MEDDELELSER OM GRØNLAND
UDGIVNE AF
KOMMISSIONEN FOR VIDENSKABELIGE UNDERSØGELSER I GRØNLAND
BD. 154 · NR. 4

DE DANSKE EKSPEDITIONER TIL ØSTGRØNLAND 1947–58
UNDER LEDELSE AF LAUGE KOCH

STRATIGRAPHY AND AMMONITE FAUNA OF THE VOLGIAN AND BERRIASIAN ROCKS OF EAST GREENLAND

BY

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WITH 3 FIGURES IN THE TEXT
AND 9 PLATES

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1964

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PREFACE

During the summer of 1957, as a member of Lauge Koch's Expedition to East Greenland of that year, I was able to visit most of the localities which are of importance for working out the latest Jurassic and earliest Cretaceous succession. The exceptions were south-western Jameson Land, and eastern Kuhn Ø, which I was not able to reach. As a result I have been able to review the rocks of this age and bring up to date their correlation, and this is the object of this paper.

I was accompanied by Mr. A. Wyttenbach as field assistant, and wish to thank him for his help. In Milne Land I also had the advantage of the company of Dr. J. H. Callomon. I am indebted to Dr. Lauge Koch and his secretary, Miss Ingrid Beck, for discussion and for assistance with publication.

I have had useful discussions on correlation with Dr. R. Casey of the Geological Survey. Dr. M. K. Howarth of the British Museum (Natural History) has kindly supplied photographs of ammonites from the Spilsby Sandstone. The other photographs illustrating the paper were taken by Mr. E. W. Seavill at Bristol University.

Bristol, July 1962.

Abstract

The localities at which Late Jurassic and Lowermost Cretaceous rocks have been found in East Greenland are reviewed and some of them redescribed. The highest Jurassic fauna is characterized by the ammonite *Laugeites*, and is probably to be correlated with the Lower Volgian of Russia. There is no positive evidence for the presence of Upper Volgian. The earliest Cretaceous fauna has the ammonites *Tollia*, *Surites* and *Hectoroceras* and corresponds to the Ryazanian of SAZONOV or Lower Valanginian of other Russian authors, and to the Berriasian of western authors. Correlation with the English sequence is also discussed.

The palaeontology of the ammonite genera *Laugeites*, *Surites* and *Tollia* is treated systematically. Three new species of *Laugeites* are named, described and figured.

I. INTRODUCTION

Among the numerous Mesozoic ammonite faunas collected by Lauge Koch's Three-Year and Two-Year Expeditions to East Greenland and described by the late Dr. L. F. Spath (see Donovan, 1957, pp. 16–19) were several belonging to littleknown horizons near the top of the Jurassic system and the base of the Cretaceous. Describing some of them Spath (1946, 1947, 1952) gave much attention to problems of dating and correlation, and to the sequence of faunas near the Jurassic-Cretaceous boundary. At one time (1947, p. 8.) he had hopes that discoveries in East Greenland might make an important contribution to the problem of defining the Jurassic-Cretaceous boundary and working out the stratigraphy of the beds immediately above and below. These hopes have not been fulfilled, and it is now clear, as will be shown, that there is a gap in the ammonite sequence known from East Greenland as compared with Europe and Russia. Since I attempted to summarise the question from inadequate knowledge in 1957 (p. 142), I have been able to visit most of the localities and collect fossils. These fossils are described and illustrated in this paper, and accompanied by a review of stratigraphy and correlation.

In addition to my own collections, I have studied material collected at the Niesen in Wollaston Forland by A. J. Standring and E. W. Roberts in 1952, and by F. Perrenoud and O. Roy in 1956.

II. THE LOCALITIES AND THEIR STRATIGRAPHY

Rocks of latest Jurassic and Berriasian age are known from five places in East Greenland, namely 1) Milne Land; 2) south-western Jameson Land; 3) northern Wollaston Forland; 4) western Kuhn Ø and 5) eastern Kuhn Ø. These will be reviewed in turn.

1. Milne Land

The sequence at Hartz Fjeld in eastern Milne Land was re-examined by Dr. J. H. CALLOMON and the writer in 1957. The following sequence was noted in part of the Harzfjæld Sandstone (for general succession in Milne Land see DONOVAN 1957, p. 41; CALLOMON, 1961, p. 264):

		m.
Upper Hartzfjæld Sandstone (part)	7. Whitish sands with indeterminate bivalves	
	6. Dark brown, ferruginous sandstone, overlying glauconitic sandstone with *Tollia groenlandica* (SPATH), and fossil wood	*c.* 1
	5. Whitish sands	20
Lower Hartzfjæld Sandstone	4. Rusty weathering glauconitic, micaceous sandstone: fragmentary impression of a large *Laugeites*, and two whorl fragments of the same genus. Impressions of bivalves and gastropods	*c.* 1
	3. Whitish sands	10
	2. Glauconitic sand capped by brown-weathered sandstone with ammonites: ?*Laugeites* and sharp-ribbed perisphinctid.	*c.* 3
	1. Whitish sands	75

Brachiopod bed forming top of Glauconitic Series.

The Lingula-Bank of ALDINGER (1935, p. 67) was not identified, but is almost certainly either bed 2 or 4; from it SPATH (1936, p. 82) described *Laugeites groenlandicus*. Also from the Hartzfjæld Sandstone above the Lingula-Bank, SPATH described and figured two new ammonite species (1936, pp. 85–87) which he assigned to *Craspedites*, although there seems no reason to put them in this genus (see below, p. 25). The suggestion is now made that these small, ill-preserved ammonites may belong to the genus *Tollia*. For the division into Lower and Upper Hartzfjæld Sandstone, see page 15.

2. South-western Jameson Land

A succession here was observed by MAYNC and published by SPATH (1947, p. 49). The only fossiliferous beds are the Hectoroceras Beds which occur in the middle of a series of barren strata. Apart from the genus *Hectoroceras*, the only ammonites are some poorly preserved "perisphinctids" all identified by SPATH as *Subcraspedites*. Their stratigraphical relationship to *Hectoroceras* is not clear. At locality 318 the two kinds of ammonite are said to have been found in association (SPATH, 1947, pp. 50, 53). Some of the "*Subcraspedites*" from here (SPATH, op. cit. pl. 1, fig. 6, pl. 4, figs. 11–13) could be *Tollia* of the group recorded by SPATH from Milne Land as *Subcraspedites*. An ammonite figured from locality 305 (Pl. 4, fig. 1) could be a *Laugeites* not very different from *L. intermedius* sp. nov. SPATH regarded his "*Subcraspedites*" as occurring in general below *Hectoroceras*, but the field evidence for this is not very clear.

At Aucellaelv, about 38 km west-north-west of Kap Stewart, a loose block yielded ammonites which were figured by SPATH (1936) as *Pectinatites?* In the present paper (p. 21) these are referred to *Laugeites jamesoni* sp. nov. The formation from which the block was derived has not been discovered.

3. Northern Wollaston Forland

The important locality here is the mountain named the Niesen by the Swiss members of LAUGE KOCH's 1936–38 expedition, marked as a 688 m summit on the Geodetic Institute 1 : 250.000 map. A resumé of earlier knowledge of the succession was made by DONOVAN (1957, p. 62 & fig. 13). Since that account was written, the mountain has again been visited, by Messrs F. PERRENOUD and O. ROY in 1956, and by the present writer in 1957. These visits render the earlier accounts out of date.

A revised geological sketch-map of the area is given in figure 1. VISCHER and MAYNC, whose map was published by KOCH (1950, pl. 6) mapped two sedimentary series, the Rigi Series of supposed Upper Jurassic age, and the Niesen Beds (Valanginian in the key to KOCH's pl. 6) placed in the lowest Cretaceous, divided into Lower Niesen Beds (Berriasian) and Upper Niesen Beds (Valanginian). The Rigi Series was named after the mountain Rigi (summit 484 m on Geodetic Institute map, 7 km. south-west of the Niesen) where a thick series of conglomerates and sandstones outcrops. A careful examination by the present writer of the country between the Niesen and the Rigi, both on the ground and from the air, showed beyond doubt that the Rigi Series

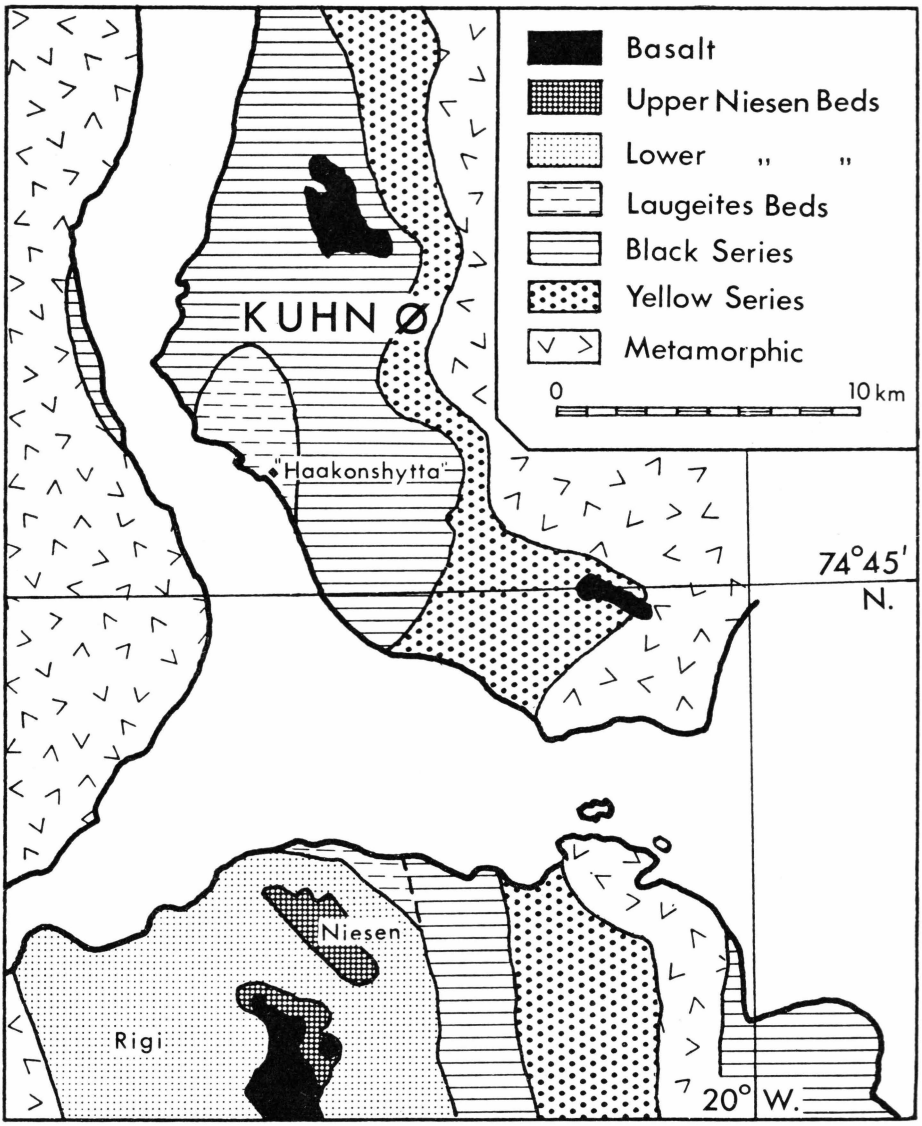

Fig 1. Geological sketch map of parts of Wollaston Forland and Kuhn Ø, East Greenland. Scale: 1 :250,000. Based on the mapping by VISCHER and MAYNC, published by KOCH (1950, pl. 6), modified by the writer's own observations. Superficial deposits omitted.

and the Lower Niesen Beds are one and the same formation; the prominent conglomerate bands can be followed through from the outcrop of the Lower Niesen Beds to that of the "Rigi Series" without a break, dipping steadily westwards at a few degrees.

On account of the westerly dip the lowest beds at the Niesen are

exposed at the eastern end of the coastal flank of the mountain. Grey, pebbly sands begin to be exposed at 27 m altitude, and pass up into "banded beds" which consist of yellow sand alternating with grey or black shaly sand and shale, the yellow sand layers being *c.* 1 cm thick. In this series at altitude 90 m were collected some poor ammonite impressions which are identified as *Laugeites ?parvus* sp. nov. The banded beds continue up to 115 m, and are succeeded by whitish sands with bands of sandstone which form crags.

At an altitude of 235 m MAYNC (1949, p. 96) found the ammonites which were described by SPATH (1952) as the new genus *Praetollia*, here placed in *Tollia* (p. 27). This fossil bed has not been re-found by later visitors to the mountain. Thirteen metres higher MAYNC found a specimen of *Hectoroceras* which was figured by SPATH (1947, pl. 3, fig. 2; wrongly localised, corrected SPATH 1952, p. 13). STANDRING in 1952 collected *Hectoroceras* sp. juv. from an outcrop at 285 m, and from a loose block nearby larger examples of the genus which appear closely similar in preservation to MAYNC's example figured by SPATH. It seems likely that both MAYNC's and STANDRING's finds were from the same horizon.

At 305 m on the north-eastern spur of the Niesen the present writer discovered ammonites in a horizon of brown-weathering, calcareous "doggers" in sands. Ammonites identical in preservation and matrix, and clearly from the same fossil bed, were collected by STANDRING at localities recorded as 320 and 322 m. The difference in altitude is doubtless due either to the dip of the rocks or to inaccuracy of the altimeters used. The fauna here comprised species of *Surites* and small ammonites which may be the inner whorls of *Tollia payeri.*

Between 360 and 370 m, on the same flank of the mountain, the writer found similar doggers and platy-weathering sandstones, which contained occasional examples of *Surites* and abundant *Tollia.* An example of the latter genus from this level was figured by SPATH (1952, pl. 4, fig. 8) as *Tollia payeri* (TOULA), but does not exactly agree with that species (see page 30). Ammonites indistinguishable from *Tollia* ("*Praetollia*") *maynci* were also found at the horizon.

At 414 m the writer found, near the north-eastern flank of the mountain, nodules with typical Valanginian *Polyptychites.* Valanginian ammonites have been found by all collectors at various higher levels, and *Lyticoceras* occurs at the summit (SPATH, 1946, p. 6; confirmed by later collecting).

4. Western Kuhn Ø

The country behind "Haakonshytta", a ruined trappers' hut, is dissected by stream valleys 15 to 30 m deep. These valleys show a number of sections through conglomerates, sands and sandstones, and

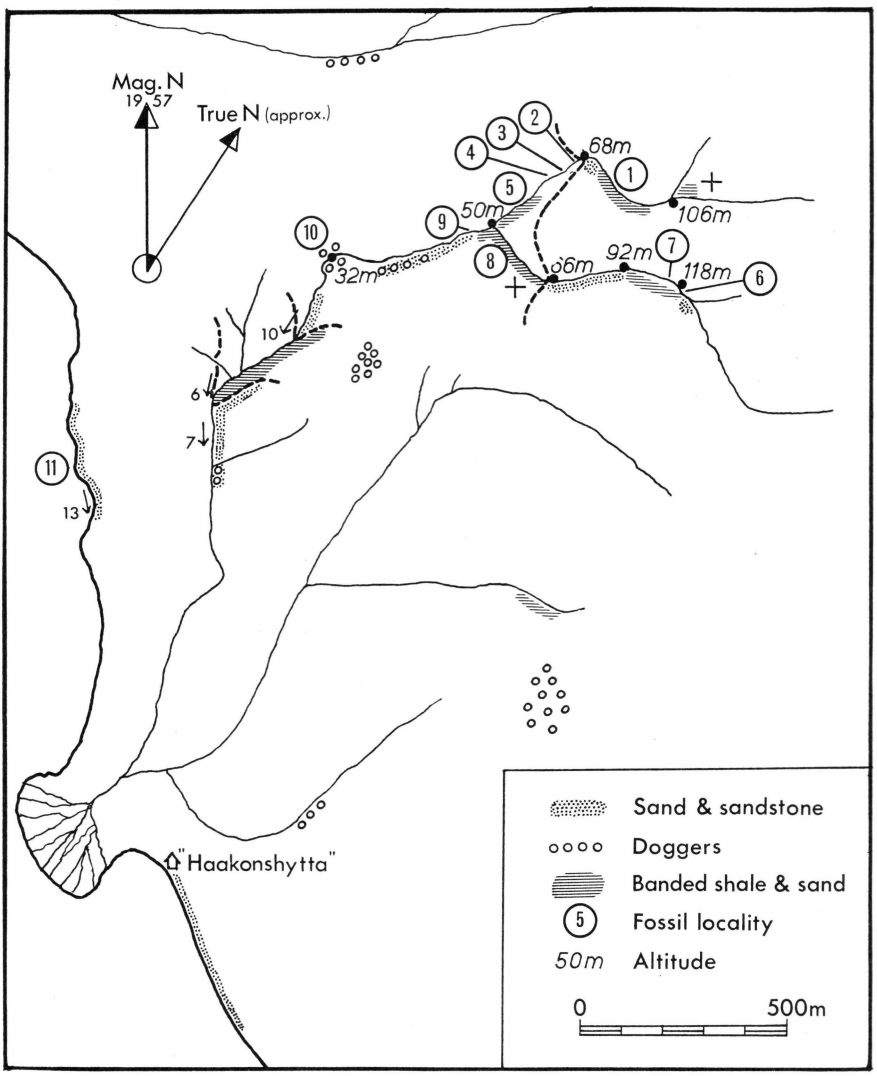

Fig. 2. Sketch map of the country north and east of 'Haakonshytta', western Kuhn Ø. Scale: 1: 18.000 approx.

dark grey shales which are often banded with thin laminae of yellow sand. One interpretation of the exposures has been published by MAYNC (1947, pp. 28–36; 1949, pp. 27–32). In summarising it I have already (1957, p. 59) expressed doubt as to the regular cyclic sedimentation which MAYNC finds. Having seen the exposures since writing my 1957 paper, I can only repeat that I can not accept the existence of MAYNC's four cycles. There is certainly alternation of lithology, and probably rapid lateral variation, but further than this I am not prepared to go. The dip of the rocks exposed in the valley sides is often very nearly

the same as the gradient of the stream, and for this reason it was found impossible to correlate or place in stratigraphical order the isolated exposures which were recorded. A sketch map of the area, showing the outcrops observed and the locality numbers referred to in the palaeontological part of this paper, is given in figure 2.

The commonest ammonite in these rocks is *Laugeites* of which at least five species are represented in collections made by the writer in 1957. They are described on pages 19–23. The only other ammonites found were fragments of pavlovid type perisphinctids, and a single impression of a *?Praetollia* at locality 6. No definite succession can be observed among these ammonites. MAYNC found an example of *Subcraspedites*, associated in the same piece of rock with *Laugeites* (specimens figured by SPATH, 1952, pl. 4, figs. 1, 4). SPATH assumed that these specimens were derived because he believed *Laugeites* to be a Jurassic, and *Subcraspedites* a Cretaceous ammonite. This interpretation has already been questioned (DONOVAN, 1957, p. 143) and is now known to be unnecessary as a result of new evidence as to the ages of these genera, discussed further on page 17.

5. Eastern Kuhn Ø

An exposure of Berriasian rocks somewhere on the east coast of Kuhn Ø was found by the Second German Expedition of 1870–71, for they collected *Tollia payeri* (TOULA, 1874, p. 498, pl. 1, fig. 1), *Pachyteuthis* and *Buchia concentrica*. The locality has not been re-discovered by later workers (see DONOVAN, 1957, pp. 64–5).

6. The ammonite sequence

The sequence of ammonites at the various localities may be summarised and correlated as follows:

Milne Land	*S. W. Jameson Land*	*Niesen*	*W. Kuhn Ø*
Tollia		*Polyptychites* *Tollia payeri* with *Surites*.	
	Hectoroceras with *?Tollia*	*Hectoroceras*	
		Tollia ("*Praetollia*") *maynci*	
			Laugeites with *Subcraspedites*
Laugeites		*Laugeites*	*Laugeites* with sharp-ribbed perisphinctids

III. CORRELATION

1. Russia

The succession in the Volga Basin in European Russia currently recognised is reproduced below from OVECHKIN (1958), SAZONOV (1951) and the *Lexicon* (U.R.S.S. fasc. iii, 1958).

Systems & Stages according to OVECHKIN		Zones	Stages according to SAZONOV	
Cretaceous	Middle Valanginian	*Nikitinoceras hoplitoides* (NIKITIN)	Valanginian	Berriasian according to ARKELL (1956)
	Lower Valanginian	*Tollia stenomphala* (PAVLOV) *Surites spasskensis* (NIKITIN) *Riasanites rjasanensis* (LAHUSEN)	Ryazanian	
Jurassic	Upper Volgian	*Craspedites kachpuricus* & *C. nodiger* (EICHWALD) *C. subditus* (TRAUTSCHOLD) & *C. okensis* (D'ORB.) *Kachpurites fulgens* (TRAUTSCHOLD)	Upper Volgian	Range of *Laugeites*
	Lower Volgian	*Epivirgatites nikitini* (MICHALSKI) *Virgatites virgatus* (VON BUCH) *Dorsoplanites panderi* (D'ORB.) & *Zaraiskites scythicus*. *Ilovaiskya spp.*		

Present-day Russian authors place the base of the Cretaceous below the Rjasanensis Zone. Some foreign authors, including SPATH (1947, p. 54; ARKELL, 1956, p. 493) correlate the Rjasanensis Zone with the earliest Berriasellid ammonite fauna at the top of the Tithonian, and hence put the base of the Cretaceous above it. The base of the Berriasian Stage coincides with the base of the Cretaceous in regions, such as south-eastern France, where the Tithonian is recognised.

The Volgian zones are taken from the *Lexicon* (fasc. iii, pp. 1662–3). OVECHKIN (1958, p. 560) differs from this in stating that the index of

the middle zone of the Upper Volgian is *Garniericeras catenulatum*. The zone characterised by species of *Surites* has been found by SAZONOV (1951) to occupy a distinct position above the horizon of *Riasanites rjasanensis* and below *Tollia*. SAZONOV coined the term "Ryazanian" for the beds with *Riasanites* and *Surites*, but it does not seem to have been generally adopted.

NIKITIN (1884) recorded *Laugeites* (as *Perisphinctes stschurowskii*) in the Virgatus Zone of the Jaroslawl district. NIKITIN regarded the Virgatus Zone as the topmost zone of the Lower Volgian, but since his day zones of *Lomonossovella blakei* (PAVLOV) and *Epivirgatites nikitini* (MICHALSKI) have been recognised above it. The two last-named zones may overlap (ARKELL 1956, p. 494). ZONOV (1937, p. 40) stated that the Laugeites beds lie above the Nikitini Zone, immediately below the beds with *Kachpurites*, along parts of the course of the Volga, and NIKITIN's record from Virgatus Zone, is, doubtless, due to the fact that the higher zones of the Lower Volgian had not then been separated. In the central part of the Soviet Arctic *Laugeites* also occurs at the top of the Lower Volgian (OVECHKIN 1958, p. 574). According to LUPPOV and DRUSHCHITZ (1958, p. 90) *Laugeites* occurs both in the upper part of the Lower Volgian and the lower part of the Upper Volgian. NIKITIN recorded *Perisphinctes Stschurowskii* from the Nodiger Zone of the Upper Volgian (1884, p. 73, repeated by ARKELL 1956, p. 493).

The Ryazanian Stage was proposed by SAZONOV (1951) but later retracted by him.

In terms of this succession it is at once clear that there is no fossil-evidence for the presence in East Greenland of any of the Upper Volgian zones, characterised in Russia by *Craspedites* and *Kachpurites*, or for the Rjasanensis Zone.

In Milne Land the Hartzfjæld Sandstone was divided by SPATH (1936, p. 149) into an "upper part" and a "lower part", separated by the Lingula-Bank. This scheme is now slightly modified to recognise a Lower Hartzfjæld Sandstone, up to and including the Lingula-Bank (the highest occurrence of *Laugeites*; probably bed 4 of the section on page 8) of Lower Volgian age; and an Upper Hartzfjæld Sandstone, of early Cretaceous date, comprising the remainder of the formation.

In south-western Jameson Land the Hectoroceras Beds are of Berriasian age.

In the Niesen (north-western Wollaston Forland) and western Kuhn Ø the lowest beds exposed are the "banded beds" of rapidly alternating black shale and yellow sand, associated with sandstones and conglomerates and yielding *Laugeites*. These beds were mapped by VISCHER and MAYNC as Rigi Series (pl. 6 in KOCH, 1950). They are now named the

Laugeites Beds, since they lie below, and are differentiated from (cf. MAYNC, 1949, pp. 95, 99), the Niesen Beds with which the Rigi Series is synonymous. The Laugeites Beds clearly include beds equivalent to the top of the Lower Volgian, as shown by the presence of *Laugeites* and of ammonites similar to *Epivirgatites*.

The equivalence of the Niesen Beds and the Rigi Series has already been pointed out. Both terms have equal priority, dating from MAYNC (1947), and Niesen Beds is to be preferred because the detailed succession at the type locality is better known. The division into Lower and Upper Niesen Beds is made on palaeontological grounds, the beds with *Hectoroceras*, *Surites* and *Tollia*, about 300 m thick, being regarded as Lower Niesen Beds, and the remainder, from an altitude of just above 400 m to the summit, as Upper Niesen Beds, about 270 m thick.

The identification of *Surites spasskensis* enables the Spasskensis Zone to be recognised in the Lower Niesen Beds. Species here assigned to *Tollia* ("*Praetollia*" of SPATH), and *Hectoroceras* already occur below *Surites* at the Niesen, but as there is nothing to suggest the presence of the Rjasanensis Zone, they are provisionally included in the Spasskensis Zone. It may be that the Stenomphala Zone is represented by the fossil horizon at 360–370 m on the Niesen, containing abundant *Tollia* with occasional *Surites*. The writer has not found a sufficiently detailed account of the sequence of *Tollia* species in the Russian succession to be able to make detailed comparison.

The dates of formations in East Greenland may be tabulated:

Russian Stages	Milne Land	S. W. Jameson Land	Wollaston Forland: Niesen	Western Kuhn Ø
Ryazanian or Lower Valanginian	Upper Hartzfjæld Sandstone	Hectoroceras Beds	Lower Niesen Beds	—
Upper Volgian	—	—	—	—
Lower Volgian	Lower Hartzfjæld Sandstone	—	Laugeites Beds	Laugeites Beds

Correlation of formations is, of course, only approximate, and the exact equation of their upper and lower limits is not suggested.

2. England

The correlation given above is different from that of SPATH (1952, p. 20). The reason for the difference is that SPATH regarded *Subcraspedites* as an early Cretaceous ammonite. He did so, presumably, because

the formation from which *Subcraspedites* was described, the Spilsby Sandstone of Lincolnshire, England, rests unconformably on Upper Jurassic rocks and was consequently regarded as Cretaceous. This obliged him to assume that the *Laugeites* and *Subcraspedites* associated in the same horizon of the Laugeites Beds were both derived, although he had no physical evidence to suggest this[1]). He therefore dated the Laugeites Beds as, at least in part, younger than the Spilsby Sandstone (1952, p. 19).

The obvious placing of the Laugeites Beds at about the boundary between Lower and Upper Volgian of Russia, on the basis of *Laugeites*, now falls into line with recent work in England. On the basis of independent evidence, namely the recognition of autochthonous Portlandian and Volgian ammonites, CASEY has revised the dating of the Spilsby Sandstone the basement bed of which he regards as the equivalent of the upper part of the Portland Beds of southern England. If, with ARKELL (1946, pp. 24–28), we place the Portland Beds in the upper part of the Lower Volgian, they, the Laugeites Beds and the basement bed of the Spilsby Sandstone are not very different in age.

Their exact relationship is more difficult to decide. The pavloviids from the Laugeites Beds, though they suggest a Portlandian date, would be too fragmentary for close correlation even if the English Portland ammonites were better known. *Laugeites* has not been recognised in either the Spilsby Sandstone or the Portland Beds. *Subcraspedites*, common in the basement bed of the Spilsby Sandstone, is rare in the Laugeites Beds. The difficulty of piecing together a sequence from isolated exposures of the Laugeites Beds has already been explained (p. 13), but if we accept that *Subcraspedites* occurs in the uppermost part of the formation (MAYNC, 1949, p. 31) then this horizon may overlap the base of the Spilsby Sandstone. This correlation is in accordance with the hypothesis (p. 26) that *Subcraspedites* evolved from *Laugeites;* but the hypothesis is as yet unsupported by good stratigraphical evidence, and must not be used in support of the correlation. Alternatively, it may be that *Laugeites* and *Subcraspedites* replace one another geographically.

Lastly, the East Greenland succession throws light on the date of the Sandringham Sands, Norfolk, England, in which the ammonite *Hectoroceras* was recently recorded (CASEY, 1961) for the first time outside East Greenland. They turn out to be equivalent, in part, to the

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[1]) Presumably SPATH assumed this as a result of his reading of the fossil evidence for although he states it without further comment, MAYNC who collected the fossils says nothing of derived fossils in his published accounts (1947, 1949). The ammonite shells in the Laugeites Beds are filled with sandstone identical with the matrix, and derivation seems most improbable.

Lower Niesen Beds, and to the upper part of the Spilsby Sandstone. They must be placed in, or just below, the Spasskensis Zone.

3. Conclusion

Formations in East Greenland near the Jurassic-Cretaceous boundary can now be dated in terms of the succession in the Volga Basin of Russia. The Upper Volgian is not proved in East Greenland, and the lowest Cretaceous horizon is identified as the Spasskensis Zone. The lowest Cretaceous beds in East Greenland fall in the Berriasian Stage, but the succession does not throw any light on the correlation of the base of the Berriasian, as defined in south-eastern France, with the Volga Basin stages.

IV. SYSTEMATIC PALAEONTOLOGY

Superfamily **PERISPHINCTACEAE** STEINMANN 1890

Family **Perisphinctidae** STEINMANN, 1890

Subfamily Virgatosphinctinae SPATH, 1923

Genus **LAUGEITES** SPATH, 1936.

The genus was proposed by SPATH (1936a) to replace *Kochina* SPATH (1936, p. 81) which was preoccupied. The type species is *L. groenlandicus* (SPATH). A later synonym is *Stschurovskya* ILOVAISKY (1941)[1]) with type species *Perisphinctes stschurowskii* NIKITIN (1881, p. 83, pl. 7, figs. 53–56). *Per. stschurowskii* was included in *Kochina* by SPATH, who cited NIKITIN's figure 53 which shows inner whorls only. NIKITIN's illustrations are not very well drawn and interpretation of the species is not easy. In 1885 (p. 129, pl. 4, fig. 17) NIKITIN figured as *Per.* aff. *stschurowskii* an ammonite which appears to be smooth by a diameter of 5 cm; neither the preservation nor the drawing, however, is very good. MICHALSKI (1890, pp. 250, 462, pl. 12, figs. 4a, b) gave an excellent figure of the inner whorls of the species.

Laugeites aff. ***groenlandicus*** (SPATH).

1936. *Kochina groenlandica* SPATH, p. 82, pl. 36, figs. 1 a, b, pl. 38, figs. 1 a–c (holotype).

1936 a. *Laugeites groenlandica* (SPATH). SPATH, p. 334.

No further material from the type horizon and locality, the Lingula Bed on Hartz Fjeld, Milne Land, has come to light, despite search by Dr. J. H. CALLOMON in 1957 and 1958. The species differs from *L. stschurowskii* (NIKITIN), as exemplified by NIKITIN's largest figured specimen (1881, pl. 7, fig. 55) by its wider umbilicus, 42% for the holotype at maximum size as compared with 38% at the same size for the Russian

[1]) Cited thus by LUPPOV and DRUSHCHITZ (1958, p. 89). What is evidently the same genus was mentioned by ZONOV (1937, pp. 38, 40) as *Stschurovskiy;* ? a *nomen nudum* at that date.

specimen. This is hardly significant; the apparent early loss of primaries in the Russian species may not be significant either, for NIKITIN's illustrations leave much to be desired. It may be, therefore, that *L. groenlandicus* will turn out to be a synonym of *L. stschurowskii*, but it seems unjustifiable to drop SPATH's name until better figures of NIKITIN's species become available.

A poor, partly crushed example from locality 10, Kuhn Ø, agrees with the holotype as far as it goes; it shows neither suture-lines, nor any ornament on the inner whorls. Two fragments of large ammonites from locality 4 are close to the species.

Laugeites intermedius sp. nov.

Pl. 1, figs. 1, 2, 4, 5; pl. 2, figs. 3, 4; pl. 8, fig. 5.

Type: The holotype is an example from locality 2, Kuhn Ø, illustrated in plate 1, figure 1. There are paratypes from the same locality.

Diagnosis: The species was probably between eight and nine centimetres in diameter when adult. The holotype at a diameter of 7.6 cm. has the umbilicus 40%, and the whorl thickness about 25% of the diameter. Most examples are too fragmentary or distorted for measurement, but the one shown in plate 1, figure 5 has the umbilicus 37% at a diameter of 4.1 cm., and the specimen from locality 10 (pl. 2, figs. 3, 4) has the umbilicus about 40% and thickness 26%, but is distorted. The inner whorls have about 35 primary ribs to the whorl, but on the last whorl the primaries become more widely-spaced, as shown by the holotype. Constrictions are present and irregularly spaced. The suture-line is shown in text-figure 3c.

The species is distinguished from *L. parvus* by the less numerous ribs, thicker whorls and larger size. *Laugeites groenlandicus* has similar proportions and rib-frequency to *L. intermedius*, but has a smooth body-chamber and is more than twice the size.

The body chamber of *Laugeites intermedius* shows a close resemblance to that of *Subcraspedites preplicomphalus* SWINNERTON from the Spilsby Sandstone of England. The holotype of SWINNERTON's species is refigured here (pl. 1, fig. 3) for comparison.

Occurrence: Holotype and six incomplete specimens from locality 2, Kuhn Ø. Body-chamber (pl. 2, figs. 3, 4) from locality 10. A fairly complete example, five fragments and two impressions from locality 11. A possible fragment from the north-east flank of the Niesen, Wollaston Forland, at an altitude of 90 m in banded beds; the same level as *L. ?parvus* recorded on page 11.

Laugeites jamesoni sp. nov.

Pl. 2, fig. 1.

1936. *Pectinatites* sp. ind. SPATH, pp. 83, 175, pl. 37, figs. 1 a, b, (holotype), 3.
?1936. *Pectinatites? (Keratinites?)* sp. ind. SPATH, pp. 83, 175, pl. 36, fig. 2, pl. 38, fig. 2.

Type: The ammonite from a loose block in Aucellaelv, southern Jameson Land, figured by SPATH (1936, pl. 37, figs. 1a, b) is now made the holotype of the new species, *Laugeites jamesoni*. The original of figure 3 on the same plate is regarded as a paratype.

Description: The holotype, consisting of parts of three successive whorls, is still septate at its full size of 13 cm. At this size the umbilicus is 44 %. Apart from the slight difference in proportions, the species is distinguished from *L. groenlandicus* by closer and longer primaries, lack of forward curve of the secondaries over the venter, and the presence of thickened ribs and constrictions at irregular intervals.

Occurrence: The species has been found at locality 4, Laugeites Ravine, in Kuhn Ø. The most complete example (pl. 2, fig. 1) is complete with plain aperture (preserved on the side not photographed) at a diameter of 12.5 cm (slightly distorted). There is a possible fragment from locality 5.

Laugeites parvus sp. nov.

Pl. 2, fig. 2; pl. 3. figs. 1-10; pl. 8, fig. 6.

(?) 1947. *Subcraspedites* (?) sp. nov. (?). SPATH, p. 27, pl. 4, figs. 1 a, b.
1952. *Laugeites* sp. nov. SPATH, p. 19, pl. 4, fig. 4.

Types: The holotype is an example from locality 10, Laugeites Ravine, Kuhn Ø, figured in plate 3, figure 2. There are a number of paratypes from this and neighbouring localities (listed below).

Complete examples are between 6 and 7.5 cm in diameter, and the adult umbilicus is 38 to 40 % of the diameter. The outer whorls are strongly compressed; the thickness is very approximately 20 % of the diameter, but most examples are distorted and cannot be measured. Each whorl overlaps half, or a little more, of the preceding one. The inner whorls are not adequately known, but have close, sharp primary ribs, which lean forwards, and divide into two, or more rarely three, secondaries half-way across the whorl-side. The secondaries are slightly concave forwards, and have a strong forward curve over the venter. At a variable diameter, often between 4 and 5 cm, the ornament fades out on the middle of the whorl-side, leaving a smooth band between primaries and secondaries, which become very faint. There are faint

constrictions, accompanied by flares on the internal mould. The septal suture cannot be seen on any of the specimens.

Although septal sutures are not visible, the majority of specimens are believed to be adults on account of 1) the constancy in size of examples complete with body-chamber, 2) the loss of ornament on the last whorl, 3) the preservation of a flared aperture on a few specimens (e.g. pl. 3, figs. 4, 5). There is variation amongst the body-chambers from those retaining well-marked primary and secondary ribs, to ones which are completely smooth. Flares and constrictions are also variable in their occurrence, but are seldom closer than two per whorl. Crushing of the septate whorls but not of the body-chamber shows that the latter was one whorl in length.

The ammonite figured by SPATH (1947, pl. 4, figs. 1a, b), now tentatively referred to the species, is from one of the *Hectoroceras* localities in south-western Jameson Land. It is too poorly preserved to be definitely identified. The other material figured as *Subcraspedites* by SPATH (1947, pl. 1, fig. 6; pl. 4, figs. 2, 11–14) consists of inadequate fragments or inner whorls.

Laugeites parvus differs from other species of the genus by its small size and compressed whorls. There is considerable resemblance to *Subcraspedites preplicomphalus* SWINNERTON (1935, p. 36, pl. 3, figs. 1a, b, 2a, b) from the lower part of the Spilsby Sandstone of Lincolnshire, England. Inner whorls of the two species appear to be indistinguishable; on the last half-whorl (presumed body-chamber) of *S. preplicomphalus* primary ribs become more prominent than in *L. parvus*, but they do not acquire the pinched-up appearance of typical *Subcraspedites*. Morphologically, *S. preplicomphalus* is intermediate between *Laugeites* and *Subcraspedites*, and might equally well be referred to the former genus. The holotype has been newly photographed through the kindness of Dr. M. K. HOWARTH, and is now illustrated (pl. 1, fig. 3) for comparison with the Greenland material; unfortunately the preservation is indifferent. Another interesting comparison is with *S. (?) subpressulus* (BOGOSLOVSKY, 1897, p. 142, pl. 4, figs. 3, 4; two of the types refigured by LUPPOV & DRUSHCHITZ, 1958, pl. 39, figs. 6, 7), described from the Riasan Beds of Tsikvino on the river Oka south-east of Moscow, and *S. primitivus* recorded from the Spilsby Sandstone of Lincolnshire by SWINNERTON (1935, p. 32, pl. 2, figs. 1a–c). The holotype is now refigured in plate 8, figures 3, 4. The septate whorls of this species are almost indistinguishable from *L. parvus* as far as ornament is concerned, but the umbilicus is smaller, about 25% of the diameter. Neither British nor figured Russian material includes the body-chamber, and it is not known whether *subpressulus* developed subcraspeditid characters on the

outer whorls. The septate whorls would pass for *Laugeites;* SPATH (1947, p. 28) doubted the attribution of "*S. primitivus*" to *Subcraspedites* and thought it "probably a form of *Tollia*", although typical *Tollia* have a smaller umbilicus and coarser ribbing. The species is morphologically intermediate between *Subcraspedites* (or *Laugeites*) and *Tollia.*

It is possible that all *Subcraspedites* have more or less laugeitid inner whorls, but much of the Spilsby Sandstone material is too poorly preserved for a thorough investigation. Specimens which show laugeitid inner whorls followed by subcraspeditid body-chamber are the holotype of *S. undulatus* SWINNERTON (1935, pl. 2, figs. 3a–c) and that of the closely similar *S. subundulatus* SWINNERTON (1935, pl. 2, figs. 2a, b), refigured here in plate 8, figures 1, 2.

Occurrence: The holotype and numerous specimens, fragments and impressions from locality 10, Laugeites Ravine, Kuhn Ø, where it is the commonest ammonite. Seven examples and fragments from locality 9, in the same valley, including plate 3, figures 1, 8. Two incomplete examples from locality 11.

Two whorl fragments (no. 788) given to Dr. EIGIL NIELSEN by a trapper in 1933 are said to have been found on Hochstetter Forland. If they really come from there, then Berriasian rocks of facies identical with that of western Kuhn Ø must exist on Hochstetter Forland, for the lithology and mode of preservation is very similar to that of the Kuhn Ø material.

Two impressions of this or a similar form were collected by the writer from a sandstone bed in banded beds at an altitude of 90 m on the north-eastern flank of the Niesen, northern Wollaston Forland.

Laugeites sp. nov.

Pl. 4, figs. 1, 2.

A species of *Laugeites* with almost smooth body-chamber is represented by a number of fragments all partly crushed. The inner whorls are unknown, and the species has not been named. An almost complete body-chamber is shown in pl. 4, fig. 2. It is an internal mould 13.5 cm in diameter and is smooth except for a rib, preceded by a constriction, about half-way round. The umbilicus is about 40 % of the diameter. Another body-chamber is complete with aperture at 10.8 cm, the umbilicus being 43 %. This and other fragments show that the aperture was slightly expanded, forwardly inclined towards the venter and with a ventral rostrum. There were no lateral lappets.

Occurrence: Five body-chambers or parts thereof, from locality 10, Laugeites Ravine, Kuhn Ø.

Perisphinctidae of 'pavlovid' type

Associated with abundant *Laugeites* in western Kuhn Ø (p. 13) are much rarer fragments of evolute, perisphinctid-type ammonites with sharp, usually bifurcating ribs of the kind exemplified by the outer whorls of the Upper Kimeridgian ammonite *Pavlovia* and its presumed descendants in the Portlandian. No complete individuals were found and all that can be done is to figure a few fragments to show the kinds of ammonite present.

The fragment from locality 7 shown in plate 5, figure 1, is distinguished by the presence of as many simple ribs as bifurcating ones. This character is suggestive of the Russian Lower Volgian genus *Acuticostites;* that genus has a sulcate venter on the inner whorls, a character which cannot be checked on the Kuhn Ø fragment.

Forms with more or less regularly bifurcating ribs occur at localities 1, 2, 4, 5, 10 and 11. They are all poorly preserved. They are hardly distinguishable from forms figured by SPATH from Milne Land as *Crendonites;* for example, the impression here figured (pl. 5, fig. 3) seems close to *C. lesliei* SPATH (1936, pl. 13, fig. 1). There is also a close similarity to the Russian Lower Volgian genus *Epivirgatites*, of which the lectotype has recently been refigured (LUPPOV & DRUSHCHITZ 1958, pl. 37, fig. 7). ARKELL (1957, p. L 333) notes the resemblance between *Epivirgatites* and English "*Crendonites*", which he regards as a synonym of *Glaucolithites.*

The third group of fragments has more than two secondaries corresponding to each primary rib. This character occurs sporadically in forms with otherwise bifurcating ribs, such as an impression from locality 2 (pl. 5, fig. 4), and in others (pl. 5, fig. 7) it is a regular feature.

One fragmentary impression in a large block from locality 5, has ornament which corresponds exactly to that of the type species of *Virgatosphinctes.* Another can be matched exactly with large English Portlandian *Kerberites.* In two impressions from locality 7 (pl. 5, figs. 5, 6) the secondary ribs are rather faint, as they are in the type species of *Dorsoplanites.* In some fragments of this group there is tendency for the ribbing to be virgatotome, but typical virgatotome ribbing is not present.

The foregoing remarks are not intended as firm identifications, but only as an indication of the forms present. They may be summarised:

	Locality
Acuticostites?	7
Dorsoplanites?	7
Glaucolithites?	1, 2, 4, 5, 10, 11.
Virgatosphinctes?	4, 5.
trifurcating ribs:	5, 7, 8.

Family **Craspeditidae** Spath, 1924

Craspedites is an involute genus[1]), the shell ranging from globose to compressed. The umbilicus is always small (less than 20%), is conical, and deep and narrow in the inflated forms. Ornament is never strong; the inner whorls bear faint secondary ribs which arise low down on the whorl-side; primaries at this stage are inconspicuous or absent. There are also periodic constrictions. The body-chamber is smooth, or nearly so, except for the strong primaries developed in some species. In *C. nodiger* these primaries appear about half a whorl before the last septum. Most examples are complete with adult body-chambers at a small size, often less than 5 cm.

Spath, in his papers on East Greenland, has not interpreted *Craspedites* in the way defined above, and accepted *Amm. subditus* Trautschold as the type species. Pavlov when he established the genus commenced with the heading: "Craspedites (Olcostephani du groupe subditus)" but did not mention a type species, and *Amm. okensis* d'Orbigny was designated type species by H. Douvillé (1911). The fossils from Milne Land referred to *Craspedites* by Spath (1936, pp. 85–88) do not belong to the genus as now defined, and there is no reason to believe that *Craspedites* occurs in East Greenland.

In 1936 (p. 83) Spath also included in Craspeditidae the genera *Kachpurites*, *Garniericeras*, *Subcraspedites* and *Paracraspedites*. *Subcraspedites* is placed in Tollinae, as explained below. *Paracraspedites* is also excluded (see Casey 1962). *Garniericeras* was made the type genus of a subfamily Garniericeratinae by Spath (1952, p. 9); it may or may not be related to the other genera included in the same subfamily by Arkell (1957, p. L 344).

Subfamily Tollinae Spath, 1952

This subfamily is now taken to include *Tollia*, *Subcraspedites*, *Hectoroceras*, *Surites* and *Nikitinoceras*. All these genera bear sharp, perisphinctid-type ribbing on the inner whorls, primaries bifurcating about halfway across the whorl-side. They are in contrast to *Craspedites* where the ribbing is never sharp and the secondaries arise near the umbilical margin.

Differences between *Tollia* and *Subcraspedites* are of degree rather than of kind. The typical *Subcraspedites* is evolute, with finely ribbed perisphinctid inner whorls; the primary and secondary ribs then become separated by a smooth band on the whorl-side, and finally the primaries

[1]) The description of *Craspedites* is based on a study of the collection of excellently-preserved Russian material in the British Museum (Nat. Hist.); for illustrations of inner and outer whorls of *C. nodiger* see Nikitin, 1885, pl. 5, figs. 19–22.

become prominent, with a "pinched-up" appearance, while the secondaries become faint or disappear. The type species, *S. plicomphalus* (J. SOWERBY), has not been adequately illustrated, and the type is now refigured in plate 9, figure 2. The species has commonly been interpreted by a later figure (J. de C. SOWERBY, 1823, pl. 404) which SPATH (1952, p. 18) held to be different from *Am. plicomphalus* J. SOWERBY, renaming it *Subcraspedites sowerbyi*. This species is illustrated in plate 9, figure 1. CASEY believes (1962, p. 98) that it will be necessary to validate *S. sowerbyi* as the type species of *Subcraspedites* in order to preserve the current interpretation of the genus.

Subcraspedites is clearly derived from *Laugeites*, for there is no difference between the two genera except for the bullate primary ribs of the former. At least one species from the Spilsby Sandstone, *S. preplicomphalus* SWINNERTON (1935, p. 36, pl. 3, fig. 1a, b), does not have the prominent primaries, and is morphologically a *Laugeites* rather than a *Subcraspedites*.

Genus **TOLLIA** PAVLOV, 1913

The type species is *Tollia tolli* PAVLOV, designated by ARKELL, 1957, p. L 344. A number of specific names have been proposed for members of this genus; almost all are inadequately defined, and some are synonyms, as far as can be seen from the evidence available. The earliest species to be named was *Tollia payeri* (TOULA), from eastern Kuhn Ø, East Greenland (TOULA, 1874, p. 498, pl. 1, figs. 1a–c). The outcrop which yielded TOULA's type has not been found by later expeditions. In side view *T. payeri* is indistinguishable from *T. bidevexa* (BOGOSLOVSKY, 1897, p. 55, pl. 3, figs. 1–3) and from *T. tolli* PAVLOV (1913, p. 39, pl. 12, figs. 1, 2), but both these species have an acute venter, at least on the inner whorls, whereas *T. payeri*, according to TOULA's section (fig. 1c) has a broadly rounded venter throughout. *Tollia bidevexa* and *T. tolli* are probably synonyms. Species in which the ornament dies out early are *T. glaber* (NIKITIN, 1888, p. 98, pl. 2, figs. 8, 9) and *T. sosnovskii* (SOKOLOV, 1913, p. 70, pl. 2, figs. 2a–c), and possibly *T. latelobata* PAVLOV (1913, p. 41, pl. 13, fig. 2).

Tollia is a genus with perisphinctid-type ornament, involute shell and small umbilicus, commonly 20–25% of the diameter. The venter may be acute on the inner whorls, becoming rounded later in development; the change occurs at different sizes in different species. The earlier whorls have sharp ribs; later the primary ribs may become blunt and prominent, the secondaries fine and numerous and separated from the primaries by a smooth area. There is a tendency, not shown by all

specimens, for the primaries to be concave forwards, with a backward inflection where the secondaries originate, producing a very characteristic appearance. Some species, at least, show constrictions on the internal mould. The ornament persists to a size which varies greatly with the species, but the later part of the shell is smooth, or nearly so. Some individuals reached large sizes: the type of *T. latelobata* PAVLOV is still septate at a diameter of 18 cm.

The genus *Praetollia* is here considered to be a synonym of *Tollia*. SPATH (1952, p. 13) when he set up *Praetollia* said that *Tollia* differed from it "chiefly in its more sigmoidal costation, with thickening of the primary stems which are also more distantly spaced, and there is an increase in the peripheral projection of the secondaries". He also (p. 14) noted the absence of constrictions which he regarded as characteristic of *Tollia*. In fact, the ornament of most of the examples of *Praetollia maynci*, the type species, is like that of the inner whorls of *Tollia* and we do not know whether the specimens were adults or the inner whorls of a larger species. Furthermore, a few individuals in the assemblage, regarded by SPATH as variety *contigua* (p. 14, pl. 3, fig. 1 etc.), show the ornament becoming like that of the outer whorls of *Tollia*, showing just those features which SPATH regarded as typical of the latter genus.

The genus *Chandomirovia* SAZONOV 1951 was regarded as a possible synonym of *Tollia* by LUPPOV & DRUSHCHITZ (1958, p. 93).

Tollia bidevexa (BOGOSLOVSKY)

Pl. 6, fig. 4.

1897. *Olcostephanus bidevexus* BOGOSLOVSKY, pp. 55, 141, pl. 3, figs. 1 a, b, 2 a, b, 3, 4.

?1913. *Tollia Tolli* PAVLOV p. 39, pl. 12, figs. 1 a, b, 2 a–c. (Lectotype: the original of fig. 1, here designated).

Type: The original of BOGOSLOVSKY's plate 3, figure 3 is now designated lectotype of the species.

BOGOSLOVSKY's figures show four fragmentary specimens of different sizes, which probably belong to the same species, although the smallest (figs. 1 a, b) is closer-ribbed than the others. Figure 4 is said to represent a variety but agrees with figures 2 and 3. The fragments are closely similar to the two syntypes of *Tollia tolli* figured by PAVLOV, of which the larger (PAVLOV, 1913, pl. 12, fig. 1 a, b) is now designated the lectotype. *T. bidevexa* has ribbing persisting to a diameter (about 9 cm) at which, on the lectotype of *T. tolli*, it has just died out, but this character is likely to be variable. It is likely that *T. tolli* and *T. bidevexa*

are synonyms, although study of actual material is desirable to settle the question.

The material from Milne Land consists solely of impressions of the umbilical portions of ammonites which agree with the figure of *T. bidevexa* and also of *T. tolli*. A cast made from the best of the impressions is shown in plate 6, figure 4. For the distinction between *T. bidevexa* and *T. groenlandica*, see under the latter species.

Material: two impressions from ferruginous fossil beds on Hennigryggen; two from pale blue–grey sandstone at altitude 440 m, on the ridge between Astartedal and Pinnadal; both occurrences in eastern Milne Land.

Tollia groenlandica (SPATH)

Pl. 6, figs. 1-3.

1936. *Subcraspedites groenlandicus* SPATH, p. 84, pl. 36, figs. 3 a, b, 4, 5, pl. 38, figs. 3, 4, 5 a, b.

Type: The holotype is the example figured by SPATH (1936, pl. 36, figs. 3a, b), preserved in the Mineralogical Museum, Copenhagen.

Description: All the material of the species is poor, consisting of impressions and fragments, but the typical features are clear enough, although no dimensions or accurate rib-counts can be given. The inner whorls are close-ribbed, with usually three secondary ribs to each primary. Later, while the shell is still septate, the primaries become separated from the secondaries by a smooth band, the secondaries now being very fine and numerous, four or five to each primary. The venter is acute from a diameter of 2 cm or less, and remains so, in some examples, to a size of 10 cm or more. This character is variable, and the holotype represents a form with less acute venter than the majority of specimens.

Tollia groenlandica is a small species compared with some in the genus. The holotype is the body-chamber of an individual which cannot have been much greater than 9 cm in diameter when complete. The impression shown in plate 6, figure 2 and an example from Hennigryggen retaining most of the body-chamber are about 12 cm in diameter. *T. bidevexa* (p. 27), the other species recorded from Milne Land, was larger; the holotype is a whorl fragment still septate at a size of 9–10 cm. The two species also differ in their ornament, which in *T. bidevexa* is stronger, with fewer secondaries, and persists to a larger size than in *T. groenlandica*.

The inner whorls of *Tollia sosnovskii* (SOKOLOV, 1913, p. 70, pl. 2, figs. 2a–c), from a loose block in Novaya Zemlya, are indistinguishable from those of *T. groenlandica*. *Tollia sosnovskii* appears to become smooth at a diameter of about 4 cm. *Tollia groenlandica* was described

by SPATH as a *Subcraspedites* but is a typical *Tollia* as already noted by CASEY (1962, p. 98). It is not clear on what basis SPATH made the distinction between the two genera.

Material: A complete but poorly preserved example, and four probable impressions of inner whorls, from the ferruginous fossil bed near the summit of Hennigryggen; also from here the fragment shown in plate 6, figure 3. Fragments and impressions from greenish-grey sandstone at 425 m altitude on ridge between Krebsedal and Astartedal, and at 440 m on ridge between Astartedal and Pinnadal. All localities in eastern Milne Land.

Tollia maynci (SPATH)

1952. *Praetollia maynci* SPATH, p. 13, pl. 1, pl. 2, pl. 3, fig. 1–5, pl. 4, fig. 2, 6, 7, text-fig. 1 a.
1952. *Praetollia aberrans* SPATH, p. 15, pl. 3, fig. 7, text-fig. 1 b.

Type: The impression from which was taken the plaster cast figured by SPATH in his plate 3, figure 2, and described as "typical example", is accepted as the holotype.

The species was described and figured by SPATH on the basis of numerous crushed individuals collected by MAYNC "from the North Coast of Wollaston Forland in Lindemans Fjord at 235 m altitude." The present writer has found the species up to an altitude of 367 m on the northern flank of the Niesen, that is, probably near to MAYNC's locality. The new material does not add anything to our knowledge of the species.

Material: Found by Mr. A. J. STANDRING at altitudes of 256 m (not in place) and 360 m, and by the writer at 363–7 m on the northern flank of the Niesen, northern Wollaston Forland.

Tollia payeri (TOULA)

1874. *Perisphinctes Payeri* TOULA, p. 498, pl. 1, figs. 1 a–c.
1952. *Tollia payeri* (TOULA). SPATH, pl. 4, fig. 8.

Type: The holotype is part of an ammonite found by PAYER on the east coast of Kuhn Ø (the locality has not been rediscovered) and figured by TOULA.

The holotype is uncrushed and parts of the last three whorls are missing, so that features of the inner whorls and whorl-section may be seen. The earliest whorl seen, at a diameter of about 2.3 cm, has an acute venter, but by a diameter of about 3.2 cm the venter has become rounded. The umbilicus is about 27 % of the estimated diameter of 9.5 cm; the whorl thickness is about 35 %. The last half-whorl has ten primary ribs and there are about five secondaries to each primary.

SPATH (1952, pl. 4, fig. 8) figured as *Tollia payeri* the inner whorls of an ammonite found by MAYNC at an altitude of 380 m on the Niesen. Larger examples of the same form have been found by the writer at an altitude recorded as 365 m and one is here figured in plate 6, figure 5. This form differs from the type of *T. payeri* in having closer primary ribs.

The differences between *Tollia payeri* and *T. maynci* (SPATH) lie in the proportions and the ornament. *Tollia maynci* has an umbilicus about 18–20 % of the diameter, at least up to sizes of about 8 cm (SPATH, 1952, p. 14), while the type of *Tollia payeri* has an umbilicus about 27 % of the diameter in both the inner and outer whorls. At a diameter of 8 cm *T. maynci* still has the close-spaced primary ribs which characterise the inner whorls of both species; they bifurcate with an occasional intercalated secondary. SPATH's *T. maynci* var. *contigua* (1952, p. 14, pl. 2, fig. 1, pl. 3, fig. 1, pl. 4, fig. 2), however, becomes more like *T. payeri* in ornament, with wider-spaced primaries and bunched secondaries, though the umbilicus remains small.

Material: Found on the Niesen only. Small examples which may belong to the species found by the writer at 305 m and by STANDRING from the same horizon, recorded as 322 m. Typical impressions of larger individuals, and a close-ribbed form, from 360–370 m.

Genus **SURITES** SAZONOV, 1951

Type species: *Surites pechorensis* SAZONOV 1951, by original designation.

LUPPOV and DRUSHCHITZ (1958, p. 92) regarded the genus as a synonym of *Paracraspedites* SWINNERTON 1935, but CASEY (1962, pp. 97–98) has upheld it and pointed out that *Paracraspedites* is a Jurassic, and *Surites* a Cretaceous genus. CASEY included in *Surites*, besides the type species, *S. kozakowianus* (BOGOSLOVSKY), *S. spasskensis* (NIKITIN), *S. suprasubditus* (BOGOSLOVSKY) and *S. tzikwinianus* (BOGOSLOVSKY). Typical *Surites* show a forward curve of the ribs over the venter, and a shortening of the primary ribs on the outer whorls.

Surites spasskensis (NIKITIN)

Text-fig. 3 a, b.

1881. *Olcostephanus spasskensis* NIKITIN, p. 65, pl. 1, fig. 9–11.
1897. *Olcostephanus spasskensis* NIKITIN. BOGOSLOVSKY, p. 141, pl. 2, figs. 1 a, b.

Type: The example figured by NIKITIN is accepted as the holotype of the species.

The genus and species is represented in East Greenland by two

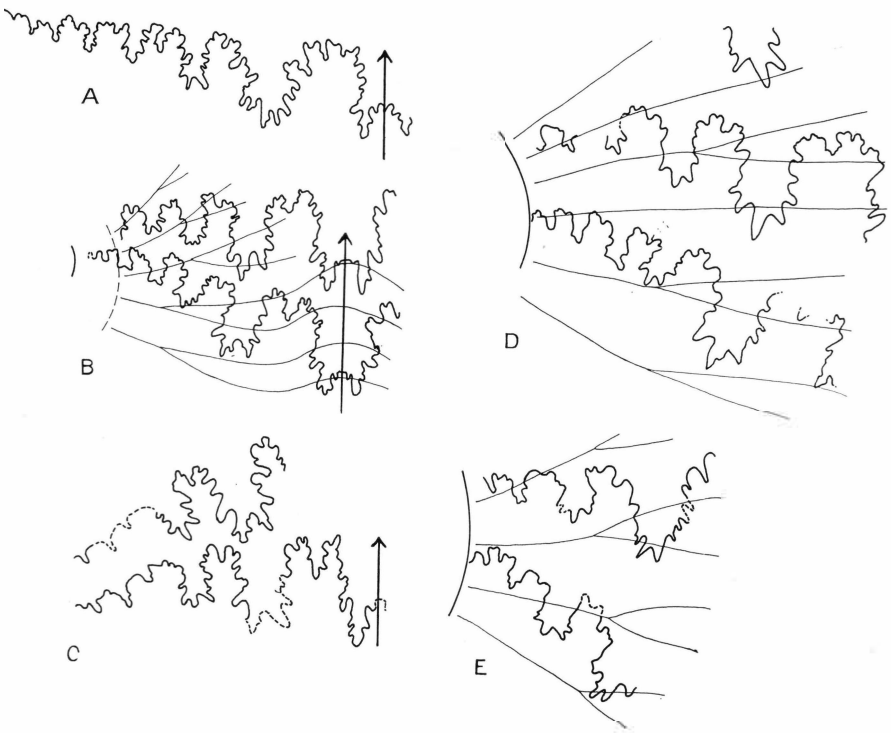

Fig 3. Suture lines of: A, *Surites spasskensis* (NIKITIN), approximately x 2. Copied from the type figure (NIKITIN, 1888, pl. 1, fig. 11). B, *Surites spasskensis* (NIKITIN), from the Lower Niesen Beds, altitude 285 m (?), north side of the Niesen, Wollaston Forland, at a diameter of about 3.0 cm; x 2.4. C, *Laugeites intermedius* sp. nov. from the Laugeites Beds, locality 2, western Kuhn Ø, at a diameter of 3.8 cm, x 2.1. D, '*Surites*' sp., from the Lower Niesen Beds, altitude 320 m, north side of the Niesen, Wollaston Forland, at a diameter of 4.5 cm, x 2.7; see plate 7, fig. 3. E, '*Surites*' sp., same horizon and locality as D, at a diameter of 4.0 cm, x 2.5; see plate 7, fig. 5.

fragmentary examples from the Niesen. One of these has well-preserved suture–lines which are shown in text figure 3 B.

Occurrence: Collected on the Niesen by A. J. STANDRING in fine-grained calcareous matrix at an uncertain altitude, probably 285 m., and in coarse sandstone at 320 m.

Surites tzikwinianus (BOGOSLOVSKY)

Pl. 7, fig. 1.

1897. *Olcostephanus tzikwinianus* BOGOSLOVSKY, pp. 59, 141, pl. 2, figs. 6 a–d.

BOGOSLOVSKY pointed out that *S. tzikwinianus* is close to his *bidevexa* (see p. 27), being distinguished from it by the whorl-section and

proportions. Only one example, 7.9 cm in diameter, was figured by BOGOSLOVSKY. On the first half of the last whorl the primaries bifurcate regularly but thereafter some extra secondaries appear and their connection with the primaries is less definite. The secondaries curve strongly forwards over the venter.

Material: Found by the writer at altitude 305 m on the north-eastern spur of the Niesen, northern Wollaston Forland.

'Surites' sp. ind.

Pl. 7, figs. 2-5, text–fig. 3 D, E.

A group of ammonites from the Lower Niesen Beds resemble *Surites* in their general proportions and strong, sharp ribbing, but differ from typical members of the genus in that the ribs pass nearly straight over the venter, and there is no shortening of the primary ribs. The latter difference may be apparent rather than real, and due to the fact that the outer whorls, where shortening occurs in *Surites*, are not preserved.

A selection of specimens from the Niesen is illustrated in plate 7, figures 2–5. All are somewhat distorted, so that the whorl-section is unknown. The umbilicus is around 30% of the diameter. Except for the smaller umbilicus and greater overlap of the whorls, there is a strong resemblance to Upper Jurassic genera such as *Pavlovia* and *Acuticostites*. Suture-lines have been exposed on two specimens and are shown in text-figure 3. The more complete (3 D) shows, dorsal to the first external saddle[1]), five saddles diminishing regularly in size and rising towards the umbilical margin so that a line joining their tips or bases is oblique to the ribbing. It shows close resemblance to *Surites spasskensis*.

Occurrence: All examples are from the Niesen in northern Wollaston Forland. The genus occurs in a horizon of doggers at about 305–320 m, again in similar preservation at 360–370 m.

[1]) Terminology of suture-line as in the *Treatise:* ARKELL *et al.* 1957, p. L 196.

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Færdig fra trykkeriet den 25. maj 1964.

PLATES

Plate I.

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Figs. 1, 2, 4, 5. *Laugeites intermedius* sp. nov. Jurassic: Laugeites Beds, locality 2, western Kuhn Ø. 1, Holotype. 2, 4, 5, paratypes 20

Fig. 3. *Subcraspedites* (*?Laugeites*) *preplicomphalus* SWINNERTON. Holotype, x 0.9. British Museum (Nat. Hist.) no. 36364. From the lowest six feet of the Spilsby Sandstone, Partney, Lincolnshire, England 20,22


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Plate II.

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Fig. 1. *Laugeites jamesoni* sp. nov. Jurassic: Laugeites Beds, locality 4, western Kuhn Ø 21

Fig. 2. *Laugeites parvus* sp. nov. Paratype. Jurassic: Laugeites Beds, locality 10, western Kuhn Ø 21

Figs. 3, 4. *Laugeites intermedius* sp. nov. Jurassic: Laugeites Beds, locality 10, western Kuhn Ø 20

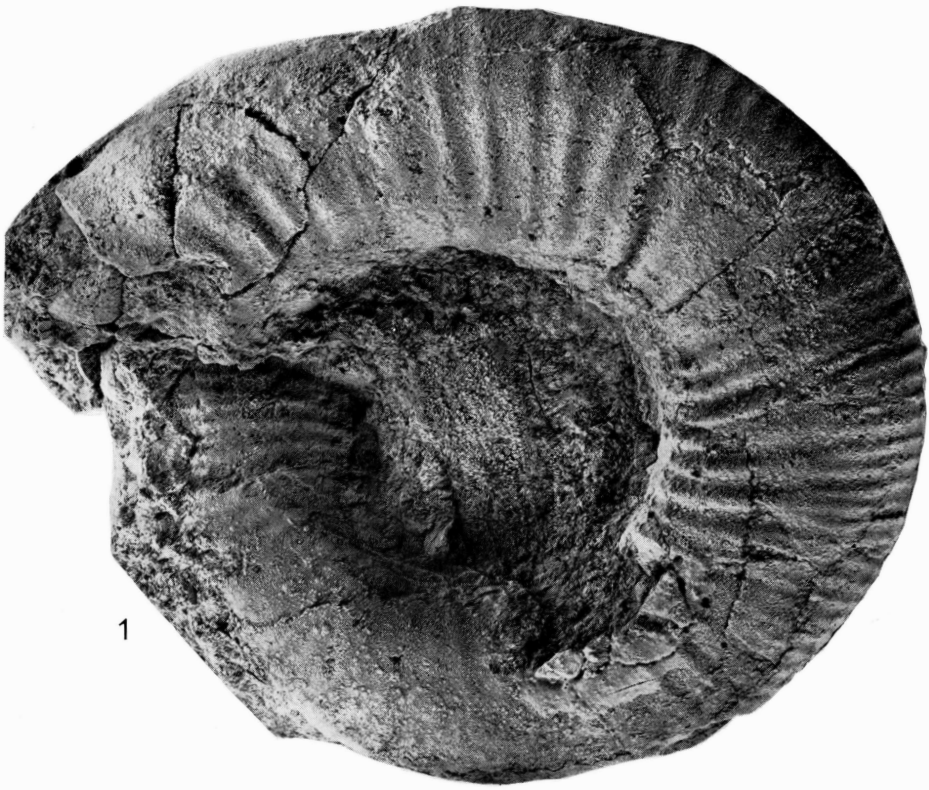

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Plate III.

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Figs. 1—10. *Laugeites parvus* sp. nov. Jurassic: Laugeites Beds, western Kuhn Ø. 2, Holotype from locality 10. Others, paratypes: 1, body-chamber from locality 9; 3, 6, 7, casts from natural moulds, locality 10; 4, 5, ventral and side views of aperture, locality 10; 8, nearly complete example from locality 9; 9, 10, nearly complete example from locality 10 21


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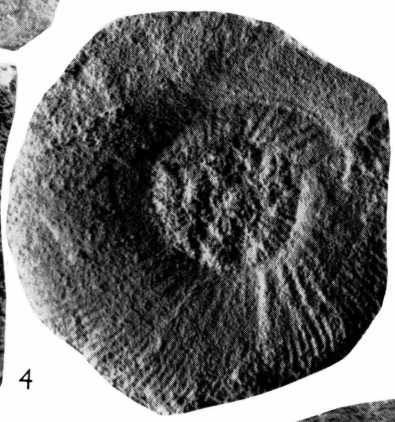
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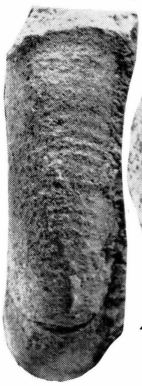
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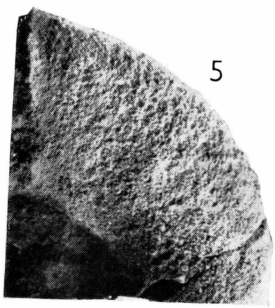
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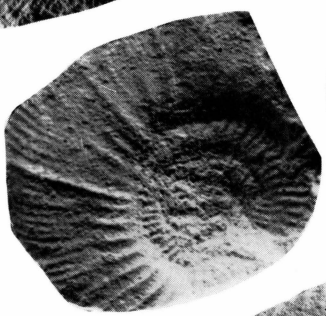
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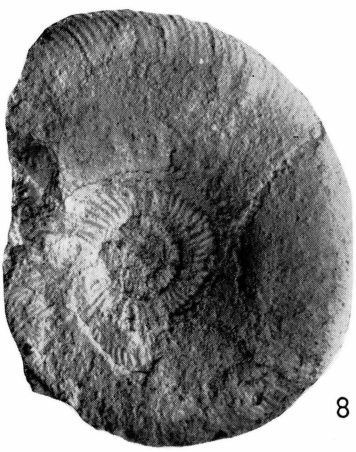
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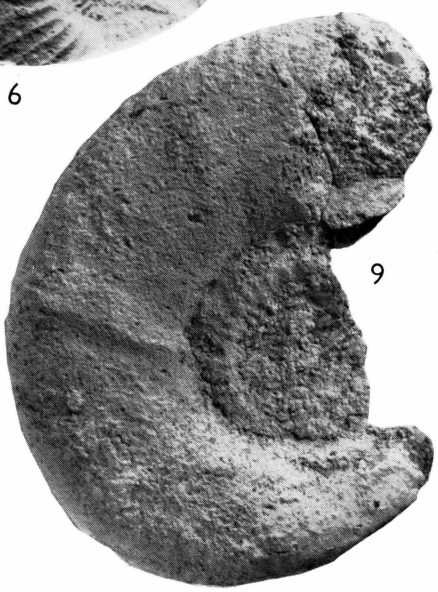
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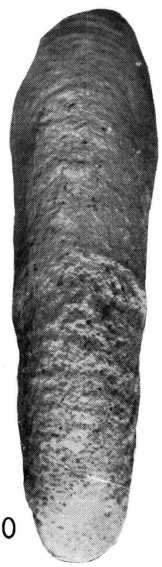
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Plate IV.

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Plate V.

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Figs. 5, 6. *?Dorsoplanites* sp. Jurassic: Laugeites Beds, locality 7, western Kuhn Ø 24

Fig. 7. *?Virgatosphinctes* sp. Jurassic: Laugeites Beds, locality 4, western Kuhn Ø 24

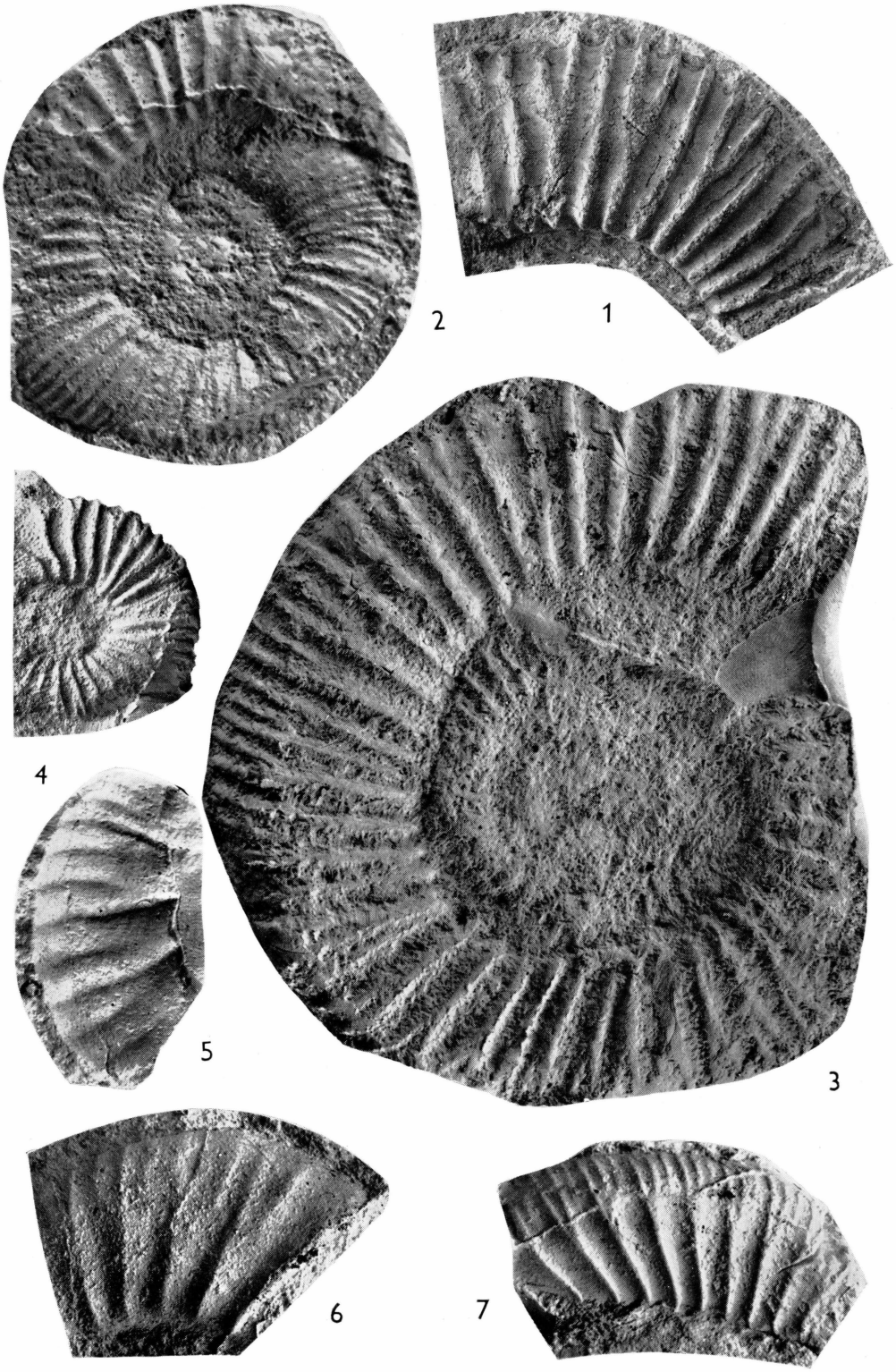
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Plate VI.

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Figs. 1—3. *Tollia groenlandica* (Spath). Cretaceous: Upper Hartzfjæld Sandstone of eastern Milne Land. 1, from an altitude of 440 m, Hartz Fjeld; 2, plaster cast from a natural mould, altitude of 425 m, Hartz Fjeld; 3, impression from a natural mould, Hennigryggen 28

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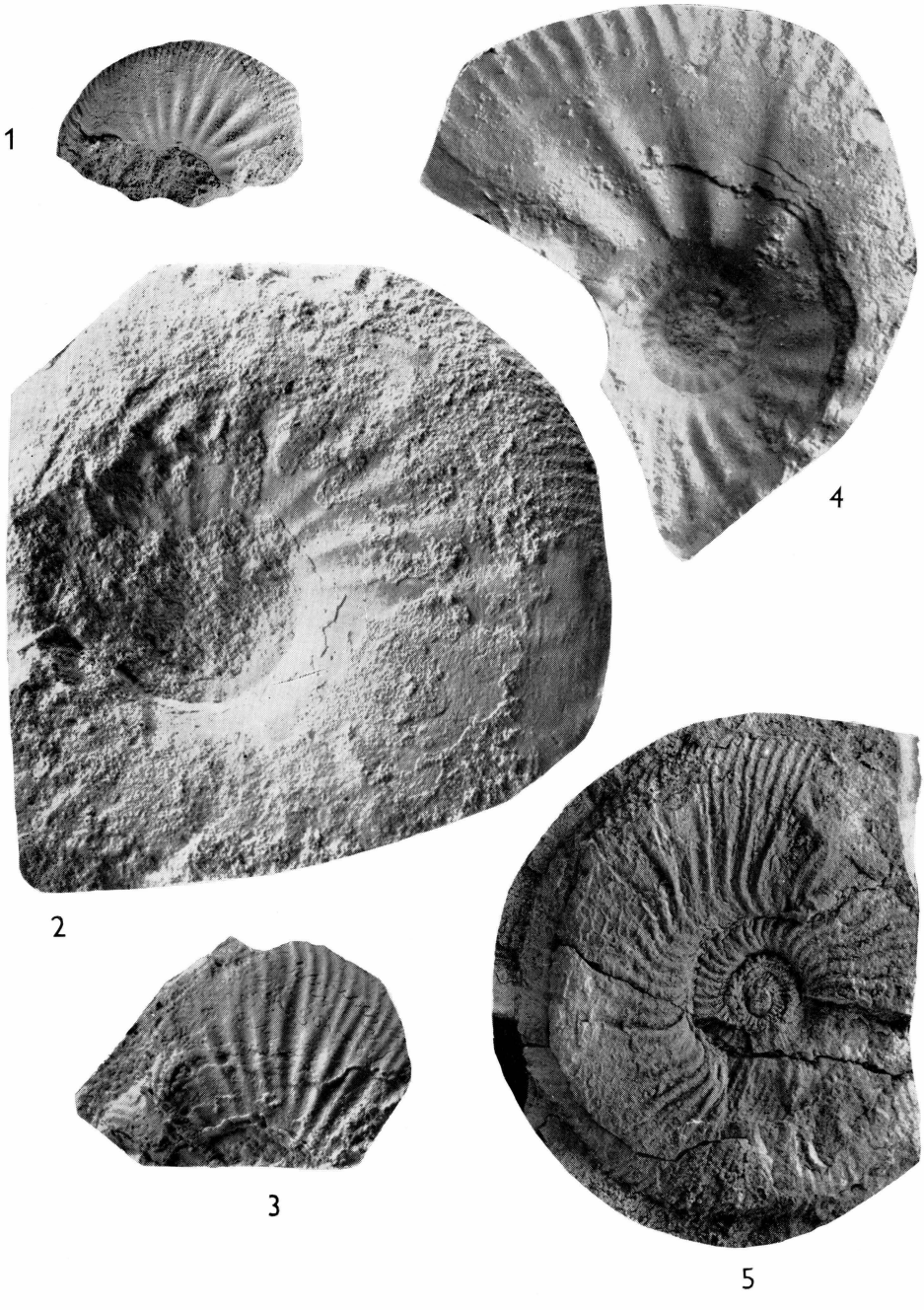
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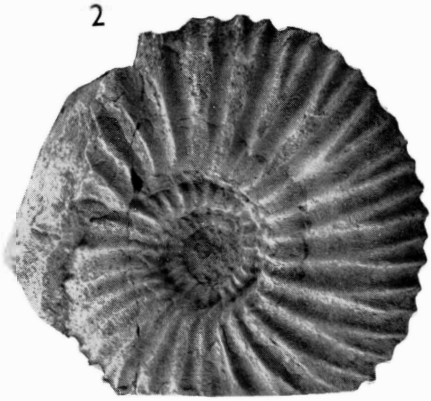

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Plate VIII.

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Figs. 1, 2. *Subcraspedites subundulatus* SWINNERTON. Holotype, British Museum (Nat. Hist.) no. C36357, SWINNERTON coll. 1, x 0.85. 2, approx. nat. size. From the base of the Spilsby Sandstone, bed D, Fordington Boring, Lincs., England 23

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Fig. 5. *Laugeites intermedius* sp. nov. Jurassic: Laugeites Beds, locality 11, western Kuhn Ø 20

Fig. 6. *Laugeites parvus* sp. nov. Jurassic: Laugeites Beds, locality 10, western Kuhn Ø 21

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Plate IX.

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Fig. 1. *Subcraspedites sowerbyi* SPATH. Spilsby Sandstone, road cutting $^3/_4$ mile north of Spilsby, Lincolnshire, England: British Museum (Nat. Hist.) no. C49964, SWINNERTON coll. 26

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