BRITISH ANTARCTIC SURVEY

SCIENTIFIC REPORTS

No. 97

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CAMBRIDGE: PUBLISHED BY THE BRITISH ANTARCTIC SURVEY: 1979

NATURAL ENVIRONMENT RESEARCH COUNCIL

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(Manuscript received 18th December, 1975)

ABSTRACT

LOWER CRETACEOUS faunas are well known in the Fossil Bluff Formation of Alexander Island but the species described here include the first extensive Upper Jurassic ammonite faunas from the area. Although the preservation is generally poor, 33 separate species are described, and there are doubtless others among the indeterminate material. In general, the ammonites show close affinities to extra-Antarctic forms and most are readily assigned to or compared with described species. Some new species are present but only in the case of *Virgatosphinctes acuticostus* sp. nov. is the material considered to be good enough to be formally named. The ammonites are grouped into four faunas of Kimmeridgian, Tithonian, uppermost Tithonian and Berriasian ages. The Tithonian fauna is the most extensive and is characterized by the two genera *Virgatosphinctes* and *Aulacosphinctoides*. Both South American and Malagasy Republic/Himalayan elements are present but in the uppermost Tithonian and Berriasian the faunas are less varied and their affinities appear to be closest to those of the Himalayan/Indonesian region. Although Lower and Upper Tithonian species are present in the "Tithonian" fauna, their stratigraphical distributions are not known well enough to subdivide the fauna. The palaeogeographical implications of the faunas are discussed but the data are too scanty at present to draw firm conclusions.

CONTENTS

I. INTRODUCTION

STRATIGRAPHICAL and palaeontological studies by M. H. Elliott and C. M. Bell in the Fossil Bluff Formation of the Ablation Point area of Alexander Island (Fig. 1; Plate Ia) (Elliott, 1974) have revealed the presence of at least three assemblages of Ammonoidea new to this area. These range in age from Tithonian to Berriasian. The only ammonites obtained here by earlier investigators were those collected by V. E. Fuchs and R. J. Adie on the north face of Ablation Hook [Ablation Point], and briefly described by Howarth (1958) as *Perisphinctes* (*Orthosphinctes*) *transatlanticus* Steinmann of Upper Oxfordian to

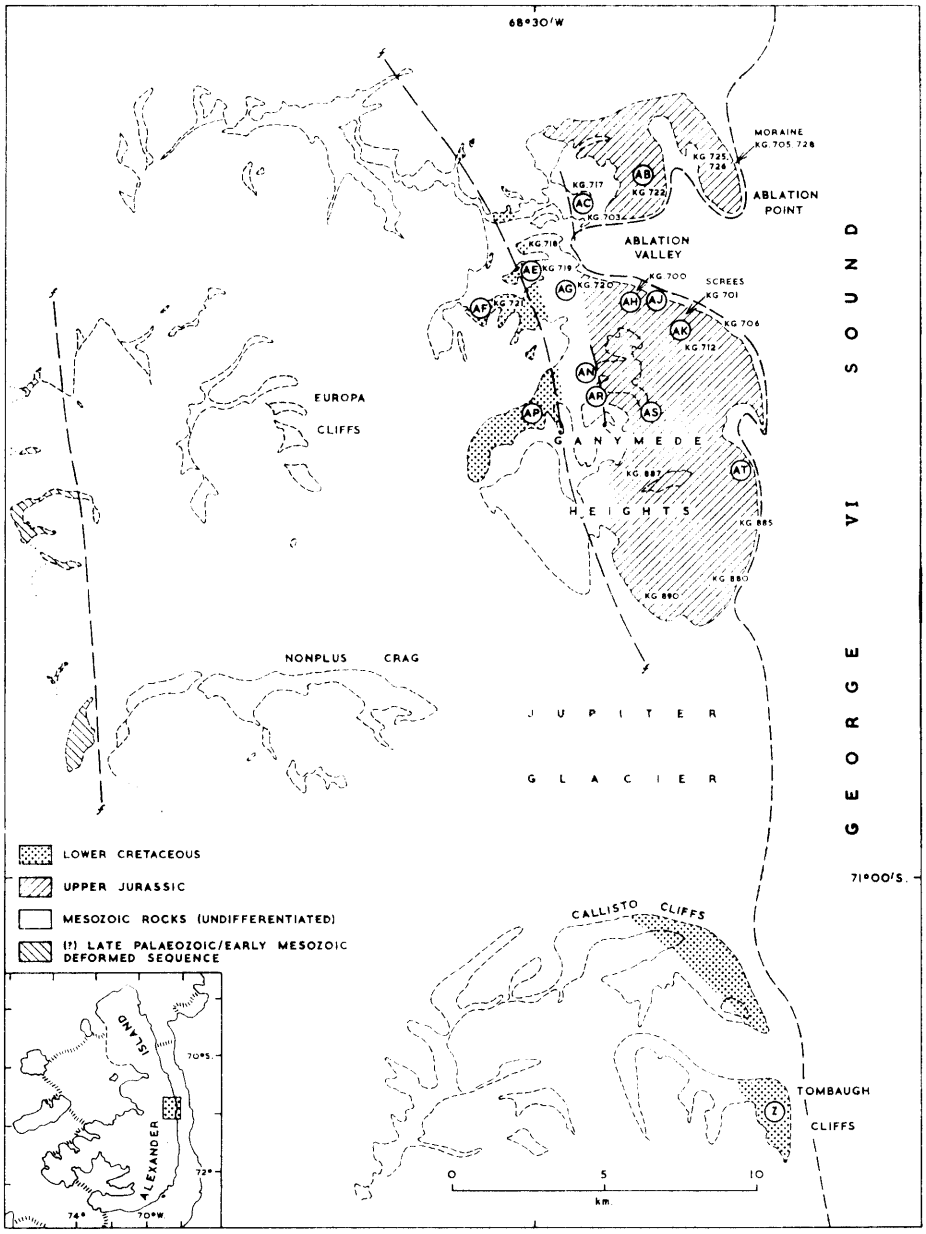

FIGURE 1

Simplified geological sketch map of the Ablation Point area to show fossil collection sites and positions of measured sections. (Outline prepared from ERTS imagery; geology partly after Bell (1975) and Elliott (1974).)

Lower Kimmeridgian age. Such forms are not represented in the present collections but a single specimen of *Pachysphinctes* (*?*) sp. (p. 15) may have come from equivalent strata.

A general impression of the succession in the Ablation Point area is given by the sketch panorama in Fig. 2 (cf. Elliott, 1974, fig. 11), which covers the whole of the measured sequence as represented by

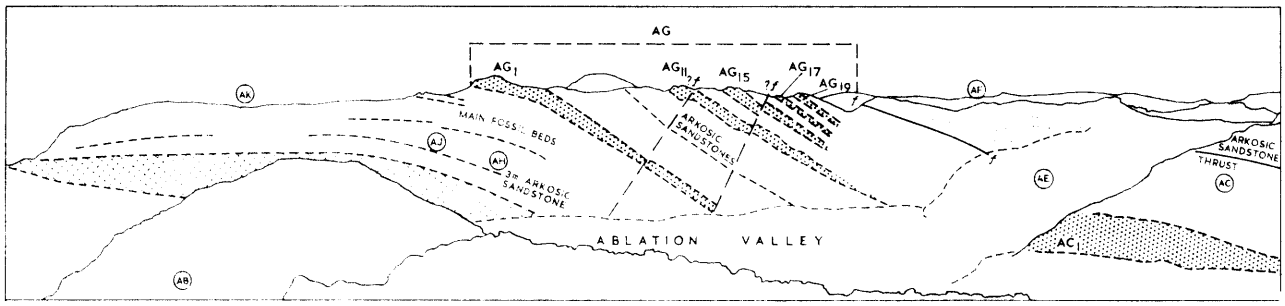

FIGURE 2

Sketch panorama of the southern side of Ablation Valley, showing a nearly complete section through the strata from which the ammonites described in this report were collected. Compare with Figs. 1 and 3, and Plate Ia. Conglomerate beds are stippled and the disturbed zone is cross-hatched. (Modified after Elliott, 1974, fig. 11.)

sections at localities AK, AJ, AH, AG and AF (Fig. 3). A yellow arkosic sandstone (AJ_6, AH_9 and AB_7), a volcaniclastic sandstone (AK_7 and AB_{13}) and five conglomerates (AG_1, AG_{11}, AG_{15}, AG_{17} and AG_{19}) form useful marker beds. The fauna in the section at locality AF suggests that it might be a repetition of the upper part of the sequence at locality AG, caused by a north–south trending reverse fault at the head of Ablation Valley (Fig. 2). However, the two sections do not correlate well lithologically.

Because of the poorly fossiliferous nature of much of the sequence, the stratigraphical sections (Fig. 3) were not measured in the detail of those described by Taylor and others (1977) but were measured with a tape and subsequently corrected for dip and surface slope. Nevertheless, the total 2,000 m. thickness of sedimentary rock, measured along the ridge on the south side of Ablation Valley (Fig. 2), is probably accurate to within 100 m. The true stratigraphical thickness could be somewhat less, depending on the effects of faulting and minor thrusting within the sequence.

Most of the ammonites were collected from three stratigraphical levels:

i. A *Virgatosphinctes–Aulacosphinctoides* fauna in the 100 m. of mudstones below the volcaniclastic sandstone, and sporadic occurrences down to 20 m. below the yellow sandstone.
ii. A *Blanfordiceras* fauna from just above and below the first conglomerate (AG_1).
iii. A *Haplophylloceras–Bochianites* fauna from above the fifth conglomerate (AG_{19}).

Considerable thicknesses of the sequence, notably the 1,170 m. between faunas (ii) and (iii), are apparently devoid of ammonites. However, it must be borne in mind that much of the sequence is not as well exposed as Fig. 2 and Plate Ia might at first suggest. In many places the outcrop is covered with scree, especially along the section referred to above, and over which is a layer of debris derived from the five conglomerates. Furthermore, the relatively steep dip in places (45–50° to the west at the western end of the ridge in Fig. 2) and the rounded form of many exposed rock surfaces (? recent deglaciation) mean that exposures of bedding planes are often of very limited extent. Thus, the apparent absence of ammonites in parts of the succession may largely be a reflection of limited bedrock exposure, perhaps together with a general paucity of fossils in such sections.

Most of the ammonites described here were collected from locality AK (KG.712), along the crest at the eastern end of the ridge in Fig. 2. Even here, where fossils are relatively common, and on other ridge tops, where bedding-plane exposures are the most extensive, they are not always easy to extract because of the strong jointing which tends to break up many of the larger species (Plate Ib and c). It is clear from the two examples illustrated that many specimens so found were incomplete because weathering and transport processes had already removed the looser joint-bounded fragments.

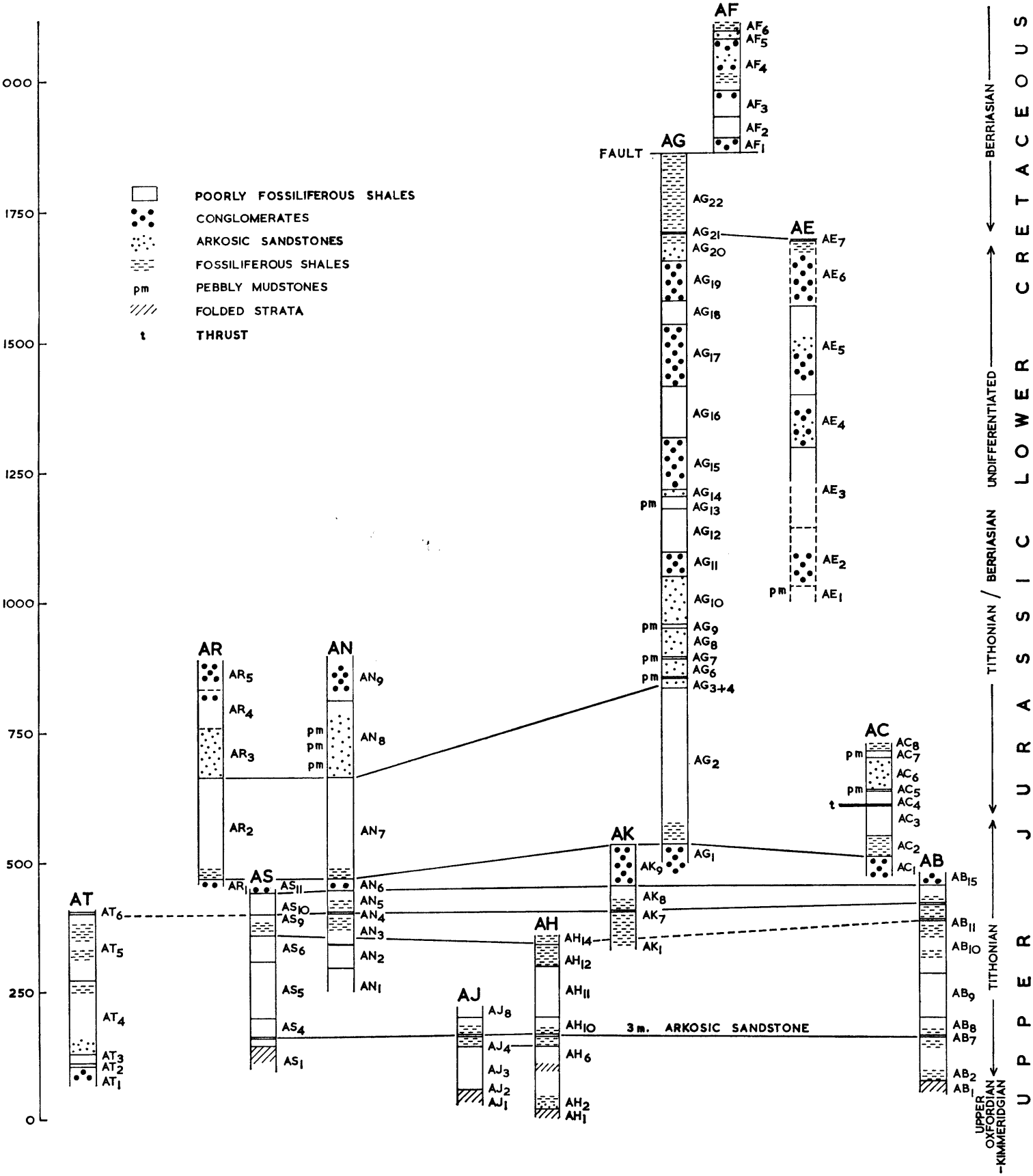

FIGURE 3

Diagrammatic representation of the stratigraphical sections measured in the Ablation Point area. The localities are indicated in Fig. 1; subscript figures are used to denote individual beds. (After Elliott, 1974, fig. 5.)

II. SYSTEMATIC DESCRIPTIONS

FOR the sake of brevity and because the following descriptions are in no way to be considered as a monographic treatment of various species, synonymies have been kept to a minimum. More complete synonymies will be found in the works referred to.

FAMILY PHYLLOCERATIDAE ZITTEL 1884

SUBFAMILY PHYLLOCERATINAE ZITTEL 1884

Genus *Phylloceras* Suess 1865

Phylloceras aff. *serum* (Oppel 1865) (*?*)

Plate IIa and b

(*?*) aff. *Phylloceras serum* Oppel; Zittel, 1868, p. 66, pl. 7, figs. 5a–c and 6a–c.
(*?*) aff. *Phylloceras serum* Oppel: Collignon, 1960, pl. CXXXIV, figs. 506 and 507.

Material

Two crushed but more or less complete external moulds from locality AK (KG.712.17 and 26).

Description and remarks

Both moulds are of laterally compressed specimens, one (KG.712.17; Plate IIb) being a juvenile and the other (KG.712.26; Plate IIa) a larger example, 65 mm. in diameter in its present crushed state. The coiling of the shell is extremely involute with the umbilicus reduced to a small funnel. Fine dense riblets are present on both specimens and they first appear on the juvenile at a diameter of approximately 12 mm. These riblets are most prominent on the ventral part of the shell and gradually become finer and weaker dorsally until they have all but disappeared near the umbilical funnel. The riblets are all almost radial with a slight tendency towards being sigmoidal.

The sutures are unknown and it is impossible to identify these specimens with certainty. In many ways they resemble a group of Cretaceous forms included within the genus *Hypophylloceras* Salfeld but, in deference to their stratigraphical occurrence (Tithonian), they are tentatively compared here to *Phylloceras serum* such as has been illustrated from the Malagasy Republic (Collignon, 1960) and from the Stramberger Schichten (Zittel, 1868).

Genus *Phyllopachyceras* Spath 1925

Phyllopachyceras beneckei (Zittel 1868) (*?*)

Plate IIc–e

(*?*) *Phyllopachyceras beneckei* (Zittel); Collignon, 1960, pl. CXXXV, figs. 511 and 512.

Material

Three external mould fragments (KG.712.25 and 104, and KG.717.4), a more or less complete internal mould of the septate part of an individual (KG.712.79), and two internal moulds of young individuals (KG.712.27 and KG.718.20) which may or may not belong to the same species. The specimens from stations KG.712 and 717 are from measured sections AK and AC, respectively.

Description

The septate internal mould (Plate IId) has a typical phylloceratid shell form, in which the outer whorl completely envelops all the others and leaves only a small funnel-like umbilicus. Although it has been slightly crushed, it is clear that the cross-section of the outer whorl was ovate and moderately inflated. Ornament consists of rather dense radial ribs which are clearly visible on the ventral two-thirds of the flank but all of which fade out as they approach the umbilicus. The two largest external mould fragments

(e.g. Plate IIe) both show a sudden increase in rib spacing with increase in size (also seen at the very end of the septate specimen) that probably represents a modification of ornament on the body chamber of adult examples. Spacing between the ribs may be as much as two or even three times the width of the individual ribs and the position at which the ribs fade out towards the umbilicus becomes more variable. The longer ribs are recurved as they approach the umbilicus.

Of the two juveniles, the smaller (Plate IIc) is the better preserved and is completely smooth except for extremely fine growth lines and a hint of coarser ribbing which is just beginning to appear on the ventral part of its latest stage. As far as may be judged, its shell form and whorl cross-section agree with those of the septate fragment above.

On the left side of the septate specimen, the sutures have been developed by weathering but in places this has occurred for too long and detail has been lost. The external saddles of all the sutures have been distorted by crushing along the line of the venter; the first lateral saddle bears three large folioles and a possible fourth which is less well developed, and all the lobes appear to be trifurcate. Beyond the first lateral saddle are at least another three smaller elements, of which the most ventral is distinctly tetraphyllate.

Remarks

The above examples have a distinctive type of ribbing pattern commonly found in Lower Cretaceous species of *Phyllopachyceras*, e.g. *P. infundibulum* (d'Orbigny) and *P. winckleri* (Uhlig). The present specimens, however, were found in association with species of *Virgatosphinctes* and *Aulacosphinctoides*, and are of Tithonian age. Tithonian occurrences of *Phyllopachyceras* are generally placed under Zittel's (1868, p. 69, pl. 8, fig. 6a–d) *P. beneckei*, first described from the Stramberger Schichten. The validity of such identifications is questionable when one considers the subtle specific variations accepted by authors within the Phylloceratidae as a whole and the difficulty of distinguishing between the coarsely ribbed forms of *Phyllopachyceras* itself. Furthermore, Zittel's description was based on a small specimen and his illustration of it is not very clear. The name is tentatively perpetuated here after noting the tolerable comparison between the Antarctic specimens and the *P. beneckei* described by Collignon (1960, pl. CXXXV, figs. 511 and 512) from the Upper Tithonian *Aulacosphinctes hollandi* beds of the Malagasy Republic.

Subfamily Calliphylloceratinae Spath 1927

Genus *Calliphylloceras* Spath 1927

Calliphylloceras sp.

Plate IIf

Material

One external mould (KG.728.2) still with some of the test adhering; collected from a moraine near Ablation Point.

Description

The shell (Plate IIf) is very involute with a small umbilicus and high, probably compressed whorls. On its external surface, as it is represented by the external mould, the test is smooth except for faint traces of growth lines which are visible in a few places. Fragments of test adhering to the mould show that, on its internal surface, the test bears six rounded ridges or internal constrictions. These commence at the umbilicus and lean well forward as they cross the flank, and there are suggestions that, on the outer third or quarter of the flank, they were recurved; it cannot be ascertained from the specimen whether the constrictions crossed the venter or not.

Remarks

Because the constrictions affect only the internal surface of the test and not the outside as well, this specimen is placed in the genus *Calliphyloceras* Spath rather than *Holcophylloceras* Spath. No profitable comparisons can be made with known species as the exact form of the constrictions is not known.

Genus *Haplophylloceras* Spath 1925
Haplophylloceras strigile (Blanford 1863) (*?*)

Plate IIg–i

(*?*) *Phylloceras strigile* Blanford; Uhlig, 1903, p. 6, pl. I, figs. 1a–c and 2a and b, pl. III, fig. 6.
(*?*) *Phylloceras strigile* Blanford; Boehm, 1904, p. 22, pl. I, fig. 5a and b, pl. II, fig. 1, pl. III, figs. 1a and b and 2, text-figs. 1 and 2.

Material

Nine fragments of internal moulds, most of which have been dorso-ventrally crushed, and all from the upper parts of the exposed sequence (KG.703.40, KG.719.13, 19, 38 and 45 from locality AE; KG.720.29 and 31 from locality AG; KG.721.7 and 8 from locality AF).

Description

The shell form is known only from the two smallest specimens (Plate IIg) which are not dorso-ventrally crushed; it is extremely involute and typically phylloceratid with a small funnel-like umbilicus. All of the fragments (Plate IIg-i) have a distinctive ornament of coarse fold-like ribs that are alternately long and short, the longer ones reaching into the umbilical funnel and the shorter ones pinching out on the flank. On the smallest specimen (KG.719.45; Plate IIg) the initial stages are smooth but distinct ribs are already well developed on the venter at a diameter of about 23 mm. On the venter, the ribs are projected forward to varying degrees, the most pronounced example being specimen KG.720.29 (Plate IIi); the true form of the ribbing in many cases has been distorted by crushing. None of the specimens preserves remains of the sutures.

Remarks

The coarse fold-like ribs of the present phylloceratid species closely resemble those of Blanford's *Phylloceras strigile* except that none of the examples included here has the acute forward bend of the ribs on the venter as found in the two Spiti Shales specimens illustrated by Uhlig (1903). However, in a large collection of specimens from Indonesia assigned to this species (Boehm, 1904), there is enough variation to suggest that this acute bend of the ribs is not developed to nearly the same extent in all examples (cf. Boehm, 1904, pl. I, fig. 5a and b with pl. III, figs. 1a and b and 2). In the present collection, specimen KG.720.29 (Plate IIi) shows the strongest projection of the ribs and is more or less comparable with the example in Boehm's pl. III, fig. 1a and b, except that the latter is a larger specimen.

Boehm's (1904) Indonesian collection seems to represent a group transitional between the Spiti Shales forms with acutely projected ribs and the Antarctic examples with less noticeably projected ribbing. Whether the present specimens should be regarded as a variant of the true *H. strigile* or as a separate species is a matter for conjecture, but the close relationship between the types from Spiti, Indonesia and Antarctica can be in little doubt.

A new species, *H. pingue*, was erected by Ryf (1962) to cover *H. strigile*-like forms with a more rounded whorl cross-section and with ribs which are not projected on the venter as strongly as they are in the typical *H. strigile* (Blanford). He included Boehm's (1904, pl. 1, fig. 5, pl. 2, fig. 1, pl. 3, figs. 1 and 2) Indonesian forms in the new species, and perhaps the Alexander Island examples should likewise be referred to Ryf's *H. pingue*.

Family Lytoceratidae Neumayr 1875

Subfamily Lytoceratinae Neumayr 1875

Genus *Lytoceras* Suess 1865
Lytoceras sp. indet.

Plate Ib

Material

A few fragments from the external moulds of three large individuals (KG.712.74, 91 and 92) from locality AK.

Description and remarks

This large species is known only from the few fragments collected and photographs of specimens *in situ* (Plate Ib); it is clear from the latter that the specimens so far encountered could not be collected. The example illustrated (Plate Ib) measures about 45 cm. across and was the largest more or less complete example found but the fragments numbered KG.712.92 are almost certainly from a larger individual. On most fragments there is an ornament of thin transverse fimbriate riblets, spaced 5–10 mm. apart. The fimbriate riblets have deep, lateral sinusoidal undulations which are in phase from one riblet to the next, and in places it is possible to see that this longitudinal lining-up reflects a faint longitudinal ribbing. In view of the size of the ammonite, this transverse ornament is very fine, and yet a fragment from an unknown position on specimen KG.712.92 has an even closer spaced ornament which is feebly sinuous rather than sinusoidal.

While the above specimens are specifically indeterminate, their sinusoidal fimbriate ornament indicates a position within the Lytoceratidae, a family to which this type of ornament seems peculiar. Many large lytoceratids similar to the present species have been compared to Oppel's *Lytoceras sutile* or *L. montanum.*

Lytoceras sp. γ

Plate IIj and k

Material

Seven internal and external moulds from a moraine to the east of the coastal cliffs at Ablation Point (KG.728.1, 4, 5, 7, 8, 9 and KG.705.2).

Description

The shell (Plate IIj and k) is multispiral and evolute with pipe-like whorls whose exact cross-section is unknown and which only just rest in contact with one another. The rate of increase in whorl height is very gradual. Ornamentation is delicate and consists of fine, irregularly spaced, straight radial riblets with three or four even finer ones in between. On the body chamber of mature examples the riblets tend to be all of one size and on internal moulds the ornament as a whole is less clearly marked than on the external surface of the shell. Poorly defined constrictions, about four per whorl, are discernible on some specimens, especially KG.728.5 (Plate IIj).

Remarks

The stratigraphical position of this species is unknown because the only specimens came from a moraine (p. 32). All are fragmentary and have been crushed so that the original whorl cross-section is unknown. Nevertheless, it seems probable that it was compressed rather than circular or even depressed, as in many lytoceratids. No comparable species have been found in the literature consulted and it is possible that the present specimens represent a new species. However, the identification of many species and genera within the Lytoceratidae is extremely difficult even with good material and, in view of the deficient preservation of the Antarctic specimens, their identification is left open.

Genus *Pterolytoceras* Spath 1927

Pterolytoceras exoticum (Oppel 1863)

Plate III and m

Lytoceras exoticum Oppel; Uhlig, 1903, p. 14, pl. I, figs. 3a–d and 4a–c.
Pterolytoceras exoticum (Oppel); Collignon, 1960, pl. CXL, fig. 533.

Material

Five incomplete external moulds (KG.701.70 from the screes at locality AH; KG.712.13, 20, 37 and 40 from locality AK).

Description

The shell (Plate III and m) is multispiral and loosely coiled; the whorls are pipe-like, slowly expanding and probably had a round to compressed oval cross-section. The external surface of the shell is smooth

except for numerous faint growth lines and thin, widely spaced flares that stand well above the general surface of the shell. In the early stages, these flares tend to be convexly curved but later they become more or less radial. The last and largest flare of specimen KG.712.13 (Plate IIm), where the whorl is 9 mm. high, stands proud of the surface by at least 1 mm. and on all specimens it appears as if the flares acted as spacers between the whorls such that none was in contact.

Measurements

Specimen number	*D* (mm.)	*h* (mm.)	*u* (mm.)	*h/D* (per cent)	*u/D* (per cent)
KG.712.13	34·5	9·0	17·5	26	51
KG.712.37	17·0	5·0	9·0	29	53

Remarks

The morphology of the species *Pterolytoceras exoticum* (Oppel) is well known from the detailed descriptions given by Uhlig (1903) from its occurrence in the Spiti Shales of the Himalayas. Its slowly expanding whorls and distinctive flares are also seen in the present examples. Apart from the objection that the whorl cross-section of the latter is unknown, there seems little reason to exclude them from Oppel's species. The loose coiling of the Alexander Island specimens is also well seen in examples of *P. exoticum* from the Lower Tithonian *Hildoglochiceras kobelli* beds of the Malagasy Republic (Collignon, 1960, p. CXL, fig. 533).

Family Bochianitidae Spath 1922

Subfamily Bochianitinae Spath 1922

Genus *Bochianites* Lory 1898

Bochianites aff. *versteeghi* Boehm 1904

Plate IIn–p

aff. *Bochianites versteeghi* Boehm, 1904, p. 27, pl. II, fig. 6a–c, text-fig. 4.

Material

Eight, possibly nine, fragments of external and internal moulds from the upper parts of the exposed sequence (KG.720.42 and 47 from locality AG; KG.721.9, 10, 13 (?), 31–33 and 42 from locality AF).

Description

This species (Plate IIn–p) has a straight, gently tapering shell and the largest specimen (KG.721.31; Plate IIn) must have been originally about 20 cm. long. In the early stages, the cross-section is round with a flattened dorsum but in the later stages it appears to have become more oval. Ornament at all periods of growth consists of prorsiradiate ribs and well-defined periodic constrictions which follow the same line as the ribs. Both ribs and constrictions pass without interruption over the venter (Plate IIp) in a forward-facing curve but, on the dorsum (Plate IIo), they are much reduced in prominence and appear to have all but disappeared in some examples. In those smaller fragments with a rounded cross-section, the ribs swell into incipient bullae at the dorso-ventral edge, but, on larger fragments, where the cross-section is more oval, the ribs appear to decrease in prominence towards the dorsum.

No sutures are preserved although one fragment (KG.721.9; Plate IIo), which is an internal mould of a body chamber, shows the last septum, and on each lateral half may be distinguished the ventral and dorsal lobes, a broad lateral lobe and two large bifid lateral saddles.

Remarks

The periodic constrictions present in this species suggest close affinities to the two species described by Boehm (1904) from Indonesia in beds of so-called Jurassic–Cretaceous transition age: *Bochianites weteringi* and *B. versteeghi*. The last two species were differentiated on their ornament and suture lines. Because of their distinct ribbing, the present examples are probably closer to *B. versteeghi* although their ornament is perhaps a little coarser than in that species. However, the ornament is not as strongly deve-

loped as in *B. africanus* Tate (Spath, 1930, pl. XIV, figs. 2 and 3, pl. XV, fig. 3) from the Lower Neocomian of South Africa, or as in *B. neocomiensis* (d'Orbigny, 1840–42, pl. 138, fig. 1) from the Lower Neocomian of Europe, and neither of these two species possesses constrictions. Boehm's *B. versteeghi* is not well enough known to be certain of its specific identity with the present fragments but the two must be closely related.

Among other examples of *Bochianites* with constrictions, *B. glennensis* Anderson (Anderson, 1945, p. 984, pl. 7, fig. 2) is perhaps not a *Bochianites* after all (Imlay and Jones, 1970, p. B30) and *B. paskentaensis* (Anderson, 1938, pl. 29, fig. 10; Imlay and Jones, 1970, pl. 1, figs. 13–15) from the Valanginian of California is almost smooth and has faint ribbing which passes transversely across the venter.

Family Haploceratidae Zittel 1884

Genus *Haploceras* Zittel 1870

Haploceras sp.

Plate IIIa and b; Fig. 4a and b

Material

Six external and internal moulds (KG.700.58 from locality AH; KG.706.6, KG.722.20, KG.880.5 and KG.885.1 and 3 from Ganymede Heights).

Description

The examples included here (Plate IIIa and b) have feebly ornamented and compressed haploceratid shells with rapidly increasing whorls that successively overlap one another by about one-half. On the external moulds, faint falcate threads are visible, particularly on the ventral half of the whorls. Only specimen KG.706.6 is preserved sufficiently well to give an accurate idea of the whorl cross-section (Fig. 4a); it is high and sub-rectangular, expanding slightly in width to a maximum at the umbilical rim; the

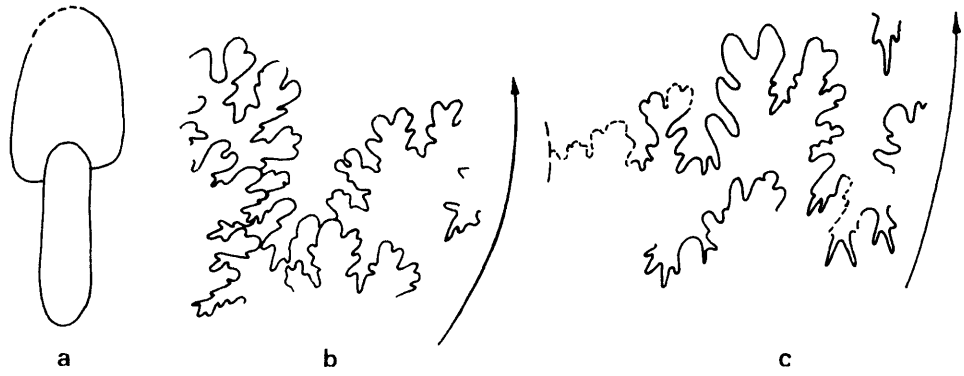

Figure 4

a. *Haploceras* sp. Shell cross-section, ×2 (KG.706.6).
b. *Haploceras* sp. Suture, ×7 (KG.706.6).
c. *Pseudolissoceras* (*?*) sp. Suture, ×7 (KG.700.60).

venter is broadly rounded and the flanks are only feebly convex. Remains of the sutures are preserved on only one specimen (Fig. 4b). These are incomplete but they show a first lateral saddle which projects forward of the external saddle.

Measurements

Specimen number	*D* (mm.)	*h* (mm.)	*u* (mm.)	*w* (mm.)	*h/D* (per cent)	*u/D* (per cent)
KG.700.58	33·0	15·0	7·3	—	45	22
KG.706.6	23·0	10·2	5·2	6·4	44	23
KG.722.20	27·5	12·1	6·5	—	44	24

Remarks

The simple shell form and the general lack of ornament make the haploceratid ammonites a particularly difficult group to work with. Although the generic assignment suggested here is reasonably sound, on the basis of the sub-quadrate whorl cross-section, good preservation is essential for any meaningful specific identification to be attempted.

Perhaps one of the best-preserved *Haploceras* faunas is that described by Burckhardt (1906) from the Upper Kimmeridgian (=Lower Tithonian) of Mexico. The fine falcate ornament of the present species is also found on several of the Mexican forms, notably *H. transatlanticum* and *H.* aff. *mexicanum*. However, on *H. mexicanum* the ornament is noticeably more prominent on the dorsal rather than the ventral half of the whorl and both have a greater *h*/*D* ratio than does the Antarctic form. *H. subelimatum* Fontaine from the Lower Tithonian of the Malagasy Republic (Collignon, 1960, pl. CXLI, fig. 538) also differs in having a slightly greater *h*/*D* value.

Genus *Pseudolissoceras* Spath 1925

Pseudolissoceras (*?*) sp.

Plate IIIc; Fig. 4c

Material

Two internal moulds (KG.700.60 from locality AH; KG.887.2) and one external mould (KG.722.13 from locality AB).

Description and remarks

These three specimens (e.g. Plate IIIc) differ from *Haploceras* sp. described above in several respects. They have more slowly expanding whorls with narrowly arched venters and they are apparently devoid of ornament. The suture on specimen KG.700.60 (Fig. 4c) is a little simpler than that of *Haploceras* sp. (Fig. 4b) and the successive septa are less closely spaced than on the last species. The more tightly arched venter suggests closer affinities with *Pseudolissoceras* than *Haploceras*. However, the suture of the present species is more complicated than that of the genotype, *P. zitteli* (Burckhardt, 1903, p. 55, pl. X, figs. 1–8) and its umbilicus is proportionally wider. Most described examples of *Pseudolissoceras* have been referred to *P. zitteli* and it has been reported from Argentina, Peru, Cuba and Kurdistan (Spath, 1950, synonymy p. 101), and Mexico (Verma and Westermann, 1973).

Measurements

Specimen number	*D* (mm.)	*h* (mm.)	*u* (mm.)	*h*/*D* (per cent)	*u*/*D* (per cent)
KG.700.60	25·0	10·2	7·2	41	29
KG.722.13	25·5	10·0	7·5	39	29
KG.887.2	12·0	5·0	2·9	42	24

Family Oppeliidae Bonarelli 1894

Subfamily Streblitinae Spath 1925

Genus *Uhligites* Kilian 1907

Uhligites aff. *kraffti* (Uhlig 1903)

Plate IIId–f

aff. *Oppelia* (*Streblites*) *kraffti* Uhlig, 1903, p. 44, pl. IV, fig. 1a–d, pl. V, fig. 1a–d, pl. XLIII, fig. 1a–c.

Material

Three incomplete specimens: an external mould with the internal mould of the body chamber, from the screes on the south side of Ablation Valley (KG.701.80), and two external moulds from locality AK

(KG.712.33 and 138). Specimen KG.890.1 from southern Ganymede Heights may also belong to this species.

Description

The shell (Plate IIId–f) is involute with high, rapidly increasing compressed whorls and a small umbilicus. On the internal mould of the body chamber ($D \simeq 50$ mm.), the flanks are more or less flat and parallel and the venter is rounded; on the external mould there is a coarsely serrate keel. The smaller of the external moulds (KG.712.33; Plate IIIf) suggests that the whorl flanks were more convex in the early stages, and it also demonstrates an interesting change in ventral ornament. Up to a diameter of 23 mm. the venter bears stout, almost discrete, triangular serrations but then there is an abrupt change to a keel with a crest of relatively finer serrations. The shell ornament is as poorly developed on the external moulds as it is on the internal one, and consists of weakly falcate ribs that are only readily visible near the venter. Growth lines are best developed around the umbilical rim.

Remarks

Despite their incomplete preservation, these fragments have much in common with *Uhligites* Kilian; apart from their feebler ornamentation, they are not unlike the type species, *Streblites kraffti* Uhlig (1903). Although *Uhligites* has a keel, it is hollow and is formed in the outer layer of shell only (Uhlig, 1903, p. 34, fig. 6). Traces of this keel are present on the early stages of some internal moulds from the Himalayas but more often the venter is rounded. Since most of the Himalayan type material described by Uhlig (1903) is in the form of internal moulds, few specimens (including those of the type species, apart from the example in pl. XLIII, fig. 1a and b) show the keel and they give the wrong impression of the external shell form. This probably accounts for the omission of this feature in the description of *Uhligites* in the *Treatise* (Arkell and others, 1957, p. *L*284), A similar hollow keel on the present species is clearly indicated by specimen KG.701.80 (Plate IIIe) where a keel is present on the external mould but not the internal one.

The Ablation Point fragments differ from *Substreblites* (*?*) sp. from locality Z (Thomson, 1971, 1974, pl. IVa) in possessing a serrate keel instead of a ventral fillet and in having even feebler ornamentation.

Genus *Substreblites* Spath 1925

Substreblites sp.

Plate IIq

Substreblites (*?*) sp.; Thomson, 1971, p. 158.
Substreblites (*?*) sp.; Thomson, 1974, p. 22, pl. IVa.

Material

One more or less complete but crushed external mould from locality AP on the western side of Ganymede Heights (KG.1573.118).

Description and remarks

This specimen is a little better than the single fragment previously recorded from Tombaugh Cliffs (locality Z; Thomson, 1971, 1974). It is preserved in a similar manner to the specimens of *Uhligites* aff. *kraffti* described above and, although it bears *Uhligites*-like ornament on the flank, it clearly lacks the denticulate or serrate keel of that genus. Instead, a flat ventral fillet is present (best seen on the left-hand side of Plate IIq) and this confirms its identification with the genus *Substreblites* Spath and also that tentatively suggested for the example from Tombaugh Cliffs. In the present specimen, the umbilicus is not well preserved but it is sufficiently well indicated to show that in the reconstruction suggested for the first example (Thomson, 1974, pl. IVa) the umbilicus was drawn too large.

The known distribution of *Substreblites* appears to be largely confined to Europe and Asia Minor, and the mention of the genus in the Salt Range by Arkell (*in* Arkell and others, 1957, p. *L*248) is not borne out by Spath's (1939) monograph. Its occurrence in Alexander Island appears to be the first known outside the Northern Hemisphere.

SUBFAMILY UNCERTAIN

Gen. nov. (?)

Plate IIIg

Material

One internal and two external moulds (KG.712.105 and 131 from locality AK; KG.887.1 from Ganymede Heights).

Description

This species has a discoidal shell (Plate IIIg) with high compressed whorls which envelop about one-half or more of the preceding one. The whorl flanks are gently convex and slope gradually towards a low umbilical wall; the venter is tabulate on the body chamber but there are indications that it was more acute in the early stages. On the best specimen (KG.712.105; Plate IIIg), the aperture is almost entire and carries a well-developed lappet with an expanded, lobe-shaped anterior termination. Lateral ornament is only preserved on the later part of the body chamber where fine, falcate growth lines are visible. The venter bears a row of coarse triangular serrations which degenerate on the body chamber into more widely spaced transverse ridges or waves, and then apparently disappear altogether. No decipherable suture remains are preserved on any of the specimens.

Measurements

Specimen number	*D* (mm.)	*h* (mm.)	*u* (mm.)	*h/D* (per cent)	*u/D* (per cent)
KG.712.105	23·0	11·5	5·2	50	23
KG.712.131	22·0	10·5	5·0	48	23
KG.887.1	19·8	9·0	4·9	45	25

Remarks

In the absence of suture remains and/or a closely similar described form, it is not possible to arrive at even a satisfactory family classification of this species. According to the criteria used by Arkell (*in* Arkell and others, 1957), its shell form resembles that of many Haploceratidae, whereas the serrations on its venter are more typical of the Oppeliidae. Although the present specimens were found in association with Tithonian ammonites, there are several Kimmeridgian species to which the present one may in some way be related. A number of small, more or less smooth species with denticulate keels from Mexico were described by Burckhardt (1912, p. 65–68) in a group centred on "*Streblites*" *pygmaeus* Uhlig from the Spiti Shales. In all of these the venter is more feebly ornamented than on the Alexander Island specimen but similar well-developed lappets are present at approximately the same size. "*Haploceras*" *crenosum* (Oppel) (Collignon, 1959, pl. CXV, figs. 436–37) from the Malagasy Republic is apparently similar in lateral aspect but ventral views indicate that its ventral ornament is a series of corrugations representing a ventral vestige of ribbing.

A similar problematical ammonite species was discovered in the Lower Cretaceous of the Fossil Bluff area (Thomson, 1974, p. 28, pl. IVj) but the venter of that species is acute, rather than tabulate, and the ventral serrations are more persistent.

FAMILY PERISPHINCTIDAE STEINMANN 1890

SUBFAMILY VIRGATOSPHINCTINAE SPATH 1923

The majority of specimens from the Tithonian sediments studied in the Ablation Point area (Fig. 3) belong to the Family Perisphinctidae and most of these belong to the genera *Virgatosphinctes* Uhlig 1910 and *Aulacosphinctoides* Spath 1923. The phyllogeny and generic relationships of the perisphinctid genera are highly complex and have been widely interpreted in the past. Generic and specific distinctions have

frequently been based on only slight differences in gross shell morphology, differences in ribbing type and/or differences in which the ribbing pattern alters with increase in size. Furthermore, the literature on this group is often confused, particularly where several authors published papers dealing either wholly or in part with perisphinctids, more or less at the same time, and where important observations have been made either in passing or in footnotes. A good example of the kind of confusion which has arisen is outlined at length in a discussion of *Virgatosphinctes* sp. nov. aff. *andesensis* Douvillé (p. 19).

While the Virgatosphinctinae form an important part of the present collection, with few exceptions the specimens available are poorly preserved; all are internal or external moulds, most are of crushed individuals and many are fragments showing parts of one or two whorls only. The identifications suggested here have therefore been based largely on the similarity of ornament at a particular growth stage (usually the body chamber), and sometimes also on the rate of coiling of the shell, to that of known species. In view of the above remarks, the identifications can scarcely be satisfactory from a systematic point of view. However, this does not invalidate the stratigraphical use made of these fossils, which almost certainly indicate a Tithonian age.

Genus *Pachysphinctes* Dietrich 1925

Pachysphinctes (*?*) sp.

Plate IIIi

A large but almost completely septate internal mould (KG.725.3; Plate IIIi), from the disturbed beds on the western side of Ablation Point, lacks the ventral part of the outer whorl and its inner whorls are strongly crushed. The coiling of the shell is multispiral and moderately evolute. All whorls bear an ornament of stout, gently concave ribs which increase gradually in stoutness and spacing in proportion to the increase in whorl size. A few ribs on the outer whorl appear to branch but the number of secondaries is indeterminate.

The lack of a venter on this single specimen makes it impossible to identify it with any certainty. However, the features preserved show such a striking resemblance to *Pachysphinctes grandti* Spath (Collignon, 1959, pl. CXVI, fig. 443), from the Middle Kimmeridgian of the Malagasy Republic, that a tentative identification with the genus *Pachysphinctes* may be suggested.

Genus *Virgatosphinctes* Uhlig 1910

Virgatosphinctes denseplicatus (Waagen 1875)

Plate IIIh

Perisphinctes (*Virgatosphinctes*) *denseplicatus* Waagen; Uhlig, 1910*b*, p. 313, pl. LIII, fig. 3a–d, pl. LIV, fig. 1a–c, pl. LV, figs. 1a–d, 2a–d, 3a–d, pl. LVI, fig. 1a–c.

Virgatosphinctes denseplicatus (Waagen); Spath, 1931, p. 532, pl. LXXVII, fig. 3a–c, pl. XC, fig. 1, pl. XCVI, fig. 3a and b, pl. CII, fig. 4.

Material

One fragment of external mould from a small distorted individual (KG.712.68) from locality AK.

Description

Only part of one whorl and a little of the preceding one are preserved (Plate IIIh). During fossilization the shell has been crushed in such a manner that the venter has been moved into a lateral position. The specimen bears numerous fine, sharp dense ribs, most of which are bifurcate but some are simple and one is trifurcate. All the ribs cross the venter and do so in an irregular fashion. Sometimes two secondaries from one primary correspond to two secondaries of an opposing primary, and elsewhere the anterior branch of a pair of secondaries on the right flank corresponds to the posterior secondary of a pair on the left flank, thus forming a narrow zig-zag pattern. The presence of simple ribs interrupts the two styles of ornament. One shallow constriction is present.

Remarks

Despite the incomplete preservation of this specimen, its fine dense ribbing, which is typically bifurcate, suggests close affinities to *Virgatosphinctes denseplicatus* (Waagen). Small individuals of comparable size and ornament have been illustrated by Uhlig (1910*b*, pl. III, fig. 3a–c) from the Himalayas and by Spath (1931, pl. LXXVII, fig. 3a–c, pl. CII, fig. 4) from the Cutch. Both authors commented on the variation shown by this species and there seems little reason why the present example may not be included with the Indian forms.

A closely similar (? conspecific) species occurs in Argentina; this is Steuer's (1897, p. 36, pl. XIV, figs. 8–10) *Reineckia striolata*, which was later doubtfully referred to the genus *Pectinatites* Buckman by Leanza (1945, p. 24, pl. II, figs. 5 and 8) and assigned to the uppermost zone of the Tithonian. *Reineckia striolatissima* Steuer (1897, p. 36, pl. XIV, figs. 5–7) (=*Substeueroceras striolatissimum* (Steuer), Leanza, 1945) is more finely and more densely ribbed than the present species. Whereas Leanza referred *R. striolata* and *R. striolatissima* to different genera, Spath (1931, p. 534) suggested that the first of these appeared to be very close to *V. denseplicatus* and that *R. striolatissima* was of similar appearance to *V. denseplicatus* var. *stratissima* Spath.

A second, closely comparable Argentine species is *V. wilfridi* (Douvillé). Although Douvillé (1910, p. 12, pl. II, fig. 6) described his original "*Holcodiscus*" *wilfridi* as having bifurcate and a few simple ribs only, Indans (1954, p. 107, pl. 13, fig. 3) has described a small example with occasional trifurcate ribs. Uhlig (1911, p. 542) has already pointed out the close similarity between Douvillé's example and *V. denseplicatus* from the Spiti Shales.

Virgatosphinctes aff. *denseplicatus* (Waagen 1875)

Plates IIIj and k, and IVa; Fig. 5

Virgatosphinctes cf. *V. denseplicatus* (Waagen); Imlay, 1943, p. 535, pl. 89, figs. 1–4.

Material

Three internal moulds from locality AK (KG.712.35, 120 and 136) and one external mould (KG.700.50) from locality AH.

Description

Only one specimen (KG.712.35; Plate IIIj) gives an accurate idea of the shell form because the others (Plates IIIk and IVa) are too fragmentary or are crushed. It is moderately evolute with whorls which embrace one-half or less of the preceding one. On the best specimen, the septate whorls have a squarely inflated cross-section with flat, almost parallel flanks, a semi-circular venter and short but steep umbilical walls that curve abruptly round from the flank. The cross-section of the larger whorl on specimen KG.712.35 is more compressed and the venter is more acutely rounded; this narrowing of the whorl cross-section has been enhanced by crushing but the three successive cross-sections shown in Fig. 5 suggest that there is a true tendency towards compression of the whorls in the late stages of development.

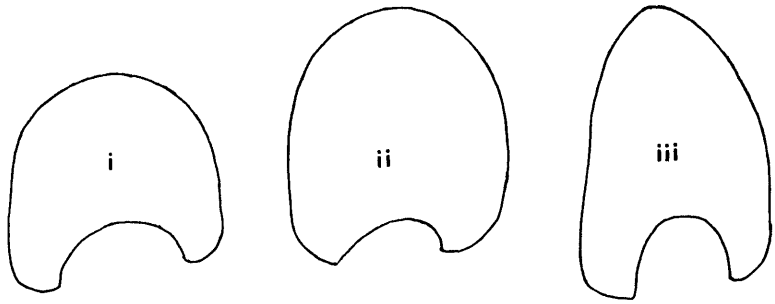

FIGURE 5

Virgatosphinctes aff. *denseplicatus* (Waagen). A series of three whorl cross-sections (i–iii) from the outer whorl of specimen KG.712.35 showing a tendency towards a more compressed section, ×1. The locations of the sections are shown on Plate IIIj.

At all stages of growth preserved in the material available, the shell is ornamented with fine, closely spaced ribs which bifurcate narrowly on the upper part of the flank where it begins to curve over on to the venter. The ribs develop on the umbilical wall, curve concavely as they cross the umbilical rim and lean forward as they cross the flank; the primary and secondary parts of the ribs are of similar proportions and all secondaries cross the venter without interruption. A few trifurcate ribs may be present in the later stages but these appear to be unusual. Periodically (about three or four times per whorl), the ribbing is interrupted by constrictions which slope forward at a slightly greater angle than that of the ribs.

Modifications of this ornament in relation to size vary from one individual to another. However, there is a general tendency for the ribbing to be sharper and more widely spaced on the earlier whorls of all examples. On the outer whorl of mature forms, it becomes more closely spaced and is sometimes less clearly defined; on specimen KG.712.120 (Plate IVa) the ribbing is still visible and is very dense, but on specimen KG.712.35 (Plate IIIj) the body chamber is virtually smooth.

Measurements

The best specimen (KG.712.35) has the following dimensions: D=111 mm., u=50·5 mm., h=33·5 mm. and w=23·0 mm. (possibly slightly reduced by crushing).

Remarks

The specimens included here show a considerable but continuous variation in ornament from one to another. *Virgatosphinctes denseplicatus* (Waagen) is generally taken to be a variable species, yet none of the variants described by Uhlig (1910*b*) and Spath (1931) shows the strong tendency towards reduction in ornament seen in the present examples. Some strikingly similar specimens are the two fragments, from the Upper Jurassic of northern Mexico, described by Imlay (1943) as *Virgatosphinctes* cf. *denseplicatus*. Specimen KG.712.120 (Plate IVa) compares well with the example in Imlay's pl. 89, fig. 4, and specimens KG.700.50 and KG.712.136 (Plate IIIk) with the example in his pl. 89, figs. 1–3, except that the latter is a little more closely ribbed.

Virgatosphinctes acuticostus sp. nov.

Plate IVb

Material

One internal mould (KG.712.59) from locality AK, partly crushed, but showing the main features of the shell.

Diagnosis

A *Virgatosphinctes* of the *V. denseplicatus* (Waagen) group, apparently having only bifurcate ribs on the septate part of the shell and also some occasional trifurcate virgatotome ones on the body chamber of the adult. Ribbing fine and sharp, especially on the body chamber, more distant than in *V. denseplicatus*. Aperture with short lappets.

Description

The shell (Plate IVb) is widely umbilicate and has gradually expanding whorls which embrace a little more than one-third of the previous one. The cross-section of the whorls is unknown. At all stages of growth there is an ornament of fine, closely spaced radiate to prorsiradiate ribs, most of which bifurcate near the middle of the flank into feebly divergent secondaries of similar strength to the primaries. On the remains of the body chamber the ribs become even sharper and well defined, and here also are the only two non-bifurcate ribs which may be observed on the specimen; these are trifurcate virgatotome (Plate IVb, arrows). The aperture is marked by a constriction and has short rounded lappets. It appears as if there is some bundling of the primary ribs just behind the apertural constriction but the mould is not well enough preserved to be certain.

Remarks

The specimen, with its closely spaced biplicate ribs and rare trifurcate ones, is comparable with *Perisphinctes denseplicatus* Waagen (extensively described and illustrated by Uhlig (1910*b*, p. 313)) and allied species, yet it does not appear to be conspecific with any so far described. From *V. denseplicatus* and *V.* aff. *denseplicatus*, described above, it differs in having more definite ribbing (even on the internal mould), which is more distantly spaced and which becomes more distinct on the body chamber instead of fainter. Leaving aside Uhlig's *V. serpentinus* and *V. similis*, which may well be identical with some of Uhlig's *V. denseplicatus* (Spath, 1931, pl. 533), the present specimen differs from *V. intermedius* Uhlig (1910*b*, p. 319, pl. LXVI, fig. 1a–d) in having more closely spaced ribbing on the early whorls, and from *V. pompeckji* Uhlig in having trifurcate ribs which were thought to be absent in that species (Uhlig, 1910*b*, p. 321).

Uhlig's (1910*b*, p. 318, pl. LII, fig. 1a–d) *V. rotundidoma* is perhaps most similar to the present species but it has simple ribs in the ornament and the body chamber appears to occupy about only half of the outer whorl, whereas that of the present species takes up three-quarters of the outer whorl. *V.* aff. *rotundidoma* (Imlay, 1942, p. 1448, pl. 2, fig. 14) from Cuba is more evolute, more densely ribbed and has frequent simple ribs.

Virgatosphinctes contiguus (Catullo 1846) (*?*) (Uhlig, 1910*b*, *non* Zittel, 1870)

Plate IVc and d

(*?*) *non Perisphinctes contiguus* Catullo; Zittel, 1870, p. 110, pl. XI, figs. 1 and 2.
Virgatosphinctes contiguus (Zittel); Uhlig, 1910*b*, p. 339, pl. LXVIII, fig. 2a–d).

Material

Two fragmented and crushed specimens (KG.712.46 from locality AK; KG.722.19 from locality AB).

Description and remarks

Largely on the basis of similarities in ornament, the two fragments (Plate IVc and d) included here are tentatively identified with another much better preserved example from the Spiti Shales, referred to *Virgatosphinctes contiguus* (Zittel) by Uhlig (1910*b*, p. 339, pl. LXVIII, fig. 2a–d). Both specimens have an ornament of distinct wiry ribs, most of which are bifurcate but some of which are trifurcate virgatotome. A particular point of similarity is the way in which the ribs branch into secondaries that trend almost parallel to each other, rather than steadily diverging as in many species of *Virgatosphinctes*. In the case of the posterior secondary, this parallelism is accomplished by a characteristic angular, sometimes almost step-like, bend shortly after diverging from the primary rib.

While there is good agreement between the present specimens and the Spiti Shales example described by Uhlig, there is some doubt as to whether these can be regarded as the true *V. contiguus*. Uhlig (1910*b*, p. 339) excluded Catullo's original *V. contiguus* from synonymy with the Spiti Shales form and instead referred his specimen to that species as described by Zittel (1870, p. 110, pl. XI, figs. 1 and 2). Later, Blaschke (1911, p. 156) noted that *V. contiguus* (Catullo) was a sack species. Uhlig (1910*b*, p. 340) remarked that the example he had described from the Spiti Shales "agrees perfectly as regards its scultpure, with the above mentioned *Perisphinctes contiguus* of Zittel". Unless Uhlig was able to examine Zittel's original material, this is hard to believe because the illustration given by Zittel (1870) is poor and the ribbing is so indistinct such that it appears much blunter than on the example described by Uhlig. It is similarly difficult to reconcile Zittel's illustrated specimen with that later figured by Blaschke (1911, pl. I, fig. 10) from the Stramberger Schichten.

Virgatosphinctes sp. nov. aff. *andesensis* (Douvillé 1910)

Plate IVe–g

(*?*) *Perisphinctes* cf. *danubiensis* Schlosser; Burckhardt, 1906, p. 112, pl. XXXII, fig. 1.
Virgatosphinctes andesensis (Douvillé); Corvalán, 1959, p. 23 (*pars*), pl. 5, fig. 19, *non* pl. 4, fig. 18.

Material

Three small fragments of internal mould (KG.712.97 and 137 from locality AK; KG.701.56 from the screes at locality AH).

Description

The three fragments (Plate IVe–g) all exhibit the same basic ribbing pattern, although they represent different stages of growth, i.e. stout, distant, rounded primary ribs which bifurcate, or trifurcate virgatotomously into thinner rounded secondaries. The ribs branch low on the flank, probably just below the middle, and on the penultimate whorl seen on specimen KG.701.56 (Plate IVe) the beginnings of trifurcate branching is clearly visible below the umbilical seam with the succeeding whorl. The style of branching is such that, in the case of trifurcate ribs, it is the middle or anterior secondary which continues along the line of the primary and not the posterior secondary rib as is often the case in other species. Specimen KG.712.97 (Plate IVf) is from the anterior extremity of an adult body chamber, about 36 mm. high, and carries a broad-based rounded lappet; its ornament is modified by the appearance of intercalated ribs and by the presence of a quadrifurcate rib.

Remarks

In many respects the ribbing on these fragments is similar to that of a group of Argentine Lower Tithonian ammonites referred to *V. andesensis* (Douvillé). This seems to be a widely interpreted species (Douvillé, 1910; Weaver, 1931; Indans, 1954) and, in the author's view, may well consist of more than one species,* but it is doubtful whether the present fragments can be considered as being conspecific with any of its variants. On all previously illustrated examples, a common factor is the variation in ornament during the various stages of growth, while on the present species this appears to be relatively stable with a basic ornament of trifurcate ribs at all growth stages represented. In *V. andesensis*, quadrifurcate ribs are common on the outer whorl and in some of the examples previously illustrated the branching is dichotomous rather than virgatotome. A related species which shows much closer similarities to the Antarctic fragments in regard to its more persistent trifurcate ribbing is *Perisphinctes* cf. *danubiensis* Schlosser (Burckhardt, 1906) from the Tithonian of Mexico. Like the present fragments, however, that unique specimen is also poorly preserved. Of two examples of *V. andesensis*, from Chile (Corvalán, 1959, pl. 4, fig. 18, pl. 5, fig. 19), only the second may be conspecific with the present material, whereas the first shows the quadrifurcate, often tree-like, branching of the ribs, typical of the true *V. andesensis*.

In the literature there appears to be a certain amount of confusion over the interpretation of the species *V. andesensis*. The holotype is a specimen described by Douvillé (1910, pl. I, fig. 4a–f) but, in his original description, Douvillé also included two fragments from Argentina previously described by Burckhardt (1903, pl. VII, figs. 1–8) as *Virgatites scythicus* Vischniakoff. In a later paper, Burckhardt (1911, p. 772) erected a new species which was based on the example in pl. VII, figs. 1 and 2 of his 1903 paper: "*Virgatites mendozanus* nob., beschrieben als *V. scythicus* in *Palaeontographica* 50, Taf. 7, Fig. 1 und 2".

There are three curious points here:

i. Burckhardt made no comment on Douvillé's (1910) previous inclusion of the relevant specimen in his (Douvillé's) own *V. andesensis*.
ii. The specimen in Burckhardt's (1903) pl. VII, figs. 1 and 2 is shown in different views also in figs. 3 and 4.
iii. Since the second specimen (pl. VII, figs. 5–8) is virtually indistinguishable from the first, did Burckhardt also consider this as being included in *V. mendozanus*?

In a description of *V. andesensis* from west-central Argentina, Weaver (1931, p. 422), like Douvillé (1910), included both of Burckhardt's (1903, pl. VII, figs. 1–8) specimens in that species and yet earlier in the same paper (Weaver, 1931, p. 46) he clearly accepted the validity of Burckhardt's *V. mendozanus*. He noted that it was extremely common in Neuquen and used it as a zone fossil for the Lower Tithonian; surprisingly, however, he did not describe this abundant form. This anomaly has also been noticed by Leanza (1945, p. 19, footnote 2).

* It is, however, recognized that any real differences in the original specimens are enhanced by the different methods of illustration which have been used; in the three papers cited, photographs, colour-wash sketches and drawings have been used, respectively.

Virgatosphinctes aff. *mexicanus* (Burckhardt 1906)

Plate IVh

aff. *Virgatites mexicanus* sp. nov. Burckhardt, 1906, p. 115, pl. XXXI, figs. 5–9.
aff. *Virgatites mexicanus* Burckhardt; Douvillé, 1910, p. 8, pl. XVII, figs. 1 and 2.
Virgatosphinctes cf. *mexicanus* (Burckhardt); Indans, 1954, p. 113, pl. 18, fig. 1.

Material

Two internal mould fragments of laterally crushed individuals (KG.712.112 and 113) from locality AK, and a third fragment of external mould (KG.700.3) from locality AH, which might possibly belong to the same species.

Descriptions and remarks

The two internal mould fragments have an ornament (Plate IVh) of sharp, stout primary ribs which bifurcate or branch virgatotomously into three or four secondaries of similar or slightly finer proportions than the primaries. As they ascend the umbilical wall, the primaries curve concavely and are then projected forward as they cross the flank; near the middle of the flank they branch and the secondaries are recurved as they ascend towards the venter. The sharp stout ribs branching into sheaf-like bundles of secondaries recall the species *Virgatosphinctes mexicanus*, first described from Mexico by Burckhardt (1906) and later from Argentina by Douvillé (1910), except that in that species the secondaries are not recurved. In this last respect the present specimens show a closer resemblance to *Virgatosphinctes* cf. *mexicanus* (Indans, 1954) from the Lower Tithonian of Argentina, and in which there is a slight tendency for some of the secondaries to be recurved. Crushing may have enhanced the recurving of the ribs in the specimens described here.

Arkell (1956, p. 562) remarked that Burckhardt's *Virgatites mexicanus* appeared "to belong to the genus *Virgataxioceras* of the Beckeri Zone" (Middle Kimmeridgian), but later he (p. 583) referred to *Virgatosphinctes mexicanus* Burckhardt when discussing the Lower Tithonian of the Andes. Among the Himalayan Spiti Shales species, the one which appears to be most similar to the present fragments is *V. burckhardti* Uhlig (1910*b*, p. 332, pl. LXII, fig. 3a–c) (=*V. douvillei*; Uhlig, 1911, p. 537, footnote).

Virgatosphinctes cf. *frequens* (Oppel 1865)

Plates Ic and Va–d

cf. *Perisphinctes* (*Virgatosphinctes*) *frequens* (Oppel); Uhlig, 1910*b*, p. 325, pl. LXIII, figs. 1a–c and 3a–c, pl. LXXV, fig. 1a–c, pl. LXXVA, fig. 1a–c.
cf. *Virgatosphinctes frequens* Oppel; Collignon, 1960, pl. CLIV, figs. 619 and 620.

Material

Three fragments of external mould (KG.712.55 and 103 from locality AK; KG.728.3 from the moraine near Ablation Point) and a piece of internal mould (KG.712.95), all from medium-sized individuals. An internal mould fragment of a very large example (KG.726.2) was collected near the top of Ablation Point.

Description

Because this species is known only from crushed whorl fragments (Plate Va–d), the mode of coiling of its shell is unknown. The severe fracturing undergone by the largest fragment (Plates Ic and Va) during fossilization suggests that it had an inflated whorl cross-section, and the smaller internal mould is preserved well enough to indicate a rounded, triangular whorl cross-section with an arched venter and maximum width at the umbilical rim.

All fragments bear an ornament of stout, distant primary ribs which branch near, or a little higher than, the middle of the flank into sheaves of finer secondary ribs that diverge only slightly as they cross the ventral part of the flank and the venter. Usually the primaries branch virgatotomously into three with the anterior secondary commencing well below the middle of the flank, but there are also instances of bifurcate and quadrifurcate ribs. Bifurcate ribs are accompanied by short intercalated ribs. The largest fragment (Plate Va) has a whorl height of 85 mm. in the crushed state, is entirely septate and was found detached but in

close association with an external mould (Plate Ic) at least 300 mm. in diameter. Pieces of inner whorl which have been detached from the back of this large internal mould agree both in size and ornament with the fragments described above (Plate Vb–d). The ornament of its outer whorl also follows the same basic pattern except that it is more massively developed.

A fragment of external mould (KG.712.55; Plate Vd), which is included here only tentatively, has more deeply excavated rib interspaces and coarser secondary ribs. It has come from near the aperture and the ribbing is modified in such a way as to suggest the formation of lappets. These are generally taken to indicate maturity and this example is many times smaller than the largest fragment described above.

Remarks

Lack of information about the overall form of the shell of this species does not permit a definite identification, yet its ribbing pattern does at least suggest close affinities to *Virgatosphinctes frequens* (Oppel) as described by Uhlig (1910*b*). He commented on the variation shown by the specimens which he included under Oppel's species and, with the exception of the doubtful fragment mentioned above, all the present material compares well with Uhlig's Spiti Shales material. The largest fragment from Alexander Island (Plate Va) represents a later stage than is present on Uhlig's (1910*b*, pl. LXXVA) largest specimen, although the latter is still incomplete at a diameter of more than 180 mm.; the development of massive ornament is just beginning to appear on that specimen.

There is also close agreement between the largest fragment (Plate Va) and an example from the Upper Tithonian of the Malagasy Republic illustrated by Collignon (1960, pl. CLIV, fig. 619).

Because the present material has been flattened, it is difficult to determine the exact position on the flank at which the ribs branch. Specimen KG.728.3 (Plate Vb) gives the impression that the branching occurs rather high on the flank and, in this respect, it is more comparable with *V. haydeni* (Uhlig, 1910*b*, p. 334, pl. LXI, fig. 2a–d).

Virgatosphinctes lenaensis Corvalán 1959 (*?*)

Plate Ve

Virgatosphinctes leñaensis Corvalán, 1959, p. 22, pl. 4, figs. 14 and 15.

Material

One fragment of external mould (KG.880.4) from the south-eastern part of Ganymede Heights, collected about 100 m. above the mudstones with interbedded lavas which are approximately equivalent to the disturbed zone of Ablation Point.

Description and remarks

The fragment (Plate Ve) probably represents part of a body chamber and it is too small to give much indication of the shell form. However, it has a distinctive ornament which recalls that of *Virgatosphinctes lenaensis* Corvalán from the Lower Tithonian of Río Leñas, Provincia de O'Higgins, Chile. The umbilical rim is missing but relatively prominent major ribs on the lower part of the flank branch virgatotomously into "fans" of four to five fine secondary ribs; one or two intercalated ribs may be present between adjacent fans. Apart from the finer ornament on the present specimen, it compares well with the Chilean example. *V. lotenoensis* Weaver (1931, p. 423, pl. 48, figs. 322 and 323), from the Middle Tithonian of west-central Argentina, has finer ribs like those of the Antarctic fragment but, according to Weaver, from five to eight secondary ribs branch from each major one. The drawing in his monograph is too indistinct to show the manner in which the ribs branch.

Genus *Aulacosphinctoides* Spath 1923

[*non Aulacosphinctoides* Beurlen; Roman, 1938, p. 270, *errore pro Aulacostephanoides* Schindewolf, 1925, p. 339].

It is clear from Spath's (1923, 1924) writings that the first reference to this genus was meant to appear in his memoir on the Blake collection of Ammonoidea from the Cutch (Spath, 1924). However, this was

eventually published after a paper on New Zealand ammonites (Spath, 1923) in which the genus was also mentioned and the type species (*Aulacosphinctes infundibulus* Uhlig) cited. The name *Aulacosphinctoides* is thus valid from 1923.

Aulacosphinctoides aff. *sparsicosta* (Uhlig 1910)

Plate Vf and g

aff. *Aulacosphinctes sparsicosta* Uhlig, 1910*b*, p. 377, pl. LXXIV, fig. 2a–f.

Material

Two incomplete external moulds (KG.712.1 and 39 from locality AK).

Description and remarks

The larger fragment (KG.712.1; Plate Vg) has much of the outer whorl missing but, as far as may be judged, the proportions of the shell and the density and style of the ribbing compare closely with Uhlig's (1910*b*) *Aulacosphinctes sparsicosta* from the Spiti Shales. However, it lacks the rib bundles behind the constrictions in the latter species and, in this respect, it is more like the closely related but more densely ribbed *A. chidamensis* (Uhlig, 1910*b*, p. 376, pl. LXXIV, fig. 1a–d). The present specimen has the suggestion of a lappet on the last piece of whorl preserved, a feature not preserved on the Himalayan example.

A second fragment (KG.712.39; Plate Vf) is included here with reservation. Its rate of coiling is about the same as that of the specimen described above and the ribbing of its inner whorls appears to be similar. However, the ribbing on the outer whorl is denser and is more like that of *Aulacosphinctoides brownei* (Marshall) (Boehm, 1911, pl. I, fig. 2; Spath, 1923, pl. 17, fig. 2a and b) from the Tithonian of New Zealand.

Aulacosphinctoides smithwoodwardi (Uhlig 1910) (*?*)

Plate VIa and b

(*?*) *Aulacosphinctes Smith-Woodwardi* Uhlig, 1910*b*, p. 372, pl. LXIX, fig. 1a–c.

Material

Two internal mould fragments (KG.701.53 and 78) from the screes at localities AH and AK, respectively.

Description

Specimen KG.701.53 (Plate VIa) represents an earlier stage than specimen KG.701.78 (Plate VIb); it is gently arcuate and there is little change in whorl height along its length. Its ornament is confined to stout, distant radial ribs, all of which bifurcate, at or a little above the middle of the whorl flank, into secondaries of equal strength to the primaries. On the larger fragment, every second or third primary rib is virgatotomously trifurcate, having an anterior secondary which branches off in the lower half of the whorl. Both specimens are partially crushed but it is clear that the whorl cross-section was sub-rectangular; the flanks are flattened, there is a short steep umbilical wall which curves rapidly round from the flank and the venter is arched.

No traces of the sutures remain and it is probable that both fragments represent body-chamber infillings.

Remarks

Although the two above fragments were widely separated on the screes, they have the same basic type of ornament and it is quite possible that they could have come from the same species. The larger fragment recalls *Subplanites elegans* (Spath, 1931, p. 500, pl. LXXXIV, fig. 1) from the Middle Katrol Beds (Kimmeridgian) of the Cutch, except that the ribs of the latter are more distinct and branch higher on the flank. The secondary ribs are also more prorsiradiate than on the present fragment. Similar differences may

be noted with reference to *Subplanites* (*?*) sp. from the *Idoceras* beds (Kimmeridgian) of Mexico (Imlay, 1939, pl. 9, fig. 13). Spath (1931, p. 1501) pointed out that *S. elegans* had been confused with the Himalayan *Aulacosphinctoides smithwoodwardi* (Uhlig, 1910*b*), which has similar ribbing but is distinguished by the slightly different attitude of the secondaries and in having different inner whorls.

The spacing and branching of the ribs on the second fragment compare closely with those on the first part of the outer whorl of Uhlig's (1910*b*) specimen of *A. smithwoodwardi*. Similarly, the ornament on the larger fragment compares tolerably well with the later part of the same Himalayan specimen, particularly with respect to the way in which the anterior branch of a virgatotome rib branches off much lower than the posterior pair, and the way in which the latter branch higher than the ordinary bifurcate ribs.

A confident identification of the present fragments is not possible because the inner whorls and the mode of coiling are unknown.

Aulacosphinctoides sp. α

Plate Vh

Material

One external mould (KG.712.70) lacking the ventral part of the external whorl, and a less complete external mould (KG.712.46) which is included here with reservation. Both are from locality AK.

Description and remarks

The larger and better specimen (Plate Vh) is evolutely coiled and has a multispiral shell whose whorl flanks are only gently convex. The whorls are ornamented with prominent narrow ribs which are feebly prorsiradiate, gently flexuous and are usually bifurcate or virgatotomously trifurcate. Simple ribs are accompanied by intercalated ribs and some ribs on the penultimate whorl (? the virgatotome ones) branch below the umbilical seam. The nearest described species appears to be Burckhardt's (1903, pl. V, fig. 8) *Perisphinctes* aff. *transitorius* Oppel from the Tithonian of Argentina. The proportions of the shell are similar and, although Burckhardt's illustration gives the impression that the inner whorls of the Argentine example are less densely ribbed than those of the present specimen, rib counts are the same for both. On the Alexander Island specimen the ribs of the outer whorl are less regularly arranged and they are more flexuous. The more radial ribbing of the second fragment more closely resembles that of *Perisphinctes* aff. *transitorius* (Burckhardt, 1903) than that of the larger specimen (Plate Vh). It differs further from the last specimen in having slightly broader ribs on its inner whorls.

Aulacosphinctoides sp. β

Plate VIc and d

Material

Two external moulds from crushed specimens (KG.700.1 from locality AH; KG.701.6 from the screes at locality AH).

Description

The better mould (Plate VIc) is of a widely umbilicate shell having slowly expanding whorls with an ornament of numerous blunt to rounded ribs. On the outer whorl of the specimen (originally 80–85 mm. in diameter) there are 68 primary ribs, most of which bifurcate on the ventral third or half of the flank. Periodic constrictions are accompanied by the bundling of the pair of ribs immediately behind them.

The lack of knowledge of the suture, cross-section of the whorls and the distortion of the ornament caused by crushing makes a confident identification of these two fragments impossible. However, described species which bear a resemblance to the present one include *A. ophidoides* (Uhlig, 1910*b*, pl. LI) and *A. tibetanus* (Uhlig) var. *percostata* Collignon (1960, pl. CLII, fig. 610). *A. ophidoides* is known from a single specimen from the Spiti Shales and that example differs from the present one in being a little more evolute and in having only one constriction which is on the outer whorl.

FAMILY OLCOSTEPHANIDAE HAUG 1910

SUBFAMILY SPITICERATINAE SPATH 1924

Genus *Spiticeras* Uhlig 1903

Subgenus *Spiticeras* Uhlig 1903

Spiticeras (*Spiticeras*) aff. *spitiensis* (Blanford 1863)

Plate VIf; Fig. 6a

aff. *Ammonites spitiensis* Blanford, 1863, p. 131, pl. II, figs. 4, 4a and b.
aff. *Spiticeras spitiensis* (Blanford); Uhlig, 1903, p. 89, pl. VIII, figs. 1a–e, 2a–c and 3a–e.

Material

One fragmentary internal mould (KG.720.46), representing about one-half of an individual, from near the top of the section at locality AG.

Description

The only specimen available (Plate VIf) lacks the innermost whorls and shows only the body chamber and penultimate whorl. The coiling of the shell is moderately involute with the last whorl embracing more than half of the preceding one. In cross-section (Fig. 6a) the whorls are triangular to ovate and are

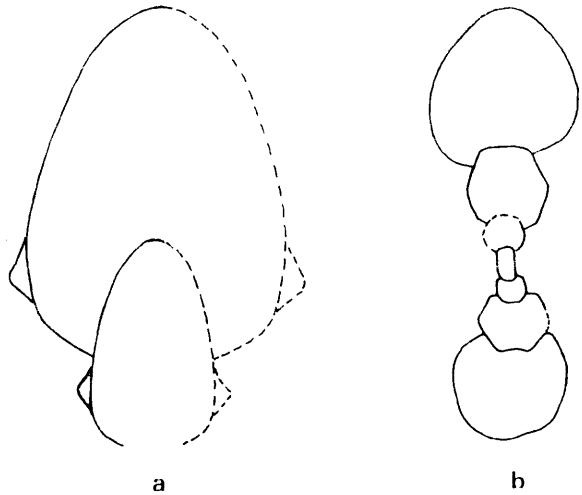

FIGURE 6

a. *Spiticeras* aff. *spitiensis* (Blanford). Cross-section of the outer and penultimate whorls of specimen KG.720.46, ×1.
b. *Blanfordiceras* aff. *wallichi* (Gray). Cross-section of specimen KG.720.1, ×1.

at their widest near the change in curvature of the surface which marks the umbilical rim. The umbilical wall of both whorls is smooth and around the umbilical rim is a series of stout tubercles from which spring bundles of ribs that radiate across the flank and cross the venter without a break. On the outer whorl, these ribs are poorly defined and there are up to six originating from one tubercle; on the penultimate whorl the ribs are much sharper and are more pronounced but it appears as if there are less per tubercle, perhaps only three or four. The involution of the shell is such that, in the umbilicus, the only externally visible ornament of the penultimate whorl is the row of tubercles.

Remarks

Spiticeras has already been described from the western Antarctic regions from its occurrence in the Tithonian–Berriasian of Livingston Island (González-Ferrán and others, 1970, p. 48, fig. 3; Tavera, 1970, pl. 5, fig. 15). That species was identified as *Spiticeras* cf. *spitiensis* and differs from the present one in having less rapidly expanding whorls and in being a little more evolute. In the umbilicus, it is possible to

see not only the periumbilical tubercles of the preceding whorls but also the start of the ribs radiating from them, and in this respect the Livingston Island species is apparently closer to the true *S. spitiensis* than the one described here (Uhlig, 1903, p. 89, pl. VIII, figs. 1a–e, 2a–c and 3a–e).

S. acutum Gerth (Gerth, 1925, p. 63, pl. III, fig. 1) is the most comparable of the species described from Argentina and has a rate of coiling which exposes only the umbilical tubercles in the umbilicus, but it is more coarsely ribbed than the present species and there are fewer ribs springing from each umbilical tubercle. *S. multiforme* example D (Djanélidzé, 1922, pl. XX, fig. 1), from the Berriasian of France, is smaller than the specimen described here but it has a similar ornament with only tubercles visible on the earlier whorls exposed in the umbilicus. However, its whorls are much more inflated.

Although the Alexander Island specimen is probably not conspecific with the Himalayan *S. spitiensis*, it is closer to that species than any other of the described species known to the author.

Spiticeras sp. indet.

Plate VIe

Material

Part of the internal mould of a large individual (KG.712.101 from locality AK) comprising part of two whorls, both entirely septate, and a small fragment of internal mould (KG.722.21) with similar ribbing and suture markings.

Description

The larger and better specimen (Plate VIe) is preserved in a peculiar manner with the mid-ventral line of the inner whorl more or less in line with one umbilical margin of the outer whorl. Such a relationship between the two whorls suggests an aberrant form of helicoidal coiling but it seems more likely to have been caused by some chance displacement of the two whorls during fossilization.

The ornament of both whorls is basically the same and consists of dense, fine rounded ribs aligned radially and perhaps feebly projected on the venter. On the inner whorl, the ribs are bundled in pairs at the umbilical rim and on the larger whorl they are grouped in bundles of between two and four, or possibly more. Very oblique lighting reveals the presence of faint bullate swellings where the ribs are bundled together on the outer whorl. Periodic constrictions interrupt the ornament on the inner whorl and behind each constriction the ribs are bundled in threes instead of in pairs. In their present state, both whorls are strongly inflated and are wider than high.

It is only possible to discern the first two saddles of the suture (Plate VIe). Both are asymmetrical and the first lateral is fractionally longer than the external one. The first lateral lobe is narrow and symmetrical.

Remarks

Apart from the unusual mode of coiling of the best specimen and the rather depressed whorl section, the ornament of ribs bundled at umbilical swellings and the suture lines of these two fragments are suggestive of affinities to the Spiticeratidae. However, without the inner whorls it is not possible to be certain to which particular genus or subgenus these specimens belong. The most comparable described species appears to be *S. mutabile* Djanélidzé (1922, p. 150, pl. XVI, fig. 1a and b) from the Berriasian of France. This is unusual in that it has the same depressed whorl cross-section; its whorls become more inflated with increase in size until the width finally becomes greater than the height. The French species appears to be more evolute than the present one and the umbilical tubercles on the last whorl are more distinct.

Family Berriasellidae Spath 1922

Subfamily Berriasellinae Spath 1922

Genus *Blanfordiceras* Cossmann 1907

This interesting genus is based on the species *Ammonites wallichi* Gray and it has a complex nomenclatural history which may usefully be outlined below. It was first named *Blanfordia* by Uhlig (1905) but

the name had already been used by Duncan (1880) for a genus of Palaeozoic coral, and it had been used even earlier by Adams (1863) for a genus of extant terrestrial gastropod. The nomenclature was soon rectified by Cossmann (1907), who proposed the amended name *Blanfordiceras* for the ammonite genus. Unfortunately, this was long overlooked; "*Blanfordia*" was still used in Uhlig's (1910*a*) monograph on the ammonites of the Spiti Shales, and both Gerth (1921, p. 114, footnote) and Spath (1924) independently proposed new names. Gerth suggested the name *Uhligites* but, not only was this a junior synonym of Cossmann's (1907) *Blanfordiceras* it was also pre-occupied by *Uhligites* Kilian (1907), a genus of oppeliid ammonite based on *Streblites kraffti* Uhlig.

Spath's (1924) *Blanfordiceras* was an objective homonym of *Blanfordiceras* Cossmann but in a number of works the genus was mistakenly attributed to Spath and it was not until 10 years later that he (Spath, 1934) noted the error and correctly referred the genus to Cossmann. Nevertheless, in Roman's (1938, p. 327) great work on ammonite genera, the genus *Blanfordiceras* was still attributed to Spath. Although Spath formally proposed his *Blanfordiceras* in 1924, the date is usually given as either 1923 or 1925. The 1923 date refers to Spath's paper on New Zealand ammonites in which he used the name *Blanfordiceras wallichi* (Spath, 1923, p. 302) in passing, having anticipated that his memoir on the Blake collection from the Cutch (Spath, 1924) would have been published before and not after his paper on New Zealand ammonites (p. 21). References to the 1925 date (e.g. Gerth, 1925, p. 93; Roman, 1938, p. 327–28) probably stemmed from the formalized manner in which Spath (1925, p. 145, text and footnote 3) then referred to his own *Blanfordiceras* in a discussion of the Berriasellidae. However, it should be noted that at no place in that work did he have the name *Blanfordiceras* set in bold type, as he frequently did when proposing a new name.

Blanfordiceras appears to be a typically Indonesian and Indian form, although it has been reported from farther afield (Malagasy Republic, Mexico, South America and Livingston Island) and it is now recorded from Alexander Island. There can be little doubt that the Malagasy Republic species (Collignon, 1960) and the present ones (p. 27) are closely related to their Himalayan relatives but the status of the South American forms is more controversial. These include *Hoplites wallichi* (Steuer, 1897, *non* Gray), *Hoplites australis* and *H. molinensis* (Burckhardt, 1903), *Berriasella patagoniensis* (Favre, 1908) and *Berriasella subprivasensis* (Krantz, 1926). Steuer's *Hoplites wallichi* is discussed on p. 28.

The two central Argentine species *H. australis* and *H. molinensis* were submitted by Burckhardt to Uhlig for his comments; he (Uhlig, 1910*a*, p. 190) was struck by the general similarity to Himalayan species of *Blanfordiceras* and in particular compared both to *B. rotundidoma*. However, at no time did he suggest that they might belong to the same genus but rather classified them in the genus *Berriasella* (Uhlig, 1910*a*, p. 159). Spath (1925, p. 145, footnote) proposed *H. australis* as the type of a new genus which he named *Pseudoblanfordia*, but other authors (e.g. Arkell *in* Arkell and others, 1957, p. *L*352; Gerth, 1925, p. 103, 1926, p. 475–76) have regarded this as a synonym of *Blanfordiceras* Cossmann. Spath (1939, p. 43) upheld the genus *Pseudoblanfordia* in strong terms: "Both suture lines and the periphery in the young . . . show that, contrary to Krantz's [*errore pro* Gerth, 1926] views, the true *Blanfordiceras* [Tithonian] has nothing whatever to do with *Pseudoblanfordia* Spath . . . of the Upper Valanginian, nor with *Hoplites wallichi* (*non* Gray) of Steuer (=*H. steueri* Uhlig)", and the author also prefers to maintain the distinction. Burckhardt's *H. australis* and *H. molinensis* have a ribbing pattern which is dominated by intercalated and simple ribs rather than bifurcate ribs with a few simple ribs as in *Blanfordiceras*, a difference also stressed by Uhlig (*in* Burckhardt, 1903).

Berriasella patagoniensis was first described by Favre (1908, p. 62, pl. XXXIII, fig. 5) from three poorly preserved fragments which showed neither the venter nor the sutures. Feruglio (1936, p. 62, pl. VI, figs. 4–6 and 8, pl. VII, figs. 1 and 2) later assigned more Patagonian specimens to this species under the generic name of *Blanfordiceras* and Tavera (1970, p. 181, pl. 3, figs. 7 and 8) described further poorly preserved material from Livingston Island, South Shetland Islands. Leanza (1967, pl. 147) has suggested that Feruglio's material included more than one species and the one specimen which seems to resemble most closely the type species, *Blanfordiceras wallichi*, was considered by Leanza to be a possible *Pavlovia*. It differs from typical species of *Blanfordiceras* in its straighter ribbing and higher point of bifurcation of the ribs. The specimens from Livingston Island are of particular importance in relation to the present Antarctic fauna (p. 34) but unfortunately they are too poorly preserved to make useful comment.

Feruglio (1936, p. 63) appears to have been the only author who has considered Krantz's (1926) *Berriasella subprivasensis* as a possible *Blanfordiceras*.

Blanfordiceras aff. *wallichi* (Gray 1830–32)

Plate VIIa–c; Fig. 6b

aff. *Blanfordia wallichi* (Gray); Uhlig, 1910*a*, p. 186, pl. XXIX, figs. 1–3, pl. XXX, fig. 1, pl. XXXI, figs. 1 and 2.
aff. *Blanfordiceras wallichi* (Gray); Spath, 1934, p. 15, pl. VI, fig. 6a and b. (Good synonymy.)
Blanfordiceras aff. *wallichi* (Gray); Spath, 1939, p. 43, pl. IV, fig. 6, pl. V, figs. 1, 9 and 10.

Material

Two internal moulds (KG.717.8 and KG.720.1 from the bases of the sections at localities AC and AG, respectively) and one external mould (KG.754.6 from locality AN).

Description

The best specimen (KG.720.1; Plate VIIa and b) comprises about one-half of the internal mould from the septate part of a medium-sized individual. It is evolute with a moderately wide umbilicus and has whorls which embrace about one-quarter to one-fifth of the preceding one. In cross-section (Fig. 6b) the whorls appear to be rounded in the early stages but soon become hexagonal with one of the flat faces along the venter. The last whorl preserved is fractionally higher than wide and is more rounded, although it still has a marked change in slope between the flank and the umbilical wall. Ornament consists of strong sharp ribs which begin on the umbilical wall, a little above the umbilical seam, and most of these bifurcate near the middle of the flank; there are a few simple ribs. The majority of the ribs rise more or less straight across the flank but a few on the inner whorls curve slightly backward as they cross the umbilical wall. From the point of bifurcation, one secondary continues straight on towards the venter and the posterior one leans slightly backward; both secondaries are then feebly projected as they pass over the ventral shoulder. On the earlier part of the outermost whorl preserved, the ribs are discontinuous across the mid-line of the venter and are slightly swollen where they terminate at a relatively smooth median band. Later, the swollen terminations disappear and the ribs are continuous across the venter although they are reduced in strength.

The external mould (KG.754.6; Plate VIIc) bears the same basic ornament but the ribs are relatively narrower and are more pronounced. They commence at the umbilical seam and increase rapidly in height as they pass over the umbilical wall. A fragment of internal mould attached to this specimen has less prominent ribs more like those of the example described above, and this suggests that the difference in ornament between the two specimens is a function of preservation and is not of specific importance. On the penultimate whorl of the external mould there is a curious aberration of the otherwise regular ribbing, where a less prominent rib converges with the one in front and all but joins with it just above the umbilical rim. No details of the venter are visible on this specimen.

A third fragment (KG.717.8) has been considerably distorted by crushing but it has the same basic ornament of distant bifurcating ribs as the above examples and may therefore be included with them.

Measurements

Meaningful measurements are only obtainable from the better internal mould (KG.720.1). Its maximum diameter (probably not a true diameter) is 87 mm.; along this line of measurement, $u=35$ mm., $h=33$ mm. and $w=30$ mm.

Remarks

Both Boehm (1904) and Uhlig (1910*a*) interpreted the species *Blanfordiceras wallichi* Gray in a wide sense and there can be little doubt that the present fragments are allied to it. However, the straighter ribbing and the hexagonal cross-section of the earlier whorls on the present species make a conspecific identification doubtful. The ornament on a whorl fragment from the Tithonian of the Salt Range, West Pakistan, identified by Spath (1939, pl. V, fig. 1a and b) as *Blanfordiceras* aff. *wallichi*, appears to be identical to that of the internal mould figured here.

Blanfordiceras sp. juv.

Plate VIIg

One small fragment (KG.717.9; Plate VIIg) has fine *Blanfordiceras*-like bifurcating ribbing which recalls that of a similar small fragment from the Tithonian of the Salt Range (Spath, 1939, pl. VI, fig. 5c) identified as *Blanfordiceras* sp. juv. cf. *boehmi* (Uhlig). Its ribbing appears to be denser than that of *B.* aff. *wallichi* described above.

Genus *Berriasella* Uhlig 1905
"*Berriasella*" *subprivasensis* Krantz 1926

Plate VIIi

Berriasella subprivasensis Krantz, 1926, p. 438.
Berriasella subprivasensis Krantz; Krantz, 1928, p. 20, pl. III, fig. 4a and b.
Berriasella subprivasensis Krantz; Weaver, 1931, p. 443, pl. 56, figs. 356 and 357.

Material

Two internal moulds (KG.717.14 and KG.720.10 from the bases of the sections at localities AC and AG, respectively).

Description

The best fragment (KG.717.14; Plate VIIi) consists of part of the penultimate whorl and the body chamber; it has suffered slight crushing and the venter is now more acutely formed than it was in its original state. Ornament consists of stout, distant flexuous ribs, most of which bifurcate near the middle of the flank into secondary ribs of comparable stoutness to the primaries. In at least one instance, a pair of non-bifurcate or simple ribs appears to join low on the flank, just above the steep umbilical wall. Some interspaces on the penultimate whorl appear to be more deeply incised than others and might be constrictions. The second specimen (KG.720.10) comprises the last part of the septate stage and the beginning of the body whorl; it is less well preserved than the first and has been more severely crushed but it bears the same type of ribbing as the fragment described above.

Remarks

These two specimens occur in the same beds as *Blanfordiceras* aff. *wallichi* described above (p. 27) and in many ways resemble specimens of the latter. However, they may be distinguished by their thicker, more rounded ribs, some of which join close to the umbilical rim, and in these respects they more closely resemble *Berriasella subprivasensis* Krantz.

B. subprivasensis has a moderately compressed whorl cross-section and has a smooth band along the venter in the early stages, reminiscent of *Blanfordiceras* Cossmann. However, Uhlig (1910*a*, p. 188) noted that the pairing of ribs at the umbilical rim did not occur in *Blanfordiceras wallichi* and that "nor is it possible to discover, even in a single case, a distinct union of two main ribs at the umbilicus" among all the Himalayan *Blanfordiceras* specimens then available (Uhlig, 1910*a*, p. 161). For this reason, he excluded Steuer's (1897, pl. XVI, figs. 1–3) Argentine "*Hoplites wallichi*" from Gray's species and proposed a new name for it: *Hoplites steueri*. In *Blanfordiceras rotundidoma* (Uhlig) and at least one Indonesian example of *B. wallichi* (Boehm, 1904, pl. IV, fig. 1a) some ribs bifurcate well below the mid-line of the flank.

Blanfordia sp. ind. cf. *wallichi* Gray (Burckhardt, 1912, p. 141, pl. XXXV, figs. 8 and 10), from Mexico, has ribs which branch lower on the flank and has more simple ribs than is usual for *B. wallichi*. It appears to be more closely related to the specimens included here under Krantz's "*Berriasella*" *subprivasensis* except that it has a highly inflated whorl cross-section.

Genus *Raimondiceras* Spath 1924
Raimondiceras sp.

Plate VIId, f and h

Material

One fragmented and incomplete internal mould of a large individual which must originally have measured about 200 mm. across (KG.720.40 from near the top of the section at locality AG).

Description

The coiling of the shell is moderately evolute, although the body chamber has been depressed around the penultimate whorl to give the impression of a greater degree of involution. In cross-section, the whorls are sub-triangular in shape, being somewhat compressed in the earlier stages and becoming more inflated with increase in size. The umbilical rim is steep and rounds on to the flank while the venter is more broadly rounded. On the early whorls the ornament is not well preserved but appears to be closely similar to that of the penultimate whorl; this consists of stout ribs of which every second or third is more pronounced than the others and bears two prominent tubercles, one dorso-lateral and the other ventro-lateral. The ventro-lateral tubercles are the stouter and are situated where the ribs split into two secondaries. All intermediate and secondary ribs are projected on the ventral shoulder and terminate on either side of a ventral groove.

On the later part of the penultimate whorl, a few intermediate ribs branch off from the dorso-lateral tubercles and thus do not originate on the umbilical wall as do the others. On the outer whorl there are suggestions in places that the dorsal tubercles are the stronger and that some are strongly spinose, standing about 10 mm. proud of the general surface. The ribs become more strongly projected and the ventral groove becomes less and less marked until the ribs are continuous across the venter, if a little reduced in prominence.

No distinguishable remains of the suture are preserved.

Remarks

Despite the fragmentary state of the present specimen, enough distinctive features are preserved to identify it with the genus *Raimondiceras* Spath, at least in the sense used by its author (Spath, 1939, p. 63). However, by limiting the distribution of the genus to Peru, Arkell (*in* Arkell and others, 1957, p. *L*358) appears to have excluded several other species admitted by Spath (1939): *R.* (*?*) *salinarium* Spath from the Salt Range, *R. gerthi* (Weaver) from Argentina and *Raimondiceras* spp. from Colombia. As far as may be judged, the present species most closely resembles a whorl fragment in the collections of the British Museum (Nat. Hist.) figured by Spath (1939, pl. XVI, fig. 7a and b) as *Raimondiceras* sp. ind. from the Lower Neocomian of Velez, Colombia, except that the latter is more densely ribbed and has a greater degree of projection of ribs on the venter. *R. gerthi* (Weaver, 1931, pl. 47, figs. 315 and 316) has finer ribbing and a broader ventral groove. The genotype, *Hoplites raimondi* Gabb (*in* Lisson, 1907, p. 41, pl. V, fig. 1a and b), loses the ventral groove much earlier than either the present species or that from Colombia to which it is compared.

The Alexander Island specimen almost certainly represents a new species but it is too poorly preserved to warrant a formal description and would make a very poor holotype.

Genus *Andiceras* Krantz 1926
Andiceras (*?*) sp.

Plate VIIe

Material

One fragment of the external mould of a large individual (KG.712.38 from locality AK) and showing about one-third of the outer whorl and a little of the penultimate one.

Description and remarks

The outer whorl of the fragment (Plate VIIe) is ornamented with strong high ribs, most of which branch narrowly near the middle of the flank into two secondaries which are of equal width to the primaries but are not so elevated. On the penultimate whorl, the point of bifurcation of the ribs is just visible below the umbilical seam. All of the ribs are gently sinuous and are slightly projected near the venter. The venter itself is not preserved and lack of information on this region makes a confident identification of the fragment impossible. However, the ribbing pattern suggests possible affinities with *Andiceras* Krantz and in particular the fragment might be conspecific with *A. acuticostum* (Krantz, 1926, p. 452, pl. XV, fig. 7). Lateral crushing of the shell in the present example has made the point of bifurcation of the ribs appear to be a little lower than it would normally have been, because of the greater expanse of the ventral shoulder visible in side view. Both specimens have similar high ribs and a low frequency of unbranched ribs.

Of the other species included by Krantz in *Andiceras*, *Ondontoceras fallax* Steuer *non* Oppel (Steuer, 1897, pl. XIV, fig. 1) is the next most comparable but its ribbing is denser and a greater relative number of simple ribs is present.

It is worth noting that the type species of *Andiceras*, *A. trigonostomum*, did not come from Paraguay as suggested by Arkell (*in* Arkell and others, 1957, p. *L*352) but from Aroyo Paraguay in Argentina (Krantz, 1926, p. 452).

Because of the lack of information with regard to the form of the venter and the inner whorls, the present specimen might also be compared to *Windhauseniceras internispinosum* (Krantz, 1926, p. 453, pl. XIV, figs. 1 and 2). However, it differs from that species in having long intercalated ribs which commence about one-quarter of the way up the flank from the umbilical seam; such ribs are also present on *A. acuticostum*.

SUBFAMILY HIMALAYITINAE SPATH 1925

Genus *Corongoceras* Spath 1925

Corongoceras cf. *lotenoense* Spath 1925

Plate VIg

cf. *Hoplites köllickeri* Oppel; Haupt, 1907, p. 201, pl. IX, fig. 7a–e.
cf. *Reineckeia koellickeri* (Oppel); Steuer, 1897, p. 31, pl. VIII, figs. 5 and 6.
cf. *Corongoceras lotenoense* Spath, 1925, p. 144.
cf. *Corongoceras loetonense* Spath var. *fortior* Collignon; Collignon, 1960, pl. CLXVII, fig. 687.

Material

One small fragment from the external mould of a specimen encrusted with serpulids (KG.701.77 from the screes at locality AK).

Description and remarks

The fragment (Plate VIg) bears a distinctive ornament of alternate sharp simple ribs and others that bifurcate from a spinose median tubercle. All ribs are swollen into incipient tubercles in the ventro-lateral region but the mid-ventral region is not preserved on the mould. At first sight, the fragment might be compared to another from locality Z which was assigned to the genus *Himalayites* Uhlig (Thomson, 1974, p. 28, pl. IVo) but the ribbing of the present specimen is finer and more widely spaced, and the presence of incipient ventral tubercles suggests closer affinities to *Corongoceras* Spath.

Arkell (*in* Arkell and others, 1957, p. *L*356) noted that in this genus all ribs possess lateral and ventral tubercles. The type species is *Berriasella koellickeri* Haupt *non* Oppel (=*C. lotenoense* Spath) and in Haupt's (1907, p. 201) original synonymy he included not only an example from the European Stramberger Schichten (discounted by Krantz, 1928, p. 28) assigned to Oppel's species but also Steuer's (1897) *Reineckeia koellickeri* from Argentina. While Arkell's observation is true of Haupt's (1907) specimen, it appears from Steuer's illustration that his example had no tubercles on the simple ribs and is thus closer to the present fragment. The sutures of the specimens described by Steuer and Haupt are almost identical.

C. loetonenese [*sic*] Spath var. *fortior* Collignon (1960) from the Malagasy Republic agrees closely with the Antarctic specimen, particularly with respect to the thin non-bifurcate ribs which lack lateral tubercles and the two could well be conspecific.

III. DISCUSSION

A. Age of the Faunas

The Ablation Point area ("Ablation Camp") was first visited by members of the British Graham Land Expedition, 1934–37 (Fleming, 1938). They collected fossils from the screes but no ammonites were found, and the rocks were dated as Middle Jurassic on the basis of fossil plants considered to be similar to others from the well-known fossil flora of Mount Flora, Hope Bay. The first ammonites were obtained by V. E. Fuchs and R. J. Adie in 1948 from the northern face of the "hook" at Ablation Point. These were identified by Howarth (1958) as *Perisphinctes* (*Orthosphinctes*) cf. *transatlanticus* Steinmann of Upper Oxfordian to Lower Kimmeridgian age. They came from a sedimentary sequence which was believed to be much disturbed by thrusting; bivalves from the same sequence were identified by Cox (1953) as *Aucellina* and were assigned an Aptian age. This intermingling of Upper Jurassic and Lower Cretaceous faunas was attributed to the effects of the thrusting.

However, studies by Bell (1975) indicate that the complicated structures in the lower part of the cliffs at Ablation Point (the disturbed zone) were formed by gravity sliding or slumping. Furthermore, a re-examination of the specimens of so-called *Aucellina* suggests that they are closely comparable to a species of *Buchia* which also occurs in large numbers in the undisturbed part of the sequence above. "*Aucellina alexandri*" Cox (1953, pl. I, fig. 11) is possibly conspecific with *Buchia spitiensis* var. *extensa* (Holdhaus, 1913) from the Spiti Shales. There are no ammonites in the present collection which would confirm the presence of Aptian strata in the disturbed zone at Ablation Point. *Pachysphinctes* (*?*) sp. and the bivalves *Inoceramus haasti* and *I.* aff. *subhaasti* (Thomson and Willey, 1972) are consistent with a Kimmeridgian age.

The bulk of the species described came from the strata above the disturbed zone and may be grouped into three main faunas (Table I). The lowest of these is the most diverse but it is characterized by the two genera *Virgatosphinctes* and *Aulacosphinctoides*. This fauna was collected from the 300–350 m. of sediments beneath the volcaniclastic sandstone marker bed (Fig. 2) and contains a variety of species of both Upper and Lower Tithonian affinities (Table I). Because of overlapping ranges of the species present, it is not possible to divide this sequence satisfactorily into Upper and Lower Tithonian. However, the preponderance of species with Lower Tithonian affinities (Table I) suggests that the greater part of it belongs to the early part of the Tithonian. *Corongoceras* cf. *lotenoense* came from the screes just below the volcaniclastic sandstone and may belong to the *Blanfordiceras* fauna above.

Uhlig (1910*c*, p. 550) considered that "*Aulacosphinctes*" *smithwoodwardi* may have been Kimmeridgian in age. The two fragments cautiously assigned to this species (p. 22) came from the base and near the top, respectively, of the sequence here assigned to the Tithonian. Bearing in mind that their identification is only provisional and that they both occur in close association with a variety of Tithonian species, it is considered unlikely that they represent a Kimmeridgian element in the present faunas.

The 150 m. of sediments overlying the volcaniclastic sandstone contain a *Blanfordiceras* fauna which probably represents the very top of the Tithonian. *Blanfordiceras*, in the sense used here (p. 26), is an Upper Tithonian genus which may even range into the base of the Cretaceous. In the Himalayan Spiti Shales, it occurs in the undifferentiated Lochambel Beds whose fauna includes many neocomitid species of Neocomian affinities (Uhlig, 1910*c*).

Above the beds with *Blanfordiceras* are 1,170 m. of shales, sandy shales and conglomerates (Figs. 2 and 3) in which no ammonites were found. Shales succeeding the fifth conglomerate contain a fauna typified by the frequent occurence of *Bochianites* aff. *versteeghi* and the coarsely ribbed *Haplophylloceras strigile* (*?*). Although these two species may range down into the Tithonian, their occurrence much higher in the sequence than the *Blanfordiceras* fauna, and the Berriasian affinities of the accompanying *Spiticeras* aff. *spitiensis* and *Raimondiceras* sp., favour an early Cretaceous (Berriasian) age.

Some useful evidence for the age of the sequence under discussion has been obtained from the belemnites (Willey, 1973). The disturbed zone contains a typical Upper Oxfordian to Kimmeridgian assemblage of *Belemnopsis* cf. *alfurica*, *B.* cf. *gerardi*, *B.* cf. *keari* and *B.* cf. *tanganensis*. Belemnites from the Tithonian include new species and *B. uhligi*, which has a much greater range in Alexander Island than it apparently does elsewhere. The Berriasian *Haplophylloceras–Bochianites* fauna is associated with *Hibolithes subfusi-*

TABLE I

RELATIONSHIPS BETWEEN THE AMMONITE FAUNAS OF ABLATION POINT AND THOSE OF EXTRA-ANTARCTIC REGIONS

Ablation Point species	*Mexico and Colombia*	*Argentina and Chile*	*Malagasy Republic*	*Pakistan*	*Himalayas*	*Indonesia*	*New Caledonia and New Zealand*	
Haplophylloceras strigile (*?*)					● UT–B	● UT–B		
Bochianites aff. *versteeghi*					○	● UT–B		**Berriasian**
Spiticeras (*Spiticeras*) aff. *spitiensis*				○ B	● UT–B			
Raimondiceras sp. nov.	○ LN	○ LN		○ LN				
Phyllopachyceras beneckei (*?*)			● UT					
Blanfordiceras aff. *wallichi*			○ UT	○ UT	○UT	○ UT		**Uppermost**
Blanfordiceras sp. juv.				● T				**Tithonian**
"*Berriasella*" *subprivasensis*		● UT						
Phylloceras aff. *serum*			○ LT					
Phyllopachyceras beneckei (*?*)			● UT					
Calliphylloceras sp.								
Lytoceras sp. (giant).			● UT					
Lytoceras sp. γ								
Pterolytoceras exoticum			● UT	● UT	● T			
Haploceras sp.	● LT		○ LT					
Pseudolissoceras (*?*) sp.								
Uhligites aff. *kraffti*					● UT	○ UT–B		
Oppeliid gen. nov. (*?*)								
Virgatosphinctes denseplicatus		● UT	● T	● LT	● T			
Virgatosphinctes aff. *denseplicatus*	● LT	○ UT	○ T	○ LT	● LT			
Virgatosphinctes acuticostus sp. nov.					○ T			**Tithonian**
Virgatosphinctes contiguus					● T			
Virgatosphinctes sp. nov. aff. *andesensis*	● LT	● LT						
Virgatosphinctes aff. *mexicanus*	● LT	● LT						
Virgatosphinctes cf. *frequens*			● UT	● LT	● LT			
Virgatosphinctes lenaensis (*?*)		● LT						
Aulacosphinctoides aff. *sparsicosta*					● T		● T	
Aulacosphinctoides smithwoodwardi (*?*)					● T			
Aulacosphinctoides sp. α		○ T						
Aulacosphinctoides sp. β			○ UT		○ T			
Spiticeras sp. indet.								
Andiceras (*?*) sp.		● UT						
Corongoceras cf. *lotenoense*	○ UT	● UT	● UT					
Pachysphinctes (*?*) sp.			● K	● K				**Kimmeridgian**

● Identical or closely comparable species.
○ Similar species.

LN Lower Neocomian.
B Berriasian.
UT Upper Tithonian.

LT Lower Tithonian.
T Tithonian (undifferentiated).
K Kimmeridgian.

[*face page 31*

formis, a widely distributed Neocomian species, and *H. compressus* of Tithonian affinities. The wide-ranging *Belemnopsis uhligi* is also present.

The occurrence of *Calliphylloceras* sp. and *Lytoceras* sp. γ in a moraine north-east of Ablation Point (Fig. 1) constitutes a fauna which has not been located *in situ*. These fossils occur in pieces of a dark, almost black mudstone which probably represent fragments of one boulder (personal communication from C. M. Bell). Most of the rock types in the moraine can be matched with those in the disturbed zone of the nearby cliffs but the source beds of this distinctive black mudstone were not located in the field. All of the ammonites from the Tithonian part of the sequence, above the disturbed zone, occur in dark mudstones characterized by a brownish ferruginous stain. *Calliphylloceras* and *Lytoceras* are wide-ranging genera and none of the present specimens is well enough preserved to suggest meaningful specific affinities and hence a precise age. Despite the objections raised on lithological grounds, the inference is that all the morainic material was locally derived, and therefore that the fauna relates to those described above. The presence of *Virgatosphinctes* aff. *frequens* in a similar black mudstone slab from the same moraine would support this hypothesis.

B. Relationships with Locality Z (Tombaugh Cliffs)

Poorly preserved ammonites from locality Z (Fig. 1) were considered to be Berriasian in age (Thomson, 1974) and belemnites from the same locality agree with this suggestion (Willey, 1973). It may therefore be expected that some degree of correlation should be possible between the sequence exposed at this locality and the *Haplophylloceras–Bochianites* beds of apparently similar age at the head of Ablation Valley. A few bivalves (*Pseudolimea*, *Myophorella* and *Inoceramus* sp. α) are common to both localities, as are the belemnites *Belemnopsis alexandri*, *B.* aff. *uhligi* and *Hibolithes subfusiformis*. However, the remainder of the belemnites are dissimilar and the bivalve *Inoceramus pseudosteinmanni* Thomson and Willey (1972), which is abundant at locality Z, is apparently absent at Ablation Valley. No ammonites (with the possible exception of *Phyllopachyceras* (*?*) sp. which may be fragments of *P. beneckei* (*?*)) are common to the two localities. Even the species of *Bochianites* from both localities are quite different. *B. gracilis* (locality Z; Thomson, 1974) is a delicate, almost smooth form, whereas *B.* aff. *versteeghi* from Ablation Valley is robust and coarsely ribbed.

Correlation of the two localities is thus not possible at present. However, the occurrence of a *Substreblites* at locality AP (Fig. 1; Pl. IIq), which is probably identical with the fragment from locality Z (Thomson, 1974, pl. IVa), suggests that at least part of the locality Z fauna is present in the western part of Ganymede Heights. Approximately 300 m. above the bed with *Substreblites*, there are mudstones with a (?) Lower Aptian aconeceratid ammonite fauna similar to that of the Fossil Bluff area (Taylor and others, 1979). Associated with the ammonites are aptychi (Thomson, 1972*a*).

C. Regional Comparisons

1. *Antarctica*

Several Upper Jurassic molluscan faunas are now known from western Antarctica (Fig. 7). The nearest of these to Ablation Point is that from Carse Point, Palmer Land, where bivalves, ammonites and belemnites occur in pyritiferous mudstones and siltstones beneath a volcanic sequence. The ammonites are dominated by *Kossmatia*, a genus so far unknown in Alexander Island, and suggest a late Jurassic age (Thomson, 1975). However, all of the belemnites and some of the bivalves are also known to occur in the Ablation Point area.

Ammonites are also known from a thick and widespread isoclinally folded sequence in the Lassiter Coast area of eastern Palmer Land (Williams and others, 1971, p. 144). Fossil determinations by Dr. R. W. Imlay (U.S. Geological Survey, Washington, D.C.) indicate a Lower Kimmeridgian to Lower Tithonian age for the faunas but there appears to be little correspondence with the faunas of Ablation Point. The Bajocian–Oxfordian ammonite faunas of eastern Ellsworth Land (Quilty, 1970) all pre-date the faunas described here, but they are interesting because they are the oldest so far known from Antarctica.

Among a collection of fossils from some volcaniclastic rocks of the Mount Bouvier massif, Adelaide Island (Thomson, 1972*b*), are two poorly preserved ammonite fragments, one of which could be some form of Kimmeridgian perisphinctid. *Inoceramus* from the same beds suggests a possible correlation with the disturbed zone of Ablation Point.

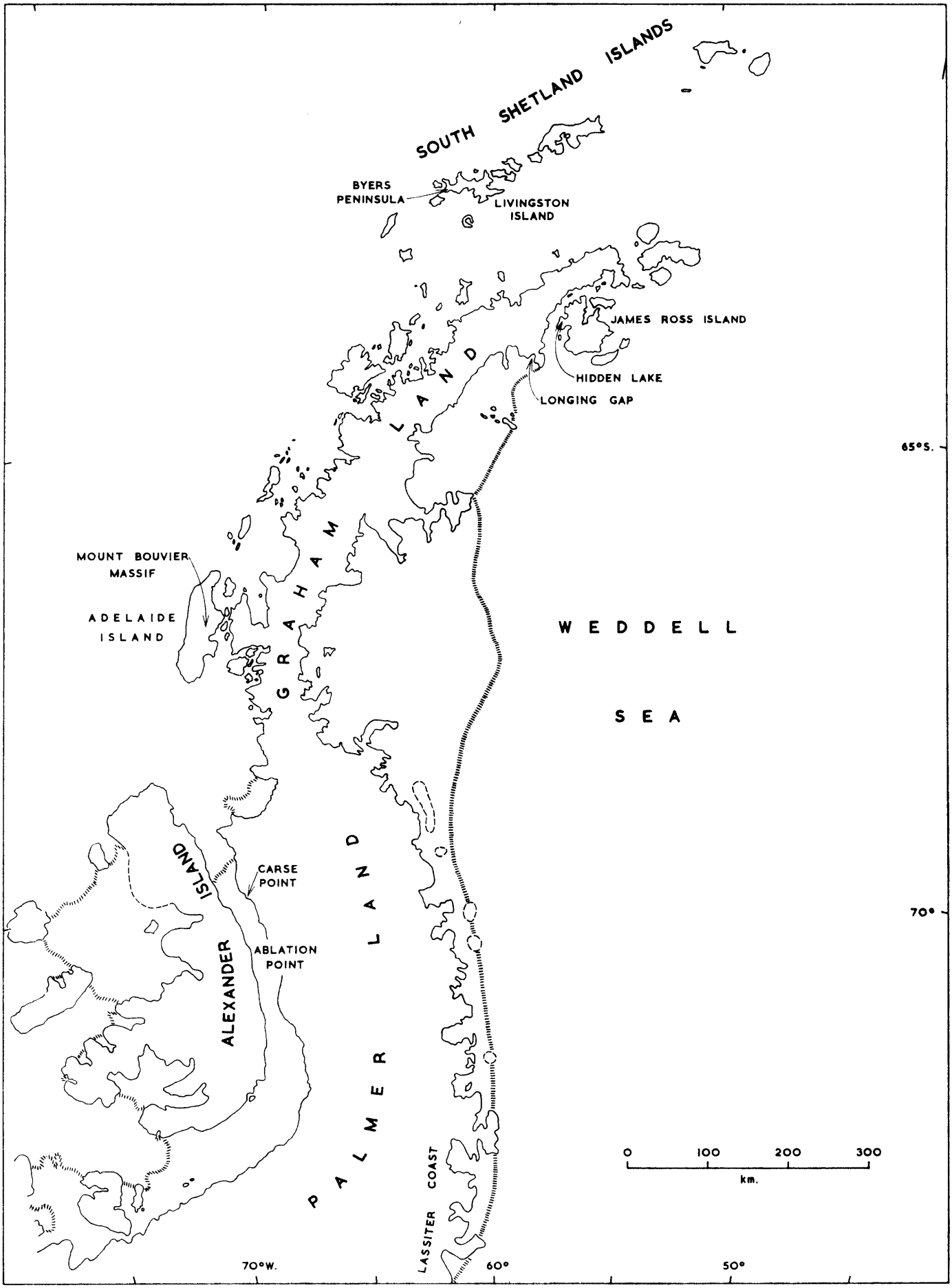

FIGURE 7

Map of the Antarctic Peninsula showing the distribution of Upper Jurassic marine sedimentary rocks from which ammonites have been obtained.

Chilean investigators have recently obtained small collections of ammonites from Byers Peninsula, Livingston Island, which vary in age from Upper Jurassic (Tithonian) to Lower Cretaceous (Neocomian). Allowing for the poor preservation of the material described (Tavera, 1970), it is difficult to find any species in common with Alexander Island. Even an example of *Spiticeras* cf. *spitiensis* (Tavera, 1970, pl. 5, fig. 15) may not be conspecific with the *S.* aff. *spitiensis* described here (p. 24) from the upper part of the sequence in Ablation Valley.

A loose fragment from west of Hidden Lake, James Ross Island, was compared by Spath (1953, p. 3) to *Perisphinctes transatlanticus* Steinmann. Although no Jurassic rocks are known to crop out in the immediate area, the presence of this ammonite suggests that sediments, penecontemporaneous with the lower part of the sequence at Ablation Point, were once deposited nearby. Outcrops of Upper Jurassic sedimentary rocks with *Perisphinctes* sp. have been reported from near Longing Gap (Fig. 7; Bibby, 1966, p. 8).

2. *Extra-Antarctic regions*

The Upper Oxfordian–Kimmeridgian ammonites of Ablation Point (p. 4; Howarth, 1958) are too poorly known to make meaningful regional comparisons. However, the varied Tithonian faunas, typified by the genera *Virgatosphinctes* and *Aulacosphinctoides*, show strong similarities with others of comparable age over a wide area of the world (Table I). A Central and South American influence is clearly indicated by certain species of *Virgatosphinctes* (notably those of the *andesensis/mexicanus* group) and such genera as *Andiceras* and *Corongoceras*. *Corongoceras* has also been described from the Malagasy Republic (Collignon, 1960), and a link with the Tithonian faunas of the Malagasy Republic, Pakistan and the Himalayas is demonstrated by a variety of *Virgatosphinctes* and *Aulacosphinctoides* common to these regions; the distinctive *Pterolytoceras* with its wide flares is also present in all four regions.

Although the uppermost Tithonian *Blanfordiceras* fauna and the Berriasian *Haplophylloceras–Bochianites* fauna are much less varied than the Tithonian one, there is a marked drop off in the number of species common to the Americas. The relationships with the Malagasy Republic are retained in the uppermost Tithonian but in the Berriasian these are *apparently* broken. Affinities with the Himalayan region persist and the species of *Haplophylloceras* and *Bochianites* have close relationships with Indonesian forms.

How real or apparent these differences may be depends a great deal on the interpretation of other faunas through published work. The genera *Virgatosphinctes* and *Aulacosphinctoides* include large numbers of species, often distinguished by subtle variations of ornament and, one may also suspect, geographical separation. The genus *Blanfordiceras* has been subject to similar treatment. Although here (p. 26) the author has sided with those who wish to separate the South American forms (*Pseudoblanfordia* Spath) from the remainder, it is conceivable that differences have been enhanced by differences in preservation and illustration. With the exception of the species described by Burckhardt (1903; *Hoplites australis* and *H. molinensis*), most described species of "*Pseudoblanfordia*" are poorly preserved (Favre, 1908; Feruglio, 1936; Leanza, 1945). Only a world-wide revision of such genera will resolve these problems.

Potential relationships with some regions may be lacking for no reason other than that deposits of equivalent age are absent, and/or relevant collections remain undescribed. This is probably the case in New Zealand, where the marine Jurassic sequence terminates in the Lower Tithonian (Brown and others, 1968, p. 264, table 9.2). Furthermore, Stevens' (1967, p. 367) mention of New Zealand *Aulacosphinctoides* and *Torquatisphinctes*, and unfigured species listed by Marwick (1953), indicate that there are still a number of Upper Jurassic species to be described from the region.

It is clear that the relationships shown by the Ablation Point faunas have important palaeogeographical implications. During the late Jurassic and early Cretaceous, there were free marine connections between the Alexander Island area and Central America, western South America, the Malagasy Republic, Pakistan, the Himalayas and Indonesia. Whether the seaway which permitted these faunal migrations was confined to the Pacific margin of Antarctica, or whether there may also have been some access around the south-eastern margin of present-day Africa, cannot be decided without a fuller analysis. In this respect, the Upper Jurassic faunas of the South Shetland Islands may be of some importance, since at least at the present day these islands occupy a position intermediate between Alexander Island and South America, and close to any hypothetical north-eastern connection with the Malagasy Republic. These faunas are in the process of being investigated. The apparent lack of any close extra-Antarctic ties of the Aptian–Albian ammonite faunas of Alexander Island (Taylor and others, 1979) constitutes an extension of this problem.

IV. ACKNOWLEDGEMENTS

ALL the specimens described in this report were collected by Dr. C. M. Bell and M. H. Elliott. The author is grateful to them and to Dr. L. E. Willey for useful discussions on the stratigraphical problems of this area. Dr. R. J. Adie provided helpful advice on the presentation of this report. The work was carried out in the Department of Geological Sciences, University of Birmingham, using facilities provided by Professors F. W. Shotton and A. Williams.

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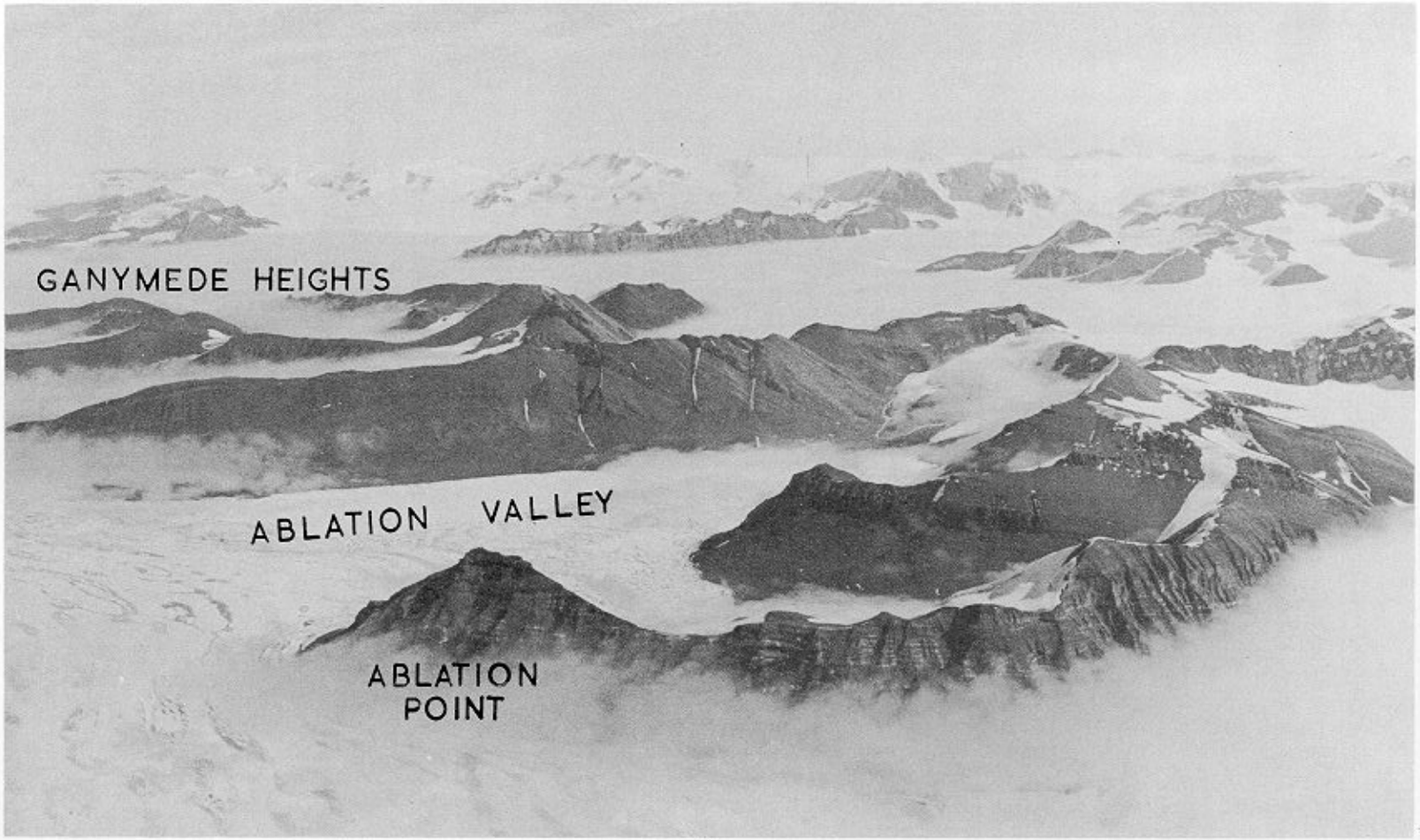
PLATE I

a. Air view looking south-westward across Ablation Point and over the area discussed in this report. Most of the ammonites were collected from the long cliff along the southern margin of Ablation Valley (cf. Fig. 2).

b. *Lytoceras* sp. indet., showing the typical occurrence of these giant forms in the field, on the crest of the ridge along the southern side of Ablation Valley (locality AK). The characteristic crinkled ribbing of the Lytoceratidae is clearly visible. The hammer shaft is graduated in inches [2·5 cm.].

c. *Virgatosphinctes* cf. *frequens* (Oppel); the field occurrence of a large specimen near the summit of Ablation Point. The specimen is much fragmented by jointing, and the large body chamber fragment (top right) is illustrated in Plate Va.



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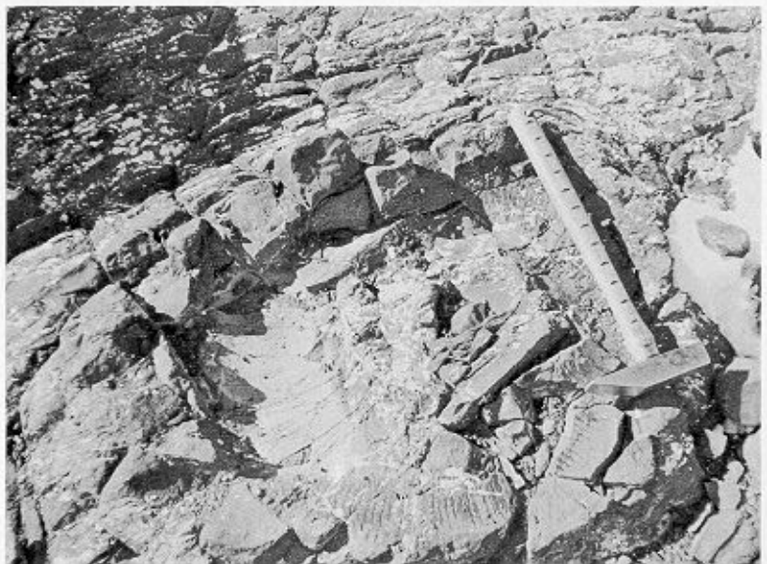


PLATE II

a. *Phylloceras* aff. *serum* (Oppel); latex cast from an incomplete external mould; locality AK, × 1, coated (KG.712.26).

b. *P.* aff. *serum* (Oppel); latex cast of a small individual showing dense fine ribbing; locality AK, × 1, coated (KG.712.17).

c. *Phyllopachyceras beneckei* (Zittel) (*?*); latex cast of a juvenile showing commencement of ribbing on the venter; locality AK, × 1·5, coated (KG.712.27).

d. *P. beneckei* (Zittel) (*?*); a septate internal mould; locality AK, × 1, coated (KG.712.79).

e. *P. beneckei* (Zittel) (*?*); latex cast from an external mould fragment showing a change from relatively dense to more distant ribbing; locality AK, × 1, coated (KG.712.104).

f. *Calliphylloceras* sp.; latex cast from an external mould with some test still adhering; moraine east of Ablation Point, × 1, coated (KG.728.2).

g. *Haplophylloceras strigile* (Blanford) (*?*); internal mould of a juvenile; locality AE, × 1, coated (KG.719.45).

h. *H. strigile* (Blanford) (*?*); internal mould of a dorso-ventrally crushed specimen showing the typical coarse ribbing; locality AE, × 1, coated (KG.719.19).

i. *H. strigile* (Blanford) (*?*); obliquely crushed internal mould showing projected ribbing on the venter; locality AG, × 1, coated (KG.720.29).

j. *Lytoceras* sp. γ; latex cast from an incomplete external mould; moraine east of Ablation Point, × 1, coated (KG.728.5).

k. *Lytoceras* sp. γ; latex cast from the largest external mould of the species; moraine east of Ablation Point, × 1, coated (KG.728.8).

l. *Pterolytoceras exoticum* (Oppel); latex cast from an external mould fragment of the inner whorls; screes on the southern side of Ablation Valley, × 1, coated (KG.701.70).

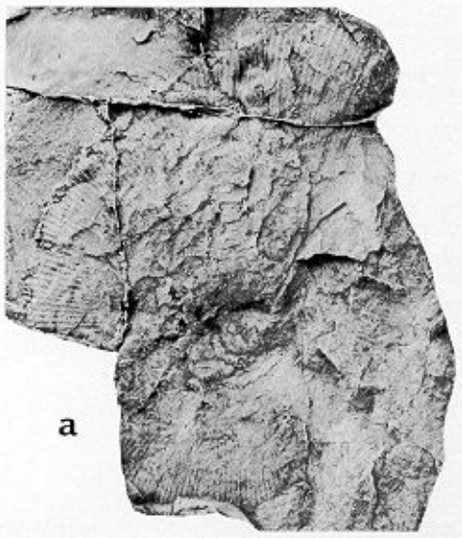
m. *P. exoticum* (Oppel); latex cast from an external mould showing the well-developed flares and some small encrusting serpulids; locality AK, × 1, coated (KG.712.13).

n. *Bochianites* aff. *versteeghi* Boehm; latex cast from an external mould, the largest individual; locality AF, × 1, coated (KG.721.31).

o. *B.* aff. *versteeghi* Boehm; internal mould showing the dorsal aspect of the species; locality AF, × 1, coated (KG.721.9).

p. *B.* aff. *versteeghi* Boehm; latex cast from an external mould of the venter; locality AG, × 1, coated (KG.720.42).

q. *Substreblites* sp.; latex cast from an external mould; locality AP, × 1, coated (KG.1573.118).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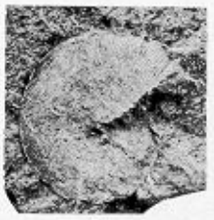
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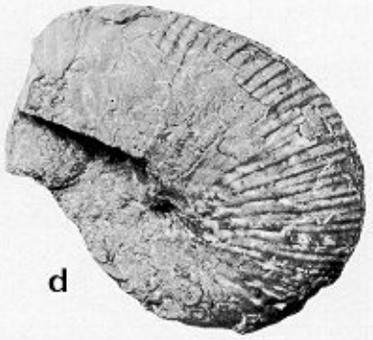
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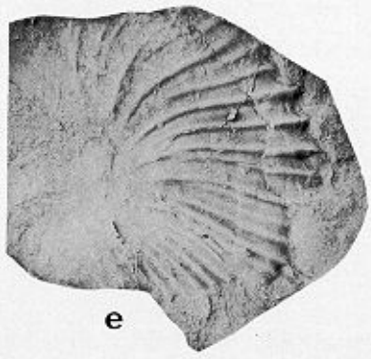
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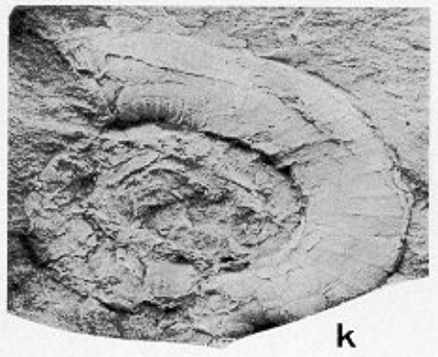
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PLATE III

a. *Haploceras* sp.; latex cast from an external mould; locality AB, ×1, coated (KG.722.20).

b. *Haploceras* sp.; natural internal mould; southern side of Ablation Valley, ×1·5, coated (KG.706.6).

c. *Pseudolissoceras* (*?*) sp.; natural internal mould; locality AH, ×1·5, coated (KG.700.60).

d. *Uhligites* aff. *kraffti* (Uhlig); latex cast from a crushed external mould; locality AK, ×1, coated (KG.712.138).

e. *U.* aff. *kraffti* (Uhlig); part external, part internal mould; screes on the southern side of Ablation Valley, ×1, c (KG.701.80).

f. *U.* aff. *kraffti* (Uhlig); latex cast from an external mould of a young individual; locality AK, ×1, coated (KG.712.33

g. Oppeliid gen. nov. (*?*); latex cast from an external mould showing a well-developed lappet; locality AK, ×1, c (KG.712.105).

h. *Virgatosphinctes denseplicatus* (Waagen); latex cast from an obliquely crushed external mould; locality AK, ×1, c (KG.712.68).

i. *Pachysphinctes* (*?*) sp.; incomplete internal mould lacking the venter of the outer whorl; Ablation Point, ×0·6, c (KG.725.3).

j. *Virgatosphinctes* aff. *denseplicatus* (Waagen); internal mould of a large individual with an almost smooth body cha locality AK, ×1, coated (KG.712.35). Arrows indicate the positions of the whorl cross-sections in Fig. 5.

k. *V.* aff. *denseplicatus* (Waagen); internal mould fragment from an outer whorl; locality AK, ×1, coated (KG.712

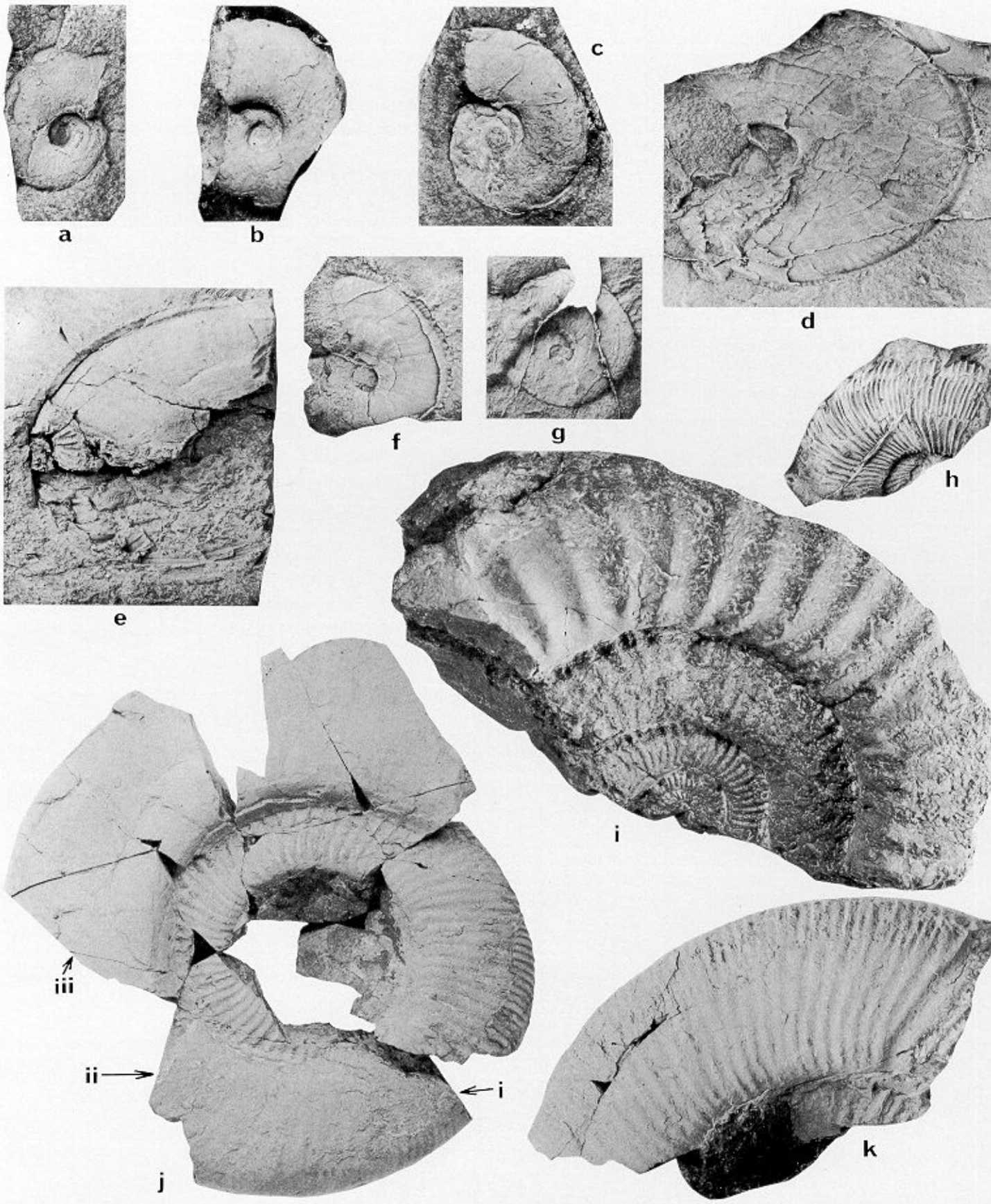
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PLATE IV

a. *Virgatosphinctes* aff. *denseplicatus* (Waagen); crushed internal mould of a large individual on which fine dense ri persists to a late stage; locality AK, × 1, coated (KG.712.120).

b. *Virgatosphinctes acuticostus* sp. nov., holotype; an internal mould with a lappet; locality AK, × 1, coated (KG.71 Arrows indicate trifurcate ribs on the body chamber.

c. *Virgatosphinctes contiguus* (Catullo) (*?*); fragment of a poorly preserved internal mould; locality AB, × 1, c (KG.722.19).

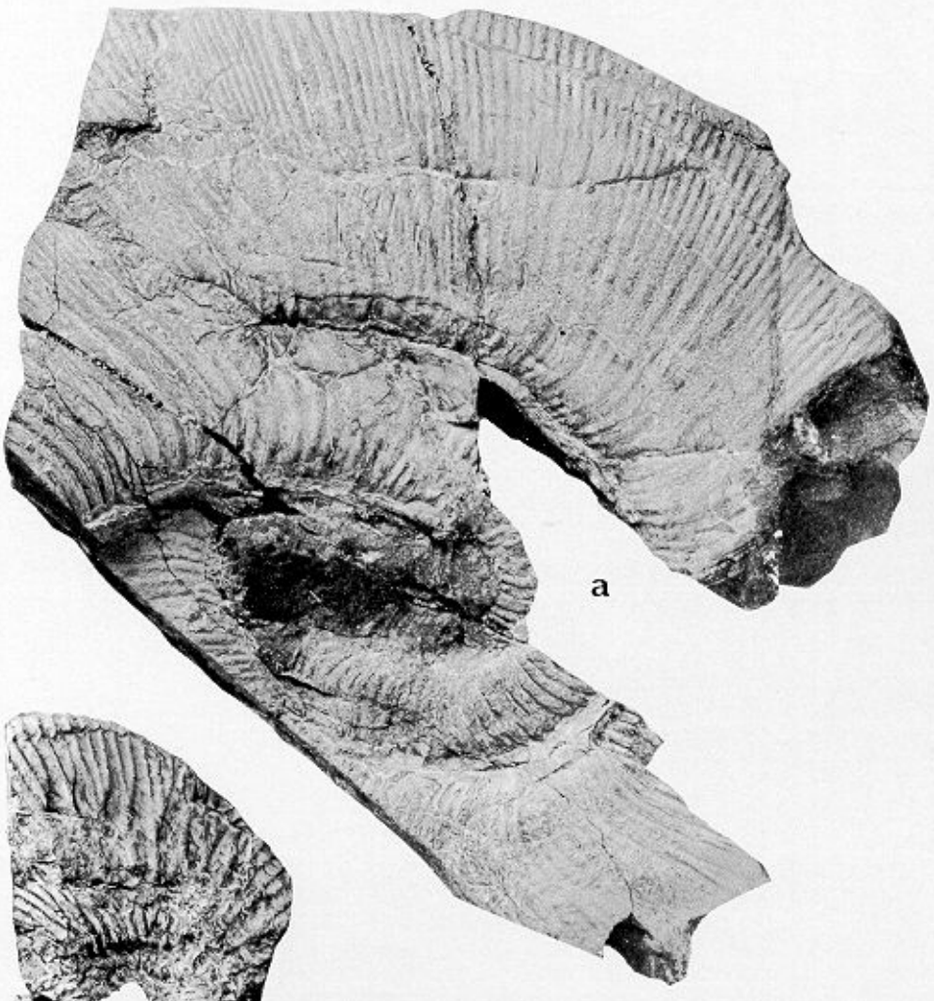
d. *V. contiguus* (Catullo) (*?*); latex cast from an external mould fragment; locality AK, × 1, coated (KG.712.46).

e. *Virgatosphinctes* sp. nov. aff. *andesensis* (Douvillé); latex cast from a fragment of external mould; screes on the sou side of Ablation Valley, × 1, coated (KG.701.56).

f. *V.* sp. nov. aff. *andesensis* (Douvillé); latex cast from an external mould of the aperture showing a blunt lappet; lo AK, × 1, coated (KG.712.97).

g. *V.* sp. nov. aff. *andesensis* (Douvillé); latex cast of a whorl fragment; locality AK, × 1, coated (KG.712.137).

h. *Virgatosphinctes* aff. *mexicanus* (Burckhardt); natural internal mould of a whorl fragment; locality AK, × 1, c (KG.712.112).



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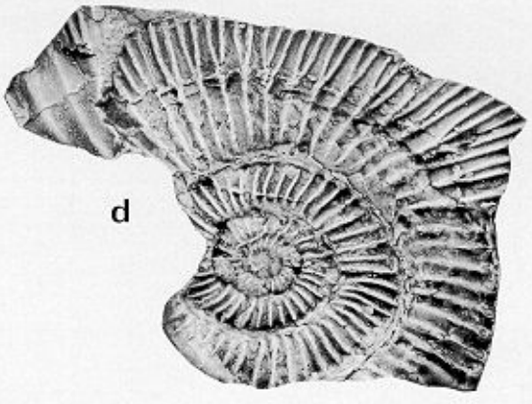

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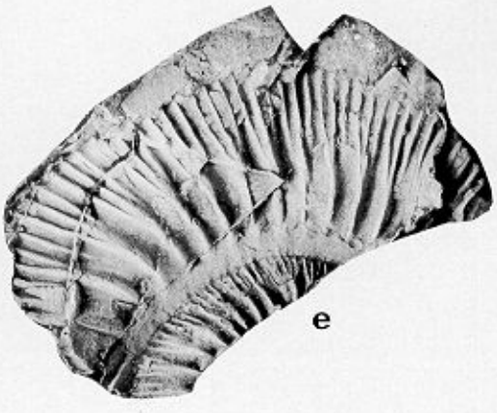

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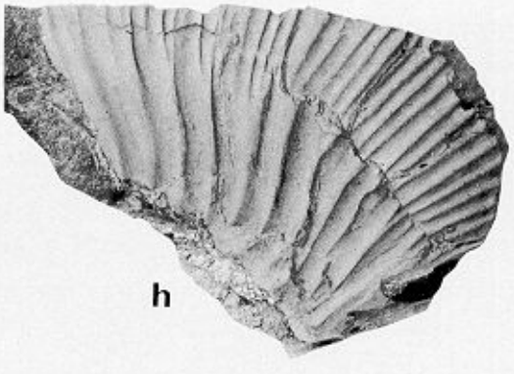

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PLATE V

a. *Virgatosphinctes* cf. *frequens* (Oppel); internal mould fragment from the body chamber of a large individual sho Plate Ic; near the summit of Ablation Point, slightly reduced, coated (KG.726.2).

b. *V.* cf. *frequens* (Oppel); latex cast from an external mould fragment; moraine east of Ablation Point, ×1, c (KG.728.3).

c. *V.* cf. *frequens* (Oppel); latex cast from a small external mould fragment; locality AK, ×1, coated (KG.712.103)

d. *V.* cf. *frequens* (Oppel); latex cast of a small external mould fragment suggesting the development of a lappet; lo AK, ×1, coated (KG.712.55).

e. *Virgatosphinctes lenaensis* Corvalán; latex cast from a small external mould fragment; south-eastern Gan Heights, ×1, coated (KG.880.4).

f. *Aulacosphinctoides* aff. *sparsicosta* (Uhlig); latex cast from an external mould fragment showing the inner w locality AK, ×1, coated (KG.712.39).

g. *A.* aff. *sparsicosta* (Uhlig); latex cast from the fragmentary external mould of a large individual showing par lappet; locality AK, ×1, coated (KG.712.1).

h. *Aulacosphinctoides* sp. α; latex cast from an external mould; locality AK, ×1, coated (KG.712.70).

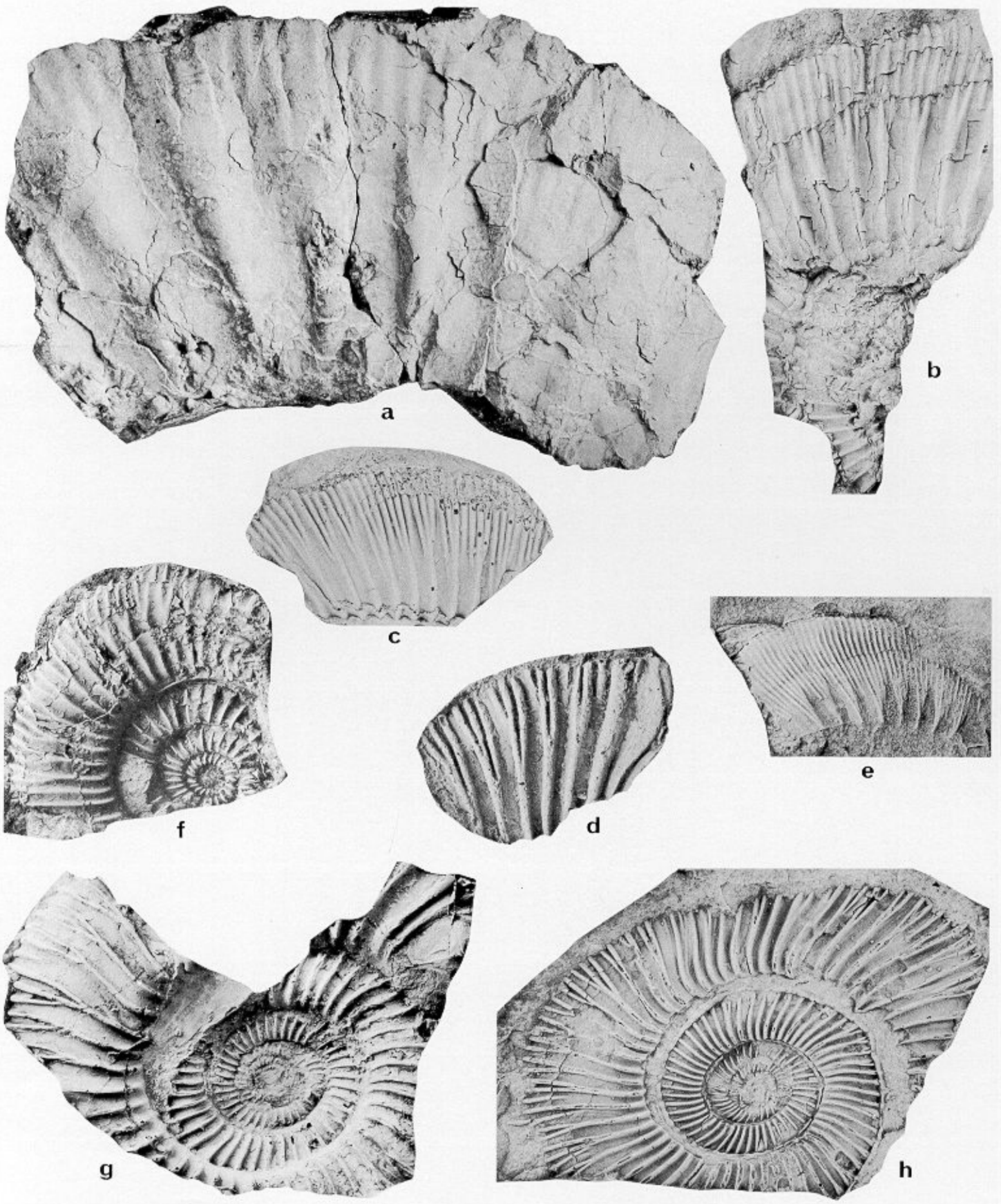
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PLATE VI

a. *Aulacosphinctoides smithwoodwardi* (Uhlig) (*?*); a natural internal mould fragment; screes on the southern si Ablation Valley, × 1, coated (KG.701.53).

b. *A. smithwoodwardi* (Uhlig) (*?*); a natural internal mould fragment; screes on the southern side of Ablation Valley coated (KG.701.78).

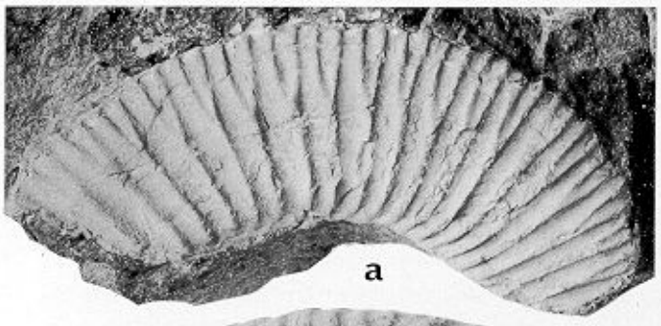
c. *Aulacosphinctoides* sp. β; latex cast from an external mould; locality AH, × 1, coated (KG.700.1).

d. *Aulacosphinctoides* sp. β; latex cast from an external mould fragment; screes on the southern side of Ablation V × 1, coated (KG.701.6).

e. *Spiticeras* sp. indet.; ventral view of a large internal mould fragment showing a laterally displaced inner whorl; lo AK, × 0·6, coated (KG.712.101).

f. *Spiticeras* (*Spiticeras*) aff. *spitiensis* (Blanford); internal mould of a large crushed individual; locality AG, × 1, c (KG.720.46).

g. *Corongoceras* cf. *lotenoense* Spath; latex cast from an external mould fragment with encrusting serpulids; screes o southern side of Ablation Valley, × 1, coated (KG.701.77).



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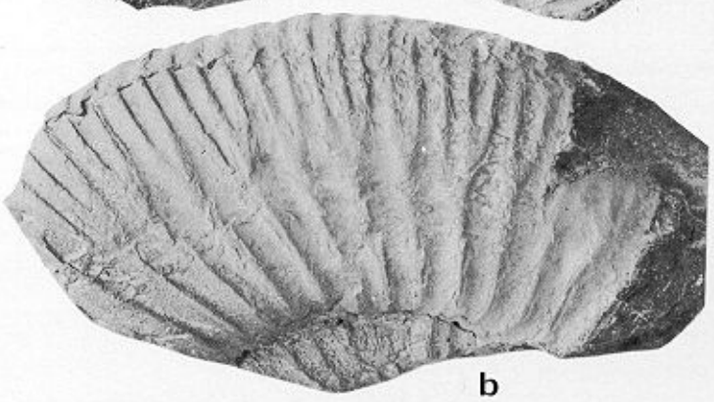

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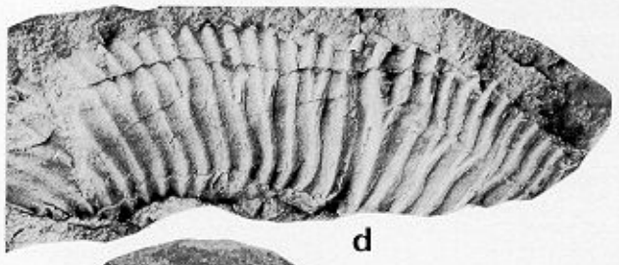

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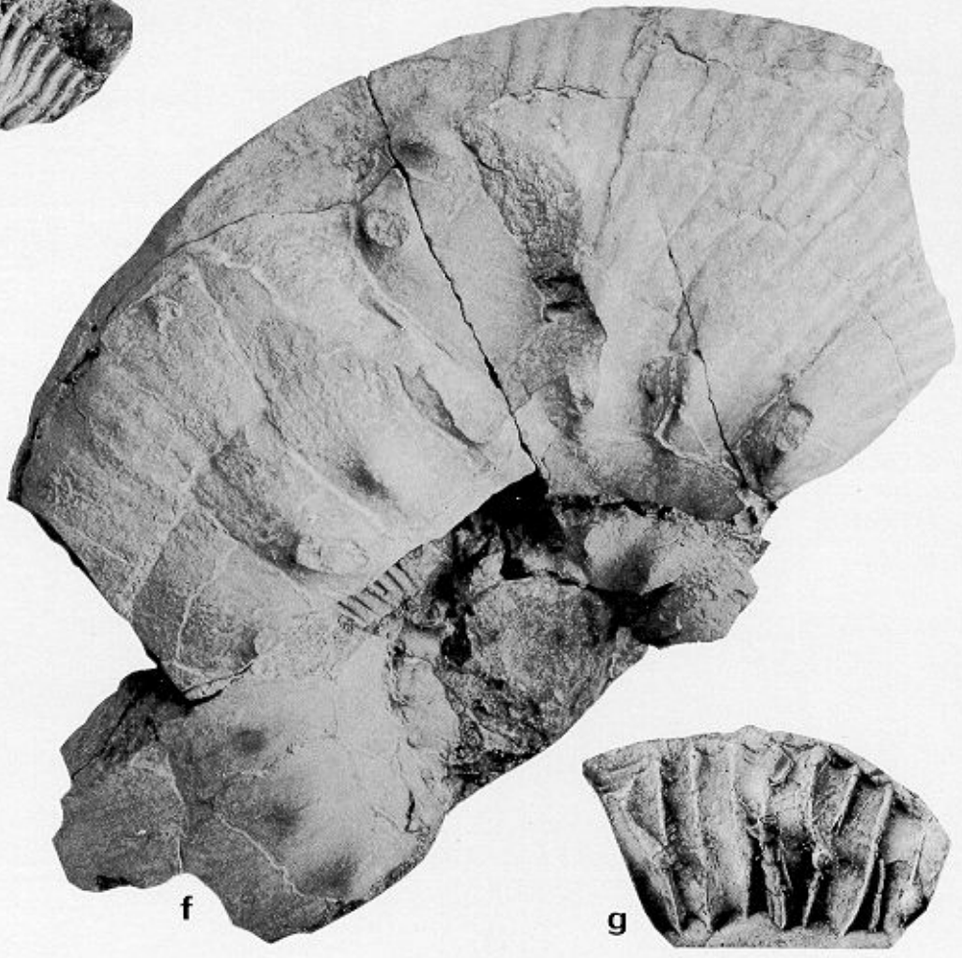

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PLATE VII

a. *Blanfordiceras* aff. *wallichi* (Gray); ventral view of a natural internal mould; locality AG, ×1, coated (KG.720.1)

b. *B.* aff. *wallichi* (Gray); lateral view of the same specimen; ×1, coated (KG.720.1).

c. *B.* aff. *wallichi* (Gray); latex cast from an external mould; col at the northern extremity of Ganymede Height coated (KG.754.6).

d. *Raimondiceras* sp.; ventral view of a body chamber fragment; locality AG, ×0·6, coated (KG.720.40).

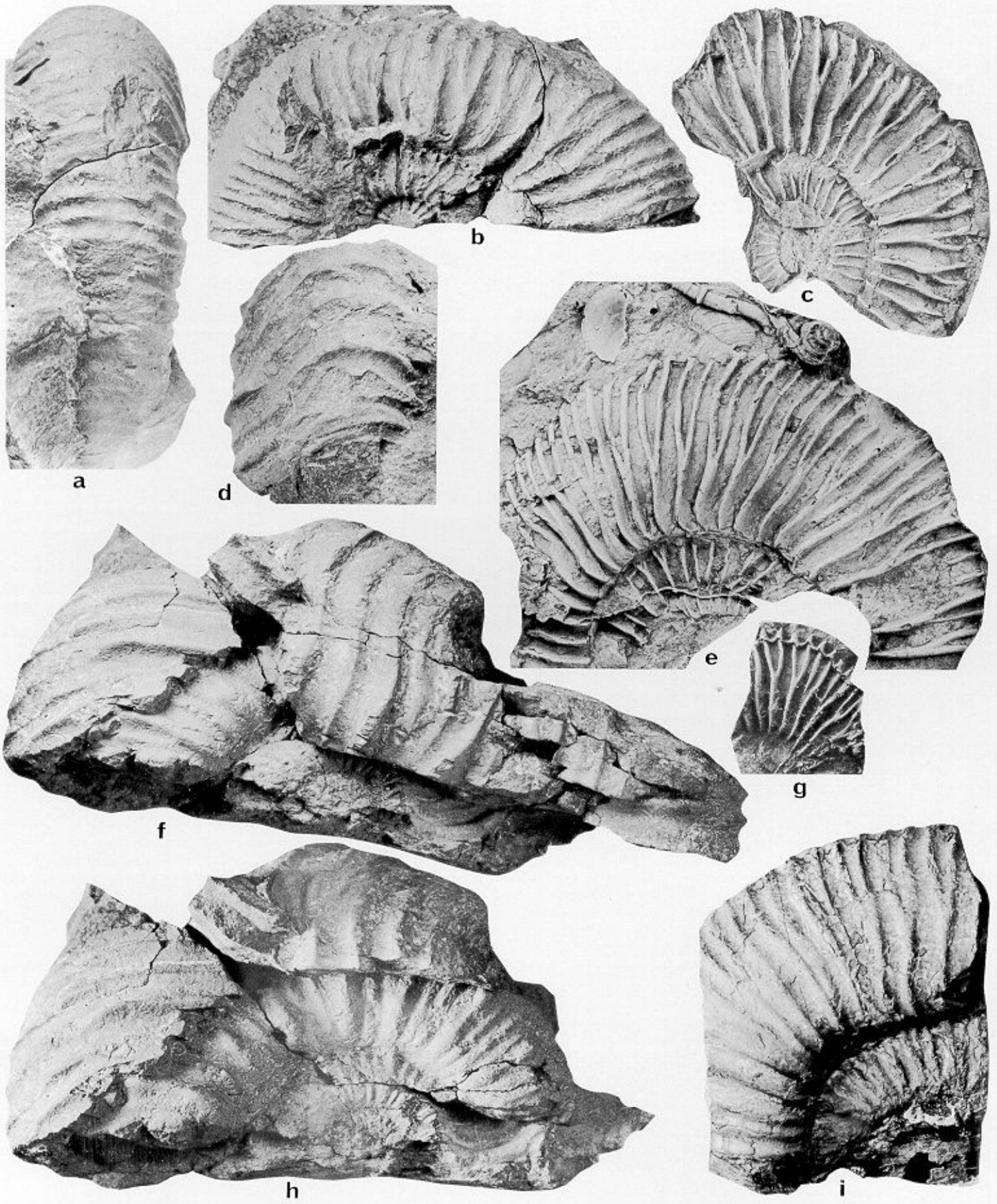
e. *Andiceras* (*?*) sp.; latex cast from an external mould fragment with associated *Rotularia* and bivalve fragments; l AK, ×1, coated (KG.712.38).

f. *Raimondiceras* sp.; lateral view of the whole fragmentary specimen; locality AG, ×0·6, coated (KG.720.40).

g. *Blanfordiceras* sp. juv.; latex cast from a small fragment of external mould; locality AC, ×2, coated (KG.717.9)

h. *Raimondiceras* sp.; lateral view of the same specimen as in Plate VIId and f with part of the outer whorl remo show the inner whorls; ×0·6, coated (KG.720.40).

i. "*Berriasella*" *subprivasensis* Krantz; a fragment of a natural internal mould; locality AC, ×1, coated (KG.717.1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