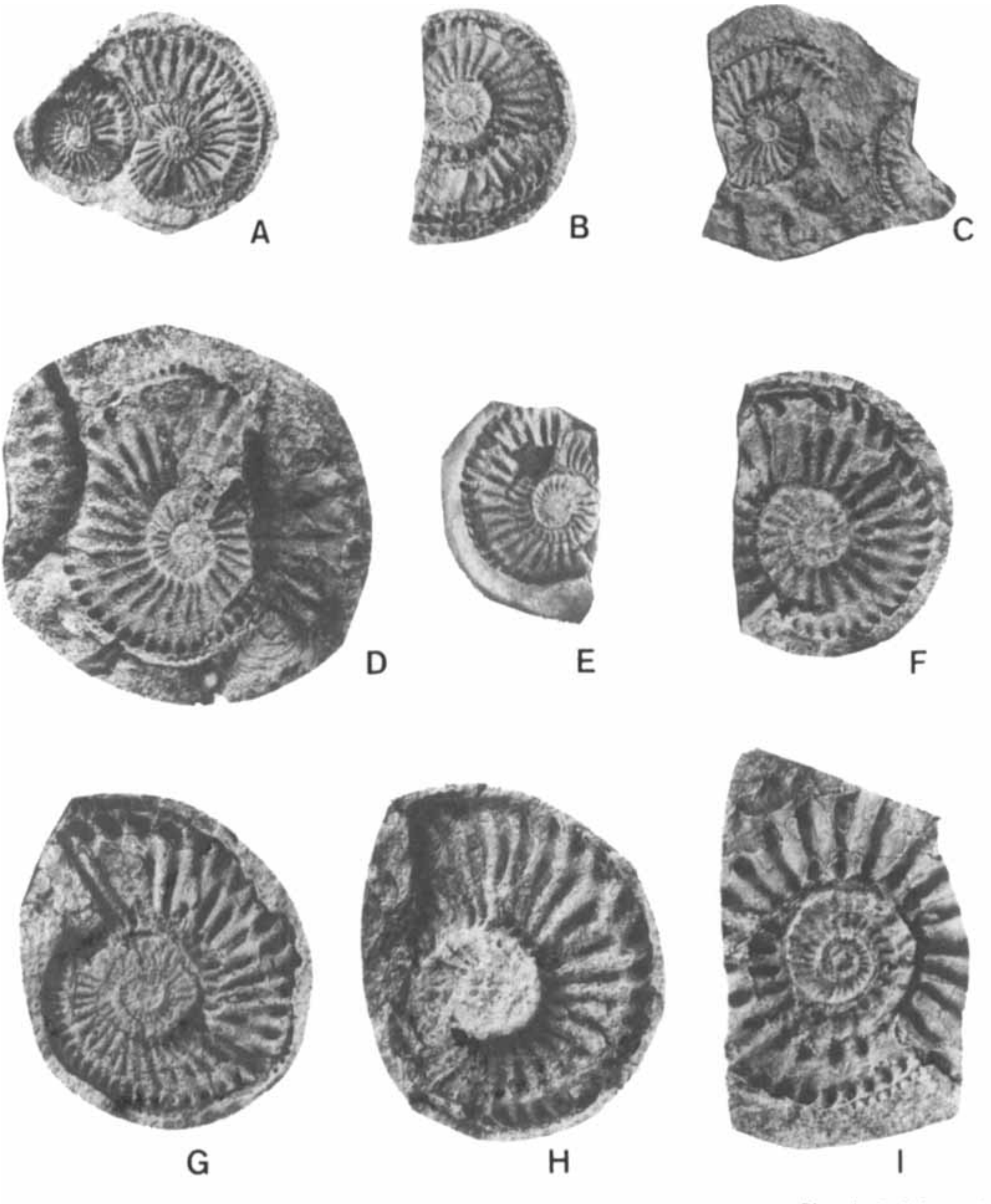

*Photo by S. Kolanowski*

*Fig. 6.* Variability of *Amoeboceras uralense* Mesezh. bsp. (biospecies). A–H. Variant (IGPUW/A 26/54, 55, 59, 57, 29, 56, 28, 26 and 5) close to the holotype. I. Variant (IGPUW/A 26/10) similar to *Amoeboceras decipiens* Spath. all figures natural size.

## Stratigraphic position

The relative stratigraphic position of the ammonite fauna with *Amoeboceras uralense* in the Kimmeridgian of Spitsbergen (Wierzbowski 1989; cf. also Birkelund & Callomon 1985) can be deduced from a morphological comparison with other ammonite faunas of the area. Our fauna undoubtedly shows the closest morphological relationship to "fauna No 4" of Wierzbowski (1989), the latter composed of the species *Amoeboceras elegans* and *A. decipiens*. It seems highly probable that

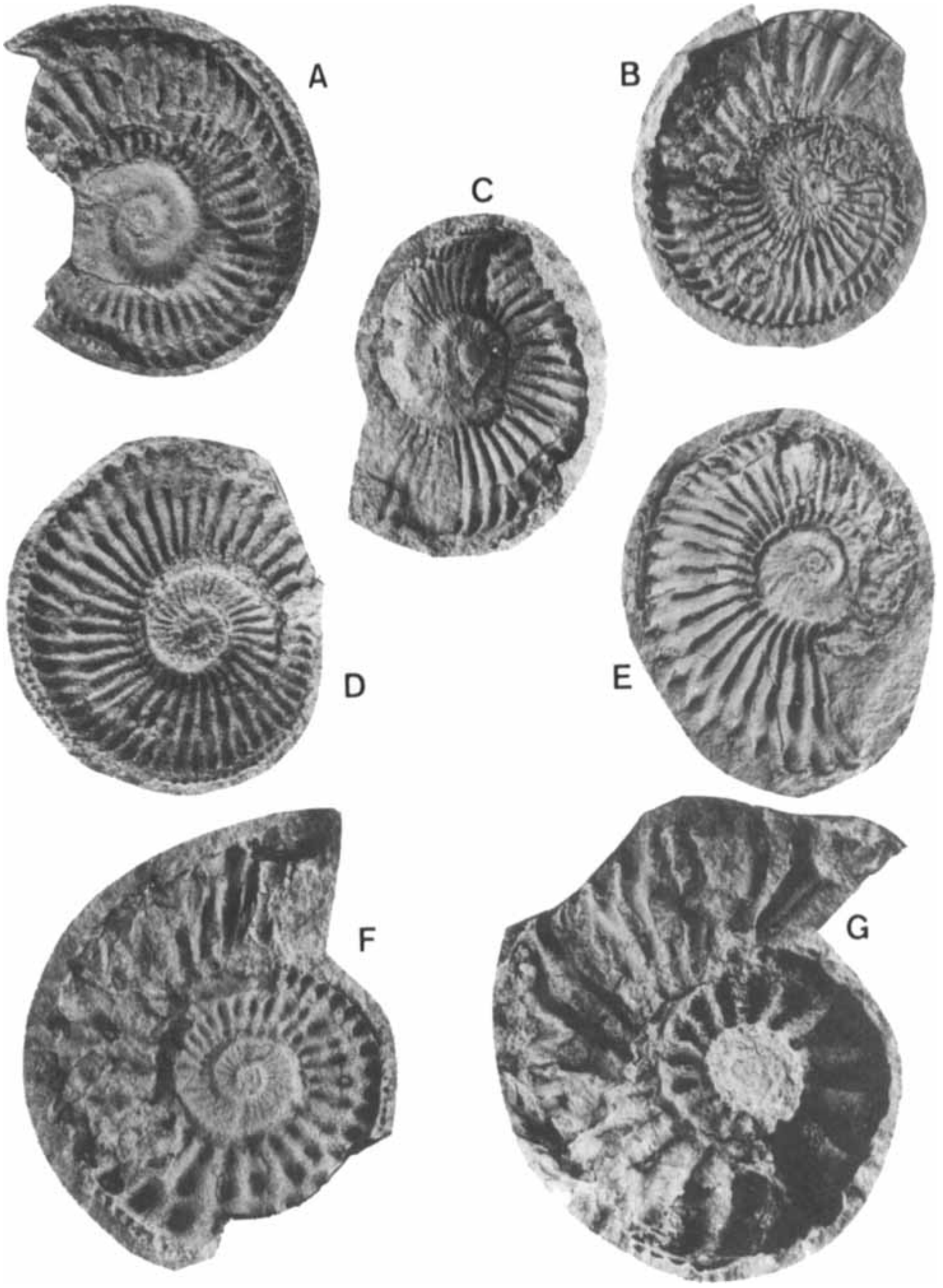

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*Fig. 7.* Variability of *Amoeboceras uralense* Mesczh. bsp. A–C. Variant (IGPUW/A 26/41, 43 and 6) similar to *Amoeboceras elegans* Spath, partly also to *Amoeboceras kochi* Spath. D. E. More strongly ornamented variant (IGPUW/A 26/25 and 24) close to the holotype of *A. uralense*. F. G. Strongly ornamented variant (IGPUW/A 26/86 and 4) similar to *Amoeboceras decipiens* Spath. All figures natural size.

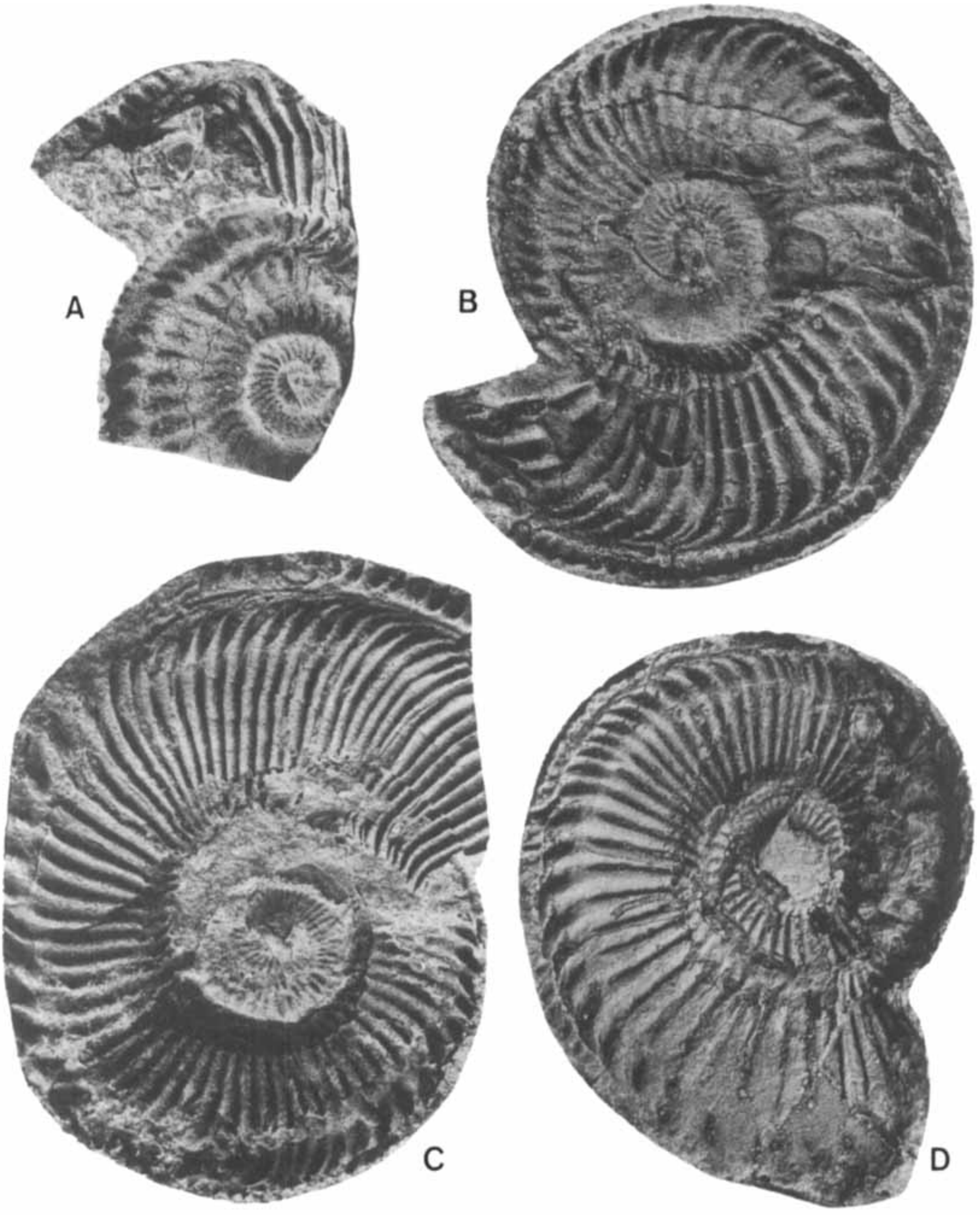

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*Fig. 8.* Variability of *Amoeboceras uralense* Mesezh. bsp. A. Specimen (IGPUW/A 26/7) close to the holotype. B–D. Variant (IGPUW/A 26/1, 26 and 3) similar to *Amoeboceras elegans* Spath. All figures natural size.

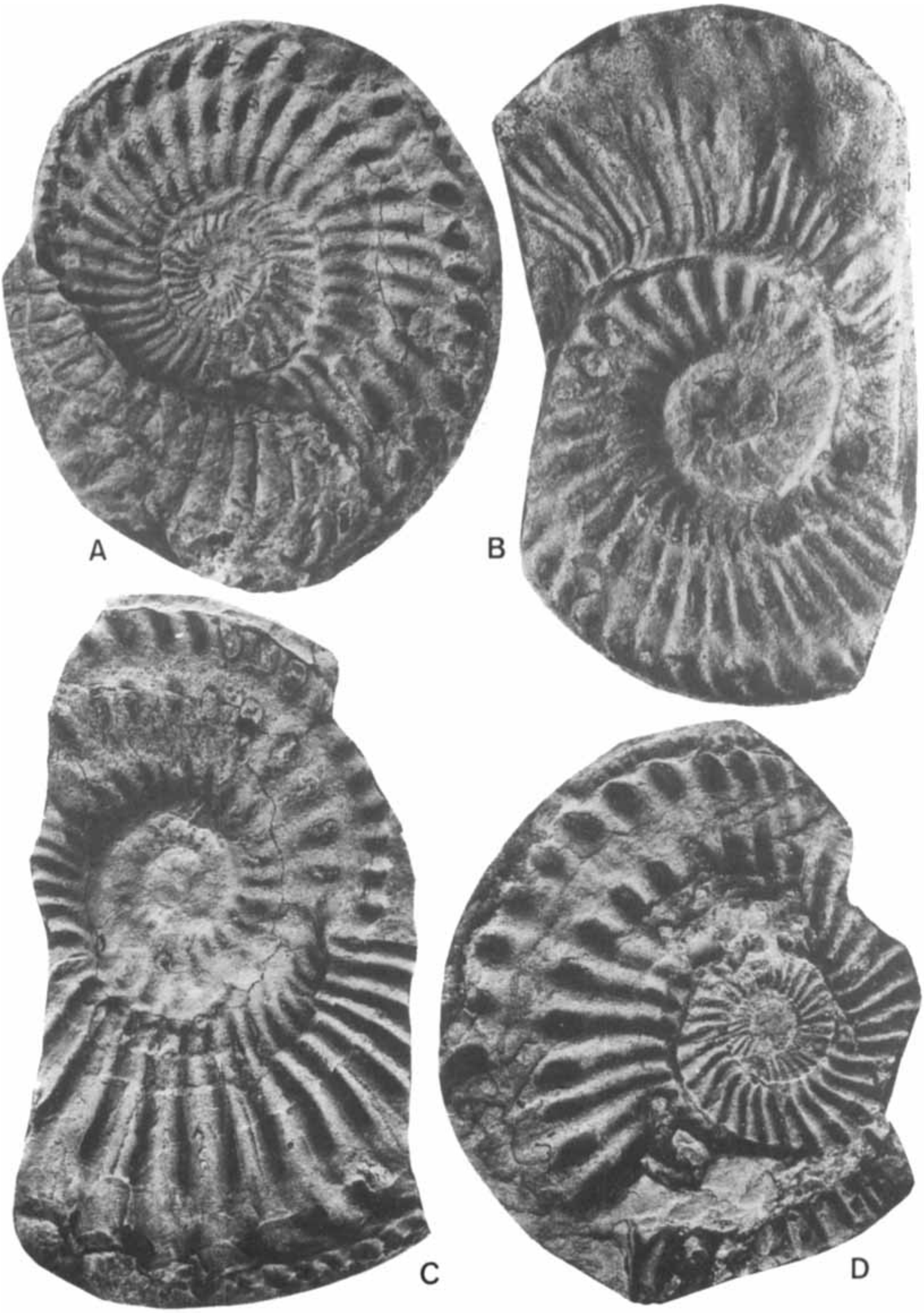

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*Fig. 9.* Variability of *Amoeboceras uralense* Mesezh. bsp. A, B. Variant (IGPUW/A 26/18 and 17) close to the holotype. C, D. Variant (IGPUW/A 26/12 and 14) similar to *Amoeboceras decipiens* Spath. All figures natural size.

the new *A. uralense* fauna is but slightly older than that with *A. elegans* and *A. decipiens*, and that the species *A. uralense* is a direct forerunner of the latter two. *A. decipiens*, the type species of the subgenus *Hoplocardioceras*, has in fact very close affinities with *A. elegans* and *A. uralense* which are traditionally placed in the subgenus *Amoebites*. Phyletic relations between these ammonites remained obscure for a long time (Birkelund & Callomon 1985). On the other hand, there exists also a similarity of some of our specimens to *Amoeboceras* (*Euprionoceras*) *kochi* Spath. In the general Boreal succession (Birkelund & Callomon 1985; Wierzbowski 1989), *A. kochi* precede *A. elegans* and *A. decipiens*. Thus it seems most probable that the fauna with *A. uralense* is stratigraphically positioned between that with *A. kochi* (below), and that with *A. elegans* and *A. decipiens* (above).

In the present collection, a few specimens occur which show no marked difference from typical representatives of *Amoeboceras* (*Amoebites*) *elegans* Spath. They differ somewhat from the rest of the collection in having a lower number of secondary ribs (secondary/primary ribs ratio 1.0 at 30–45 mm diameter, Fig. 10). They may well be merely the end-members in the range of variability of this assemblage. However, it could just be that they came from the youngest part of the stratigraphic zone sampled, from just above that with the main *A. uralense* assemblage.

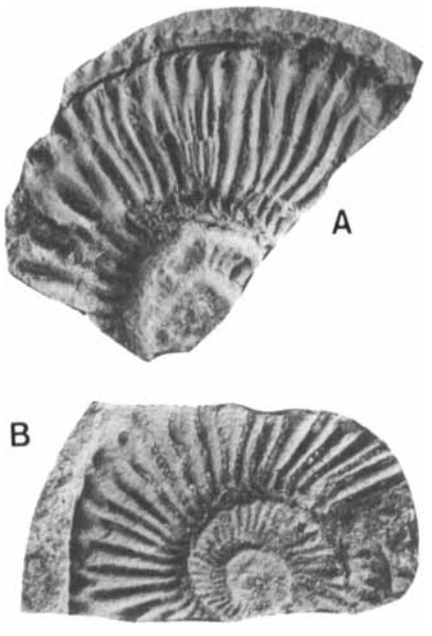

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*Fig. 10.* A, B. Specimens (IGPUW/A 26/83 and 80) of *Amoeboceras elegans* Spath showing the presence of looped ribs. Figures natural size.

According to Mesezhnikov & Romm (1973), type specimens of the species *A. uralense* came from the Borealis and Mutabilis Zones of northern Siberia. As the upper part of the Borealis Zone there corresponds in fact to the Mutabilis Zone in the Subboreal zonal scheme (Birkelund & Callomon 1985), the exact age of the type specimens of *A. uralense* must have been close to the Mutabilis Zone. This corresponds well with the phyletic interpretation given above. It shows that this species, as originally defined, occurs stratigraphically in a very similar position to that of *A. elegans* and *A. decipiens*, whose vertical ranges correspond to some parts of the Eudoxus Zone, and that of *A. kochi*, which ranges somewhere within the Mutabilis and Eudoxus Zones (see Birkelund & Callomon 1985).

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