

Biochronology of the marine boreal latest Jurassic, Berriasian and Valanginian in Canada

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Marine rocks with boreal faunas of latest Jurassic to Valanginian age occur in the Sverdrup Basin, the Porcupine Plateau—Richardson Mountain Trough, and adjacent parts of the Arctic Coastal Plain. Among macroinvertebrates, only *Buchia* species and ammonites are of value for zonal subdivision. One *Buchia* zone is recognised in the uppermost Volgian and two in each of the Berriasian and Valanginian stages. *Buchia* species are used for internal correlation while ammonites, although irregularly and sparsely distributed, are the principal means of correlation with other parts of the world. One new ammonite species, *Praetollia antiqua*, is described and figured.

Marine Sedimente mit borealen Faunen von Spätjura- bis Valangin-Alter gibt es im Sverdrup-Becken, in dem Porcupine Plateau—Richardson Mountain—Trog und in den benachbarten Gebieten der arktischen Küstenebene Kanadas. Von den Makroinvertebraten eignen sich nur *Buchia*- und Ammoniten-Arten für eine Zonengliederung. Eine *Buchia*-Zone wird im Ober-Wolga und je zwei werden im Berrias und Valangin unterschieden. Die *Buchia*-Arten sind für eine regional begrenzte Korrelation brauchbar. Für Vergleiche mit anderen Teilen der Welt müssen die selteneren und unregelmäßig verbreiteten Ammoniten herangezogen werden. Eine neue Ammoniten-Art, *Praetollia antiqua* wird beschrieben und abgebildet.

Des roches d'origine marine et à faune boréale d'âge jurassique terminal à valanginien se rencontrent dans le Bassin du Sverdrup, la dépression du Plateau Porcupine et des Montagnes Richardson ainsi que dans les régions bordières de la plaine côtière arctique. Parmi les Invertébrés, seules les espèces du genre *Buchia* et les Ammonites jouent un rôle dans la subdivision zonale. Une zone à *Buchia* est reconnue dans le Volgien terminal et deux dans chacun des étages Berriasien et Valanginien. Les espèces du genre *Buchia* sont utilisées pour les corrélations locales, tandis que les Ammonites, en dépit de leur distribution irrégulière et peu abondante, sont les principaux éléments des corrélations sur le plan universel. Une nouvelle espèce d'Ammonite *Praetollia antiqua* est décrite et figurée.

1. Introduction

This paper attempts to summarise and to bring up to date the information now available about the zonal sequence, internal correlation and external correlation of the marine boreal latest Jurassic, Berriasian and Valanginian rocks in Canada. These rocks have received considerable attention since their first outcrop areas were discovered in the eastern Richardson Mountains and the northwestern part of the Canadian Arctic Archipelago during the early nineteen-fifties. Published information is synthesised in several regional papers (Gabrielse 1957; Heywood 1957; Jeletzky 1958-Jeletzky 1972; Plauchut 1971; Tozer 1956, 1960; Tozer *in* Thorsteinsson and Tozer 1970; Tozer and Thorsteinsson 1964) but much remains unpublished. Because of the rapid accumulation of new information the writer's publications are already outdated and, for the same reason, this paper should be regarded as a progress report only.

Many of the diagnostic elements of the Canadian boreal marine faunas discussed in this paper have already been briefly described and/or figured (Jeletzky 1964,

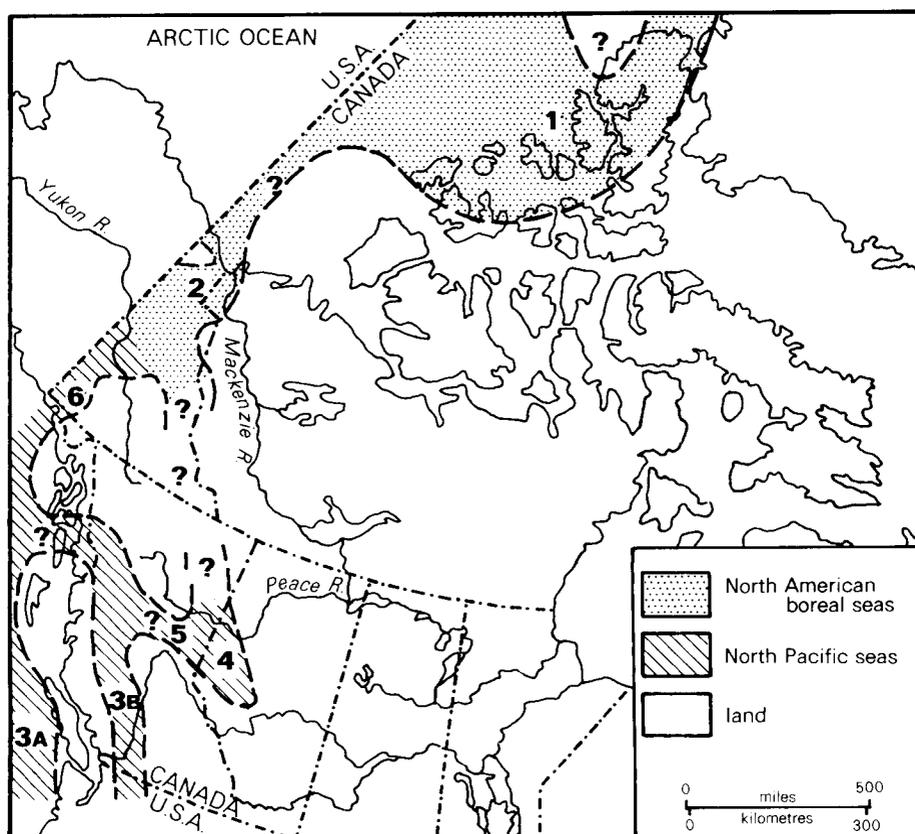


Fig. 1. Latest Jurassic, Berriasian and Valanginian biotic provinces and palaeogeography of western and Arctic Canada.

1 Sverdrup Basin; 2 Porcupine Plateau—Richardson Mountain Trough; 3A Insular Trough; 3B Tyaughton Trough; 4 Peace River Basin; 5 Vanderhoof Seaway; 6 Dawson City Strait.

1965a, 1965b, 1970) while others have received only passing mention. In order to document the presence of these important faunas some of the diagnostic ammonites are described and illustrated in the palaeontological appendix to this paper.

The term "external correlation" is applied to the correlation of the Berriasian and Valanginian rocks of the report area with occurrences elsewhere in Canada and abroad. The ultimate objective of the external correlation attempted in this paper is to recognise the approximate positions of the international standard stages (based on the West European fossil-zones) in the Canadian boreal sequence. The correlation of this sequence with the standard zones and regional stages used in the central part of the Russian Platform and in Northern Siberia will be discussed in detail because it is an indispensable step toward the ultimate goal. Other important early Lower Cretaceous outcrop areas will be considered where necessary. The term "internal correlation" is applied to the correlation of individual outcrop areas and sections situated within the report area and to the working out of a regional zonal sequence applicable to the Canadian boreal succession (see Fig. 2).

2. Palaeogeographical and palaeobiotic setting

The faunas of the Canadian boreal early Lower Cretaceous rocks form part of a separate biotic province (Jeletzky 1970, 1971a, 1971c) named the North American Province of the Boreal Realm (Jeletzky 1970). This province was named Chukotian-Canadian biotic Province by Saks *et al.* (1971). In latest Jurassic, Berriasian and Valanginian time the Canadian part of the province was restricted to parts of the Canadian Arctic Archipelago and parts of the Yukon and Mackenzie District of the Northwest Territories (Fig. 1).

The Western Cordillera of Canada and the Peace River region formed part of the North Pacific Province of the Tethyan Realm at this time (Jeletzky 1970, 1971a, 1971c; Fig. 1 here); they are consequently beyond the scope of this paper except for the purposes of external correlation. They were connected with the Canadian boreal seas by the Vanderhoof and Dawson City seaways (Fig. 1).

The palaeozoogeographical interpretation of early Lower Cretaceous rocks of the Peace River region may be subject to revision in the light of a still unfinished study of their lithofacies (Dr. D. F. Stott, unpublished data).

3. Biochronologically useful macrofossils

Like the rest of the marine Cretaceous faunas of the Canadian part of the North American Boreal Province, the faunas of the Berriasian and Valanginian stages (and of the latest Jurassic) differ markedly from those of other provinces of the Boreal Realm (climatic belt). They are characterised (Jeletzky 1970, 1971a, 1971c; Saks *et al.* 1971) by a lack of diversity in comparison with the coeval faunas of the North Atlantic and North Siberian (= Arctic Province of Saks, Mesezhnikov and Shulgina 1964) Provinces. Because of this extreme impoverishment only a few groups of marine macroinvertebrates have a practical biochronological use.

Ammonites occur only sporadically and are often extremely rare or absent. They belong almost exclusively to the subfamilies Craspeditinae (inclusive of Tollinae) and Polyptychitinae and are common only in parts of the Canadian Arctic Archipelago succession. Even in that region, characterised by the prevalence of the

deeper water, outer neritic, concretionary shales of the Deer Bay Formation, considerable parts of the sequence are all but devoid of ammonites. On the whole, ammonites are considerably more useful for the purpose of external rather than internal correlation and are commonly used only to assess the time ranges of other much more numerous but less reliable index-fossils (mainly *Buchia* species) as well as to effect the approximate correlation of the regional zones with the standard ammonite zones of other regions and the international standard stages.

Within the Canadian boreal region, more-or-less short-ranging and facies-tolerant pelecypods, such as species of *Buchia*, *Inoceramus* and *Meleagrinnella* (apparently including ?*Aucellina schmidti* Sokolov and its Canadian allies), and *Arctotis* have to be used for dating and internal correlation. Other pelecypods appear to be too long-ranging or facies-bound, or both, to be of much use, even as parachronological indices. Of the above mentioned, parachronologically and partly orthochronologically useful pelecypod taxa, *Buchia* has proved to be much superior because of its considerably greater abundance and facies tolerance coupled with its reasonably rapid evolution. Because of their extended (often intercontinental) geographical ranges and short time ranges a number of *Buchia* species were found to be valuable for external correlation.

Belemnites are rare, restricted in occurrence, and usually execrably preserved. All other macrofossil groups are too rare (Jeletzky 1970, 1971a) to be of any practical use. Hence the regional zonal table for Canada proposed herein (Figs 2, 3) is based exclusively on *Buchia* and ammonites. A number of zones are named after two fossils instead of one because of the internal usefulness of *Buchia* species contrasted with the orthochronological, external usefulness of the coeval ammonite species.

4. The Jurassic/Cretaceous boundary and the problem of regional stages

The lower boundary of the Cretaceous is placed at the base of the Berriasian stage in accordance with the now prevalent usage. The Berriasian is interpreted to include the *Berriasella grandis* Zone of the type-area, following the recommendation of the Lyon Colloquium on the Lower Cretaceous (Busnardo, Le Hégarat and Magné 1965). The value of this recommendation has been demonstrated by more recent research (Jeletzky 1968, 1971b; Sazonova 1971) which indicates that in Central Russia the equivalents of the *Berriasella grandis* Zone do not form part of the Upper Volgian stage but are represented by a hiatus between the uppermost Volgian beds (*Craspedites nodiger* Zone) and the late Berriasian Ryazan Beds. In Northern Siberia the equivalent Lower Berriasian beds appear to be represented only by the *Chetaites sibiricus* and *Hectoroceras kochi* Zones and in Canada only by the *Buchia okensis* and *Craspedites (Subcraspedites) aff. suprasubditus* Zone (see following sections for further details).

Although it represents the youngest known zone of the type Upper Volgian stage (Sazonova 1971), the *Craspedites nodiger* Zone hardly represents the topmost part of the boreal Jurassic. For reasons discussed below, it must be older than the North Siberian Zone of *Chetaites chetae* (e.g. Saks and Shulgina 1964; Saks *et al.* 1965; Saks, Mesezhnikov and Shulgina 1968a) and the *Praetollia antiqua* n. sp. beds of the Canadian Arctic Archipelago. The latter zones are tentatively correlated with the uppermost part (i.e. *Berriasella chaperi* Zone) of the *Virgatosphinctes transitorius* Zone of the European Tethys (Fig. 3).

The formidable difficulties which long stood in the way of a reasonably close correlation of the entirely Tethyan ammonite faunas of the type-areas of the Berriasian and Upper Tithonian stages (e.g. Mazenot 1939; Busnardo, Le Hégarat and Magné 1965; Le Hégarat 1965; Le Hégarat and Remane 1968) with the almost totally Boreal ammonite faunas of the type-areas of the Upper Volgian stage and the Ryazan horizon have been largely overcome recently with the aid of mixed ammonite and/or *Buchia* faunas found in the Jurassic/Cretaceous and Berriasian/Valanginian boundary beds of eastern Siberia (Shulgina 1967), the central Russian Platform (Sazonova 1971), Western British Columbia (Jeletzky 1965a, 1968, 1971b; Jeletzky and Tipper 1968), Northern California (Imlay and Jones 1970; Jones, Bailey and Imlay 1969) and the Northern Caucasus (Grigorieva 1938; Rengarten 1951).

This situation is reflected in the widespread application of the stage term Berriasian to the basal Cretaceous rocks of the Boreal Realm (e.g. Saks and Shulgina 1962, 1964; Saks, Mesezhnikov and Shulgina 1968a; Jeletzky 1964, 1968, 1970, 1971b; Gerasimov 1955; Sazonova 1958, 1971), where it often supplants regional biochronological terms such as the Infravalanginian substage (e.g. Spath 1924, 1947, 1952), the Lower Valanginian substage (e.g. Bodylevsky 1960, 1967; Voronets 1962; Kemper 1968) or the Ryazanian stage or Ryazan horizon (Bogoslovsky 1902; Sazonova 1967; Casey 1971). In the writer's opinion the progress achieved makes it possible to dispense with the regional stage nomenclature for the equivalents of the Berriasian and Valanginian stages in the Boreal Realm and to use the Tethyan stages throughout its extent. This is undertaken in this paper in the Canadian part of the North American Boreal Province.

5. Biochronology of the marine boreal Berriasian and Valanginian in Canada

5a. Internal correlation

The sequences of macro-invertebrate faunas of all known outcrop areas, and their internal correlation, are summarised in Figure 2, which also includes the inferred ages of their individual zones in terms of the international standard stages. None of these sequences is complete, and one of the principal objectives of the writer's research was therefore to work out a composite, regionally applicable zonal sequence (see Fig. 3) from these incomplete sequences. No attempt was made to zone the non-marine intervals, which are discussed elsewhere (e.g. Stott *in* Douglas *et al.* 1970; Jeletzky 1970).

The latest Jurassic, Berriasian and Valanginian marine boreal rocks are strongly localized in the Canadian part of the North American Boreal Province (see Jeletzky 1968, 1970, 1971a, 1971c; this paper Fig. 1). The presence of shoreward facies changes toward the peripheries of the known outcrops and the presence of coeval nonmarine rocks in several adjacent areas suggests that the major hiatus representing the latest Jurassic to latest Valanginian time over most of Western and Arctic Canada reflects a lack of deposition rather than a subsequent removal of the marine sediments concerned.

On the Canadian mainland the marine boreal latest Jurassic, Berriasian and Valanginian rocks are only known in the Porcupine Plateau-Richardson Mountain Trough and adjacent parts of the Arctic Coastal Plain. This marine basin occupied parts of Northern and West-Central Yukon and adjacent areas of the Mackenzie

preservation of ammonites among its predominantly pelecypod faunas (Jeletzky 1964; this paper Fig. 2). The sequence must therefore be correlated externally with the aid of the relatively poorly known sequence of the Sverdrup Basin in the Canadian Arctic Archipelago (see Tozer *in* Thorsteinsson and Tozer 1970) which has provided the bulk of well preserved ammonite faunas of that age in Canada (see Fig. 2).

The succession in the Sverdrup Basin is the only other known outcrop area of boreal latest Jurassic to Valanginian rocks in Canada. The sequence here consists largely of homogenous shale with clay ironstone concretions and bands, comprising the middle and upper parts of the Deer Bay Formation. This shale overlies gradationally the lithologically similar shale of the lower part of the formation which has yielded early to late (but not the latest) Volgian fossils (Jeletzky 1966). The spacial and stratigraphical distribution of all presently known ammonite faunas in the Deer Bay Formation is random (see Tozer *in* Thorsteinsson and Tozer 1970) and none of the sampled sections has yielded more than three latest Jurassic and early Lower Cretaceous faunas. The stratigraphical and chronological relationships of these faunas (Figs 2, 3) had therefore to be deduced from the known stratigraphical and chronological relationships of the same or closely related ammonite faunas found in other parts of the Boreal Realm.

The recently measured and palaeontologically well-sampled latest Jurassic to Valanginian sections of the Khatanga Depression (Saks *et al.* 1959; Saks *et al.* 1963; Shulgina 1965, 1967; Saks, Mesezhnikov and Shulgina 1968a, 1968b; Saks and Shulgina 1969; Voronets 1962) and other areas of Northern and Western Siberia provided an invaluable standard of comparison because of a close affinity, and sometimes a complete identity, of their ammonite faunas with those of the Sverdrup Basin.

5b. The uppermost Jurassic beds and the Jurassic/Cretaceous boundary

Sections are known in the Sverdrup Basin and in the Porcupine Plateau-Richardson Mountain Trough in which the uppermost Jurassic rocks grade imperceptibly into the basal Cretaceous rocks (Jeletzky 1966, 1971b). However, well preserved, diagnostic latest Jurassic ammonites are unknown in the beds immediately underlying the basal Berriasian beds except in one section of the Deer Bay Formation. This section, measured and palaeontologically sampled by R. Thorsteinsson and E. T. Tozer in 1962, occurs about 7 kilometres southwest of Buchanan Lake, Axel Heiberg Island (see Tozer *in* Thorsteinsson and Tozer 1970 and GSC Map 1302A).

A well preserved fauna including *Praetollia antiqua* n. sp. (described in section 6, below), *Craspedites* (*Subcraspedites*) n. sp. indet., *Buchia terebratuloides* (Lahusen) f. typ., *B. terebratuloides* var. *obliqua* Tullberg, and *B. terebratuloides* var. *subuncitoides* Bodylevsky (GSC loc. 52488) was found there in place about 8.5 metres stratigraphically below the lowest bed containing the Berriasian *Buchia okensis* and *Craspedites* (*Subcraspedites*) aff. *suprasubditus* fauna (GSC loc. 52490). The *Praetollia antiqua* fauna was previously recorded (Jeletzky 1966, 1970, 1971b) as the *Tollia* (*Subcraspedites*?) n. sp. and *Buchia* ex gr. *uncitoides* fauna and eventually assigned an uppermost Jurassic age. The reasons for reappraisal of its ammonites are given in section 6.

According to E. T. Tozer (personal communication 1972), who has studied the Buchanan Lake section together with R. Thorsteinsson, the normal stratigraphical position of the *Praetollia antiqua* fauna about 8.5 metres below the *Buchia okensis*

		1 STAGES, ZONES & SUBZONES OF SOUTH-WEST EUROPE	2 WESTERN BRITISH COLUMBIA	3 CANADIAN BOREAL REGION	
LOWER CRETACEOUS	L. HAUT.	<i>Acanthodiscus radiatus</i>	<i>Homolomites oregonensis</i>	Non-marine beds of Isachsen Fm. & coal-bearing division	
	U. VALANGINIAN	?	<i>Lyticoceras cryptoceras</i>	Beds with <i>Valanginites</i> aff. <i>nucleus</i> (devoid of <i>Buchia</i>)	
		Saynoceras	<i>Saynoceras verrucosum</i>	<i>Buchia crassicollis</i> <i>Homolomites quatsinoensis</i> & rare <i>Buchia</i> n.sp. aff. <i>inflata</i>	Basal beds of Isachsen Fm. & marine beds of White Sste. Member <i>B. crassicollis</i> <i>Homolomites</i> aff. <i>quatsinoensis</i>
	M. VALANGINIAN	?	<i>Valanginites</i>	<i>Buchia pacifica</i> & <i>Tollia mutabilis</i>	<i>Polyptychites keyserlingi</i> & <i>Polyptychites stubendorffi</i>
	L. VALANGINIAN	Kilianella roubaudi	?	<i>Buchia tolmatschowi</i> & <i>Tollia</i> aff. <i>paucicostata</i>	<i>Polyptychites</i> ex gr. <i>keyserlingi</i> & <i>Buchia keyserlingi</i> <i>Thorsteinssonoceras ellesmerensis</i> <i>Temnoptychites novosemelica</i>
			?	<i>Platyleniceras heteropleurum</i> <i>Kilianella</i> aff. <i>pexiptycha</i> <i>Tolypeceras marcouisianum</i>	<i>Tollia tolli</i> s.lato
BERRIASIAN		<i>Berriasella (Pseudoargentinoceras?) boissieri</i>	<i>Buchia uncioides</i> s.lato. <i>Buchia okensis</i> s.str.	<i>Buchia</i> n.sp. aff. <i>volgensis</i> <i>Tollia</i> (T.) cf. <i>payeri</i> <i>Surites</i> aff. <i>analogus</i>	
		<i>Berriasella grandis</i>	<i>Berriasella</i> n.sp. aff. <i>gallica</i> ? <i>Argentinoceras</i> sp.	<i>Buchia okensis</i> & <i>Craspedites</i> (S.) aff. <i>suprasubditus</i>	
U. JURASSIC	U. TITHONIAN	<i>Virgatospinectes transitorius</i> (pars)	<i>Buchia terebratuloides</i> s.lato. & <i>Buchia</i> n.sp. aff. <i>okensis</i>	<i>Prætolia antiqua</i> & <i>Buchia terebratuloides</i> s.lato. & <i>Craspedites</i> (Taimyroceras?) <i>canadensis</i> & <i>Buchia unshensis</i> s.str.	

Fig. 3. Biochronology and external correlation of the latest Jurassic, Berriasian and Valanginian rocks of the Canadian part of the north American Boreal Province.
Columns 1 after Lyons Colloquium 1963; Moullade and Thieuloy 1967; Kemper 1968, etc.:

4 NORTH-WEST GERMANY	5 NORTHERN SIBERIA	6 RUSSIAN PLATFORM		
<i>Endemoceras amblygonium</i>	Apparently not represented by ammonite-bearing beds	Absent or not represented by diagnostic fossils	L.HAUT.	
"Astieria" beds Dichotomites beds	? <i>Homolsomites bojarkensis</i> ? <i>Dichotomites</i> spp. ?	? <i>Homolsomites petschorensis</i> ? <i>Polyptychites polyptychus</i> ?	U. VALANGINIAN	LOWER CRETACEOUS
Polyptychites beds	<i>Polyptychites stubendorffi</i> <i>Polyptychites michalskii</i> & <i>Polyptychites keyserlingi</i>	<i>Polyptychites michalskii</i> & <i>Polyptychites keyserlingi</i>	M. VALANGINIAN	
Platylenticeras beds	<i>Temnoptychites syzranicus</i> <i>Astieriptychites astieriptychus</i> <i>Tollia</i> spp.	<i>Temnoptychites hoplitoides</i>	L. VALANGINIAN	
<i>Platylenticeras heteropleurum</i>	<i>Tollia tolli</i>	<i>Pseudogarnieria undulatopectatilis</i>		
<i>Tolyp. marcousianum</i>	<i>Tollia klimovskiensis</i> <i>Tollia mesezhnikovi</i>	<i>Surites spasskensis</i>		
<i>Platylenticeras robustum</i>	<i>Surites analogus</i>	<i>Berriasella rjasanensis</i>		
Non-marine beds ("Wealden")	<i>Hectoroceras kochi</i>	Hiatus		
Serpulit	<i>Chetaites</i> ? <i>sibiricus</i> ?			
Münder Mari	<i>Chetaites chetæ</i>			
	<i>Virgatospirinctes</i> SPO <i>Craspedites (Taimyrocera) taimyrensis</i>	<i>Craspedites (Craspedites) nodiger</i>	BERRIASIAN	U. JURASSIC
			C. U. TITHONIAN	

2 after Jeletzky 1965a, 1971c; Jeletzky and Tipper 1968; 3 this paper; 4 after Kemper 1961, 1968, etc.; 5 after Saks *et al.* 1963, 1965; Saks and Shulgina 1969; Shulgina 1965, etc.; 6 after Sazonova 1971, etc.

and *Craspedites* (*Subcraspedites*) aff. *suprasubditus* fauna is well established. The latter fauna occurs about 138 metres above the base of the Deer Bay Formation. There is no reason whatsoever to assume the presence of any faults, erosional intervals or unconformities in the regularly and moderately tilted and well-exposed shale interval separating these two faunas. (Since this paper was written a well preserved uppermost Jurassic fauna consisting of prevalent *Buchia terebratuloides* var. *subuncitoides* (Bodylevsky), less common *B. terebratuloides* s. str., and very rare *Praetollia antiqua* n. sp. was identified from GSC loc. 86878 situated in the headwaters of Bern Creek, northwestern Ogilvie Mountains, northwestern part of Central Yukon (approximate Lat. 66° 01' 15" N., Long. 140° 22' 40" W). This discovery suggests a more widespread occurrence of the *Praetollia antiqua* fauna in the uppermost Jurassic of Arctic Canada).

The complete absence of *Buchia* forms referable to or comparable with *B. okensis* s. str. and the prevalence of diagnostic late Upper Volgian forms (*B. terebratuloides* Lahusen f. typ., *B. t.* var. *obliqua* Tullberg and *B. terebratuloides* var. *subuncitoides* Bodylevsky; see Bodylevsky 1936 pl. 1 figs 1-8; pl. 2, figs 1-5; Jeletzky and Tipper 1968; Jeletzky 1971b fig. 2; this paper pl. 4 figs 2-3, pl. 5, fig. 2) precludes the interpretation of the *Praetollia antiqua* fauna as a faunal phase of the *Buchia okensis* Zone and indicates its correlation with some part of the *Buchia terebratuloides* s. lato--*Buchia* n. sp. aff. *okensis* Zone of Western British Columbia (Jeletzky 1971b) and the *Buchia* aff. *B. okensis* Zone of Northern California (Jones, Bailey and Imlay 1969). The late Upper Tithonian age of these *Buchia* zones is proven beyond reasonable doubt by their Tethyan ammonite faunas. In the Boreal Realm the *Praetollia antiqua* fauna appears to be equivalent to part or all of the *Chetaites chetae* Zone of Northern Siberia (Shulgina 1968; Saks and Shulgina 1969; Fig. 3 here) because of its inferred stratigraphical position between the late Upper Volgian *Craspedites* (*Taimyroceras*) *canadensis* fauna and the basal Berriasian *Buchia okensis* and *Craspedites* (*Subcraspedites*) aff. *suprasubditus* fauna (Jeletzky 1966, 1971b).

The presence of a new *Praetollia* species in the latest Jurassic beds of the North American Boreal Province does not necessarily conflict with the actual age of the

Plate 1.

1 a-b. *Polyptychites* (*Dichotomites*) aff. *bidichotomus* (Leymerie).

Upper Valanginian, Deer Bay Formation. Ellef Ringnes Island, exact locality unknown. The specimen presumably was found within 60 metres of the contact with the Isachsen Formation. Presented by J. C. Sproule and Associates Ltd. and preserved in the GSC palaeontological collections, GSC. cat. no. 33332.

a, b. Ventral view of outer whorl (a, b) and earlier (b) whorl fragment.

2. *Polyptychites* (*Polyptychites*) *keyserlingi* (Neumayr and Uhlig).

Upper Valanginian, Deer Bay Formation. Amund Ringnes Island, GSC loc. 82695, on the north side of a large diapir: Lat. 74° 40' N, Long. 98° 00' W. GSC. cat. no. 32592. Ventral view.

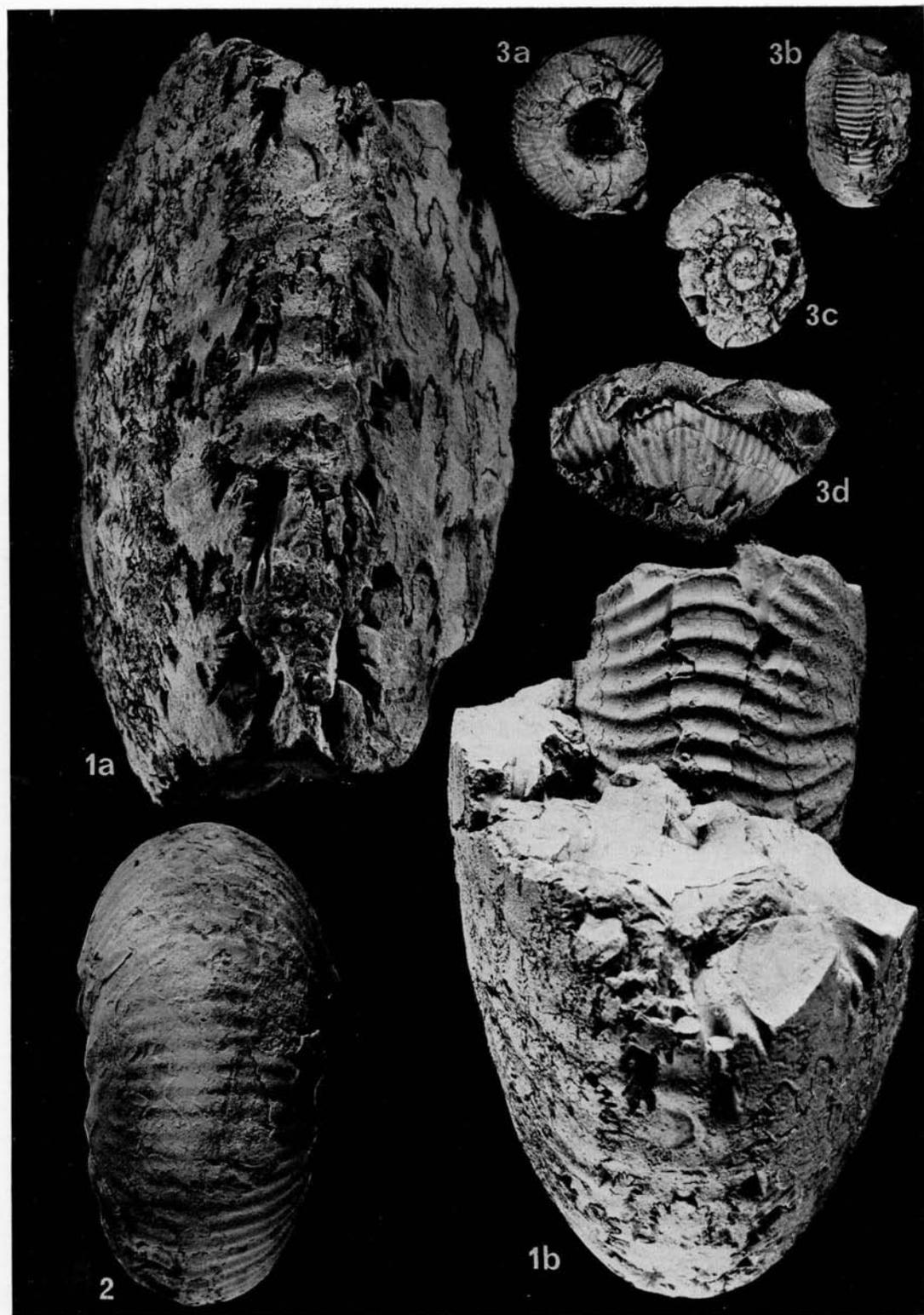
3 a-d. *Valanginites* sp. aff. *V. nucleus* (Roemer).

Uppermost Valanginian or basal Hauterivian, Relay Mountain group. Taseko Lakes Map area, GSC loc. 80218, east side of Tchaikazan Ridge, elevation about 2,280 metres at a point about 5 kilometres east of south of the eastern end of Yohetta Lake: approx. Lat. 51° 12' N, Long. 123° 51' W. GSC. cat. no. 32593.

a, b, c. Lateral view (a), ventral view (b), and oblique cross-section (c) of septate part of shell, including penultimate whorl. c shows the almost perfectly circular cross-section characteristic of the genus.

d. Fragment of living chamber.

all figs x 1.



Praetollia maynci Zone in East Greenland as Spath's (1952) mid- to late-Berriasian dating of this zone is not well founded. The *Praetollia maynci* fauna was said to occur stratigraphically below the *Hectoroceras* fauna (Spath 1952; Donovan 1964) which was subsequently placed in the late lower Berriasian by Soviet workers (Saks *et al.* 1963; Saks and Shulgina 1964; Saks, Mesezhnikov and Shulgina 1968a). [Since this paper was written the writer learned from Dr. F. Surlyk that *Hectoroceras* and *Praetollia* have almost identical time ranges in sections measured in southern Jameson Land (see Surlyk, this volume). The two genera make their first appearance in the same bed but *Hectoroceras* ranges higher than the *Praetollia*. The writer deduces from this information that, like *Praetollia*, *Hectoroceras* may possibly range down into the uppermost Jurassic beds in East Greenland and elsewhere]. The underlying ammonite fauna could permit the placement of the *Praetollia maynci* fauna in the Upper Volgian as well as in the basal Berriasian. The *Laugeites? parvus* fauna found stratigraphically beneath *Praetollia maynci* (Donovan 1964) in the same unit is of a Lower rather than an Upper Volgian age. The association of specifically indeterminate *Subcraspedites* in the same piece of rock with *Laugeites* on Western Kuhn Island (Donovan 1964) is actually suggestive of an Upper Volgian age of "a single impression of ?*Praetollia*" found nearby in a different exposure of the same unit. As pointed out by Casey (1962) and Donovan (1964), new evidence discredits Spath's (1952) opinion about *Subcraspedites* being diagnostic solely of the Cretaceous. Finally, "*Buchia volgensis* Lahusen" identified by Spath (1952) from the *Praetollia maynci* beds does not seem to belong either to *B. volgensis* s. str. or to *B. okensis* s. str. diagnostic of the Berriasian rocks. Judging by the specimens figured by Spath (1952) these *Buchia* are more comparable with *Buchia terebratuloides* s. lato (including *B. t.* var. *subinflata* and var. *subuncitoides*) and *B. n.* sp. aff. *okensis* than with any of the previously mentioned Berriasian species.

The discovery of the new *Praetollia* fauna in the latest Jurassic of Arctic Canada and the possibility that the *Praetollia maynci* fauna is also Upper Volgian rather than Berriasian in age should not be interpreted in the sense of the genus *Praetollia* being a diagnostic latest Jurassic (latest Upper Volgian or latest Tithonian) genus. Firstly, *Olcostephanus bidevexus* Bogoslovsky and *Pronjaites nikitinoense* Sazonova from the late Berriasian *Berriasella (Riasanites) rjasanensis* Zone are typical representatives of *Praetollia* in the writer's opinion (see section 6). Secondly, *Praetollia maynci* Spath was recently reported from those beds of the Khatanga Depression, Northern Siberia (Saks, Mesezhnikov and Shulgina 1968a) presumably corresponding to the basal part of the Canadian *Buchia okensis* and *Craspedites (Subcraspedites)* aff. *suprasubditus* Zone (see Fig. 3). *Praetollia* Spath appears therefore to be yet another perisphinctid genus crossing the Jurassic/Cretaceous boundary and ranging well up in the boreal facies of the Berriasian stage.

5c. The Berriasian stage

(i) *The Buchia okensis* and *Craspedites (Subcraspedites)* aff. *suprasubditus* Zone.

Throughout the Canadian part of North American Boreal Province the Jurassic/Cretaceous boundary is placed at the base of beds containing a *Buchia* fauna dominated by large to giant representatives of *Buchia okensis* (Pavlow) f. typ. and *B. okensis* var. *canadiana* (Crickmay) (see Jeletzky 1964 pl. 1 figs 1A-1C, pl. 2 figs 2A-2C).

The rocks of the *Buchia okensis* Zone are widespread in the Porcupine Plateau-Richardson Mountain trough (Jeletzky 1958, 1960, 1961, 1967, 1971d, 1972) where they are mostly represented by 15 to 16.5 metres of multicoloured shale in the

upper part of the Husky Formation. The zone is mostly rich in the name fossil and contains rare *Craspedites* (*Subcraspedites*) aff. *suprasubditus* (Bogoslovsky) and *C. (S.)* aff. *hoeli* (Frebald) locally. Richly fossiliferous rocks of the zone are equally widespread in the western and northern parts of the Canadian Arctic Archipelago where the zone seems to be confined to the middle part of the Deer Bay shale (Tozer and Thorsteinsson 1964; Tozer in Thorsteinsson and Tozer 1970).

Except for very rare, non-diagnostic phylloceratids (Tozer and Thorsteinsson 1964; Jeletzky 1971a), only craspeditid ammonites have been found in the *Buchia okensis* Zone of the Canadian boreal region. The ammonites are represented exclusively by peculiar *Craspedites* (*Subcraspedites*) forms closely allied to *Olcostephanus suprasubditus* Bogoslovsky from the Ryazan beds (= late Berriasian) of Central Russia (Sazonova 1971) and *Ammonites plicomphalus* J. Sowerby, 1822 (including *A. plicomphalus* J. de C. Sowerby, 1823) from the Spilsby Sandstone of eastern England. Closely similar ammonites were also described by Voronets (1962) from the basal Cretaceous beds of the Lena-Anabar area (Paks Peninsula) under the names *Taimyroceras(?) bodylevskyi* Voronets and *Subcraspedites* ex gr. *bidevexus* Bogoslovsky. These Siberian forms and the Canadian *Craspedites* (*Subcraspedites*) (see Jeletzky 1964 pl. 2 fig. 1, pl. 3 fig. 2; this paper Pl. 6 Figs a-d) appear to be congeneric with representatives of the genus *Borealites* Klimova (1969), recently erected for craspeditid ammonites from the *Hectoroceras kochi* Zone of Western Siberia. The Canadian *Craspedites* (*Subcraspedites*) aff. *suprasubditus*, the North Siberian *Subcraspedites* ex gr. *bidevexus*, the West Siberian *Borealites fedorovi* and the Central Russian *Olcostephanus suprasubditus* are extremely similar morphologically and presumably closely allied to such late Volgian forms as *Craspedites* (*Craspedites*) *nodiger* (Eichwald) and *Craspedites* (?*Taimyroceras*) *canadensis pseudosubditus* Jeletzky. However, they differ from these older and presumably ancestral *Craspedites* forms in having a more complex suture line with a greater number (four or five) of auxilliary lobes. From the late Berriasian *Surites* these ammonites differ in the absence or very feeble development of the characteristic tongue-shaped forward swing of the secondary ribs on the venter, the prevalence of fasciculate *Craspedites*-like rib bundles (three to five secondaries rising at the same level from a single primary) in middle growth stages (Jeletzky 1964 pl. 2 fig. 1A; this paper Pl. 6 fig. 1a), and a complete loss of sculpture, except for bullae-like primaries, in late growth-stages.

All these apparently congeneric forms are assigned to *Subcraspedites* Spath (*Borealites* being treated as a junior subjective synonym) until such time as the age and generic nature of the type species, *Ammonites plicomphalus* J. Sowerby (1822), is clarified. The external morphology and the ontogenetic development of the sculpture of the type species (see Donovan 1964 pl. 9 figs 1, 2) is extremely similar to that of the Canadian, West Siberian and Central Russian Berriasian forms concerned.

Because of the extremely close morphological similarity of these early Berriasian representatives of *Subcraspedites* with the latest Jurassic completely ribbed *Craspedites* forms, the writer's original decision (Jeletzky 1958, 1968) to treat *Subcraspedites* as a subgenus of *Craspedites* evolutionary transitional to *Surites* and *Tollia* appears preferable to the subsequent proposal (Jeletzky 1964, 1965a, 1971b) to regard it as a subgenus of *Tollia*. It appears that, contrary to current ideas, slightly modified representatives of the completely ribbed stock of the genus *Craspedites* (e.g. *Subcraspedites* sensu stricto) range well up into the Berriasian stage and may dominate at least some early Berriasian ammonite faunas in the Boreal Realm (e.g. in Northern Siberia and in Arctic Canada).

Because of its presence in the same stratigraphical position in Western British Columbia (forming part of the North Pacific Biotic Province) and in Arctic Canada (forming part of the North American Boreal Province) (Jeletzky 1965a, 1971b), the *Buchia okensis* Zone represents an extremely important datum plane for the correlation of the basal Cretaceous beds of the Boreal and Tethyan Realms. *Buchia okensis* is remarkably facies-tolerant and short-ranging (Jeletzky 1965a), and throughout Western and Arctic Canada is just as reliable an index fossil for the early Berriasian as are the best of zonal ammonites. The conclusion of Saks, Mesezhnikov, and Shulgina (1968a) that *Buchia* alone does not permit a reliable delimitation of the Jurassic and Cretaceous systems in the Siberian and North American parts of the Boreal Realm is not applicable to Western and Arctic Canada. This misconception is probably caused by the restriction of the most diagnostic variants of *B. okensis*, such as the large to giant representatives of the typical form and *B. okensis* var. *canadiana*, to the Canadian and American (e.g. Northern Alaska: Imlay 1961) parts of the North American Boreal Province and to adjacent areas of the North Pacific Biotic Province (e.g. Western British Columbia and the State of Washington: Jeletzky 1965a). *Buchia okensis* does not appear to penetrate at all into the early Berriasian rocks of Northern California and ?Oregon (Jones, Bailey and Imlay 1969), or into the *Hectoroceras kochi* Zone of Western Siberia (Klimova 1969). All published representatives of *B. okensis* from northeastern Siberia (Paraketev in Verestchagin *et al.* 1965) and the European Arctic (Sokolov and Bodylevsky 1931; Spath 1947, 1952) represent small to medium-sized, rather closely ribbed variants approaching *B. okensis* var. *subokensis* Pavlow (= *B. spasskensis* Pavlow). When found alone, such forms may be easily confused either with the latest Jurassic *Buchia* n. sp. aff. *okensis* of Jeletzky (in Jeletzky and Tipper 1968; Jeletzky 1971b) and Jones, Bailey and Imlay (1969) or with the late Berriasian *Buchia uncitoides* var. *spasskenoides* Crickmay. These forms are known to range, rarely, above and below the *Buchia okensis* Zone.

The dating of the *Buchia okensis* Zone as early Berriasian, formerly based on indirect evidence, has been confirmed recently by the discovery of diagnostic late Upper Tithonian ammonites in the next older *Buchia terebratuloides* and *Buchia* n. sp. aff. *okensis* Zone of the Pacific Province, and by that of Berriasian, presumably early Berriasian, berriasellids in the upper part of the *Buchia okensis* Zone proper (Jeletzky and Tipper 1968; Jeletzky 1971b). These critical finds, made in Western British Columbia, agree perfectly with the presence of a different, more diversified, presumably late Berriasian ammonite fauna (Jeletzky 1965a, 1968, 1971b) in the next younger *Buchia uncitoides* Zone of the same region (see also p. 57, below). There is therefore little doubt that the *Buchia okensis* Zone of Arctic Canada is older than the *Berriasella* (?*Pseudoargentinoceras*) *boissieri* Zone of the West European standard and corresponds largely or entirely to the next older *Berriasella grandis* Zone (Jeletzky 1971b).

Plate 2.

1 a-c. *Polyptychites* (*Dichotomites*) aff. *bidichotomus* (Leymerie).
Same specimen as reproduced in Plate 1, figs 1 a-b.

a. Lateral view of outer whorl. Note the polyptychitid suture-line with only three auxiliary lobes.
b. c. Cross-sections of outer (b) and inner (c) whorls.

all figs x 1.



Craspedites (*Subcraspedites*) forms closely allied to and possibly conspecific with *C. (S.)* aff. *suprasubditus* (Bogoslovsky) occur in the *Chetaites sibiricus* (with *Praetollia maynci*) and *Hectoroceras kochi* Zones of Northern Siberia and the eastern slope of the Ural Mountains. This suggests an approximate correlation between these Siberian zones and the Canadian *Buchia okensis* Zone. This would also agree with the previously proposed correlation (Jeletzky 1968) of the Canadian zone with part or all of the East Greenland *Hectoroceras* Zone of Spath (1947, 1952) which contains a *Buchia okensis* rather than a *B. volgensis* fauna. The suggested correlation of the *Buchia okensis* Zone with the *Praetollia maynci* Zone of East Greenland (Jeletzky 1968) and *Praetollia maynci* beds of Northern Siberia (this paper, Fig. 3) may have to be withdrawn for reasons discussed above (p. 52).

(ii) *The Buchia n. sp. aff. volgensis and Tollia (Tollia) cf. payeri Zone*

This zone is so far known only from the Canadian mainland where it is widespread in the Porcupine Plateau-Richardson Mountain trough. In this vast region the zone begins in the uppermost beds of the Husky Formation. It ranges through all but the highest beds of the Buff Sandstone Member of the overlying Lower Sandstone Division and its shale equivalents (Jeletzky 1958, *et seq.*).

Although its fossils are unknown in the Canadian Arctic Archipelago, marine rocks of this zone were apparently deposited in the Sverdrup Basin (Figs 2, 3). This is indicated by an apparent lack of any arenaceous interbeds or erosional boundaries in a sequence of unfossiliferous shale (about 48 metres thick in the Buchanan Lake section) separating the uppermost bed (GSC loc. 52487) with the *Buchia okensis* Zone fauna from the basal bed (GSC loc. 52491) with the *Tollia (T.) cf. tolli* var. *tolmatschowi* and *Buchia keyserlingi* fauna.

The *B. n. sp. aff. volgensis* and *Tollia (T.) cf. payeri* Zone was originally named the *Polyptychites (Tollia) cf. tolli* and *Buchia volgensis* Zone (Jeletzky 1958) and then renamed the *Craspedites (Tollia) cf. payeri* and *B. volgensis* Zone (Jeletzky 1968) because of the more common (though still rare) occurrence and better preservation of *Tollia (Tollia) cf. payeri* (see Jeletzky 1964 pl. 4 fig. 11). Moderately evolute, *Tollia (T.) payeri*-like craspeditids apparently range right through the zone. A good example is provided by "*Tollia (Praetollia?) n. sp. A*" from the upper member of the Husky Formation (Jeletzky 1964 pl. 4 fig. 8) which is now included in this group.

The dominant *Buchia* of the zone was initially identified as *B. volgensis* (see Jeletzky 1964 pl. 4 figs 5-7, 10), diagnostic of the Berriasian beds of northern Eurasia, but a subsequent study of more extensive and better preserved material showed that it is specifically distinct. *B. n. sp. aff. volgensis* appears to be an undescribed species characteristic of Arctic Canada but possibly occurring in northern Alaska (Imlay 1961) and eastern Greenland (unpublished data). Its designation as the primary zonal index (Jeletzky 1971b and this paper) was prompted by its biochronological reliability as well as by the rarity and poor preservation of *Tollia (T.) cf. payeri* (Toula) throughout the zone.

The records of *Tollia (T.) cf. tolli* Pavlow from this zone (e.g. Jeletzky 1958, 1968) may be valid in part. However, they are all based on poorly preserved, incomplete specimens which may belong elsewhere. Therefore, and because of the presence of reliably identifiable *Tollia (T.) tolli* and closely related forms in the Sverdrup Basin in association with the next younger *Buchia keyserlingi* fauna (see below) the writer (Jeletzky 1971b) had abandoned the previously suggested (Jeletzky 1968) correlation of the *Buchia n. sp. aff. volgensis* and *T. (T.) cf. payeri* Zone with the Eurasian zones

characterised by *T. (T.) tolli* and *T. (T.) pseudostenomphala* Sazonova. The latter two zones are now considered to be faunal facies of the Canadian early Lower Valanginian *T. (T.) tolli* Subzone (Fig. 3). It seems probable, however (see Sazonova 1961, 1967, 1971; Saks and Shulgina 1969), that *T. (T.) tolli* and its allies range down into the latest Berriasian (i.e. the upper part of the *B. n. sp. aff. volgensis* Zone) as well as into the *Polyptychites*-bearing latest Lower Valanginian beds.

The occurrence of *Surites* aff. *analogus* (Bogoslovsky) in the lower part of the *B. n. sp. aff. volgensis* Zone (Jeletzky 1961, 1964 pl. 4 fig. 1) indicates the correlation of these beds with part or all of the late Berriasian *Surites analogus* and *Surites spasskensis* Zones of Siberia and the Russian Platform (Fig. 3). Klimova (1969) regarded *Surites* as a characteristic late Berriasian genus, drawing the boundary between the *Hectoroceras kochi* and *Surites spasskensis* Zones on the first appearance of this genus. However, other workers have cited *Surites* species from beds representative of, or correlative with, the *Chetaites sibiricus* and *Hectoroceras kochi* Zones (e.g. Saks *et al.* 1959; Saks *et al.* 1963; Saks and Shulgina 1964; Saks *et al.* 1965; Saks and Klimova 1967; Saks, Mesezhnikov and Shulgina 1968a). None of these “*Surites*” have been figured or described, to the best of the writer’s knowledge. However, the latest available lists of “*Surites*” from the key section of these zones on the Kheta River in the Khatanga Depression (Saks *et al.* 1965) do not include *Surites spasskensis*, *Surites analogus*, or *Surites* forms allied to these index species of the overlying *Surites spasskensis* and *Surites analogus* Zones of Northern and Western Siberia (Saks and Shulgina 1969 table 1). This suggests that the earlier identifications of *Surites* ex gr. *spasskensis-analogus* from the *Chetaites sibiricus* and *Hectoroceras kochi* Zones made by the same team of Siberian workers were withdrawn by them in the meantime. This conclusion finds additional support in the gradual changes of the zonal scheme proposed by these workers for the Berriasian rocks of Northern and Western Siberia. The earlier (1959–1965) variants interpret the *Chetaites sibiricus*, *Hectoroceras kochi*, and *Surites analogus* Zones as Subzones of the *Surites spasskensis* Zone, which is treated as a regional Siberian zone. The later variants (1968–1969) interpret these three subzones as independent regional zones, remove the *Surites spasskensis* Zone from the list of North Siberian zones, and interpret the *Chetaites sibiricus* Zone as older than the *Surites spasskensis* Zone of the Russian Platform. The latest variant (Saks and Shulgina 1969 table 1) also admits the correctness of Klimova’s (1969) conclusion that in West Siberia (i.e. Northern Urals) *Surites spasskensis* is restricted to beds overlying the *Hectoroceras kochi* Zone.

Thus, whatever the true nature of “*Surites*” in the *Chetaites sibiricus* and *Hectoroceras kochi* Zones of Northern and Western Siberia, the data available suggest that neither *Surites* ex gr. *spasskensis* nor *Surites* ex gr. *analogus* range down into these zones (Fig. 3). The presence of *Buchia uncioides* s. lato in association with *Surites* aff. *analogus* in the lower part of the *Buchia* sp. nov. aff. *volgensis* Zone provides a link with the *B. uncioides* Zone of western British Columbia, which contains a diversified Berriasian fauna of Tethyan ammonites, presumably referable to the late Berriasian *Berriasella (Pseudoargentineras?) boissieri* Zone (Jeletzky 1965a, 1968, 1971b).

The upper part of the *Buchia* sp. nov. aff. *volgensis* Zone (overlying the *Surites*-bearing beds) is tentatively correlated with the upper part of the *Surites analogus* and *Surites spasskensis* Zones of Siberia and the Russian Platform rather than with the overlying *Tollia (Tollia) mesezhnikovi* and *Pseudogarnieria undulatoplicatilis* Zones of the same regions (Fig. 3). This is suggested by the replacement of the

Buchia n. sp. aff. *volgensis* fauna by the *B. keyserlingi* fauna at the top of the zone and by the association of well-preserved *Tollia* (*T.*) *tolli*, *T.* (*T.*) aff. *mutabilis* and allied moderately involute to involute *Tollia* forms with the *B. keyserlingi* fauna. This faunal change is generally accepted as diagnostic of the Berriasian/Valanginian boundary throughout the Boreal Realm (Saks and Shulgina 1969; Sazonova 1971).

The East Greenland beds with *Tollia* (*T.*) cf. *payeri* (Donovan 1964) seem comparable with the Canadian *B. n. sp. aff. volgensis* Zone because of the presence of *Surites*.

(iii) *Age and correlation of the Ryazan Beds of the Russian Platform*

A clarification of the age of the Ryazan Beds of the Central Russian Platform is critical as it provides an independent control of the correlation of the Canadian boreal fossil zones with those of Tethys: in the discussions above, this correlation is attempted by comparison with the coeval, predominantly Tethyan faunas of western British Columbia and northern California.

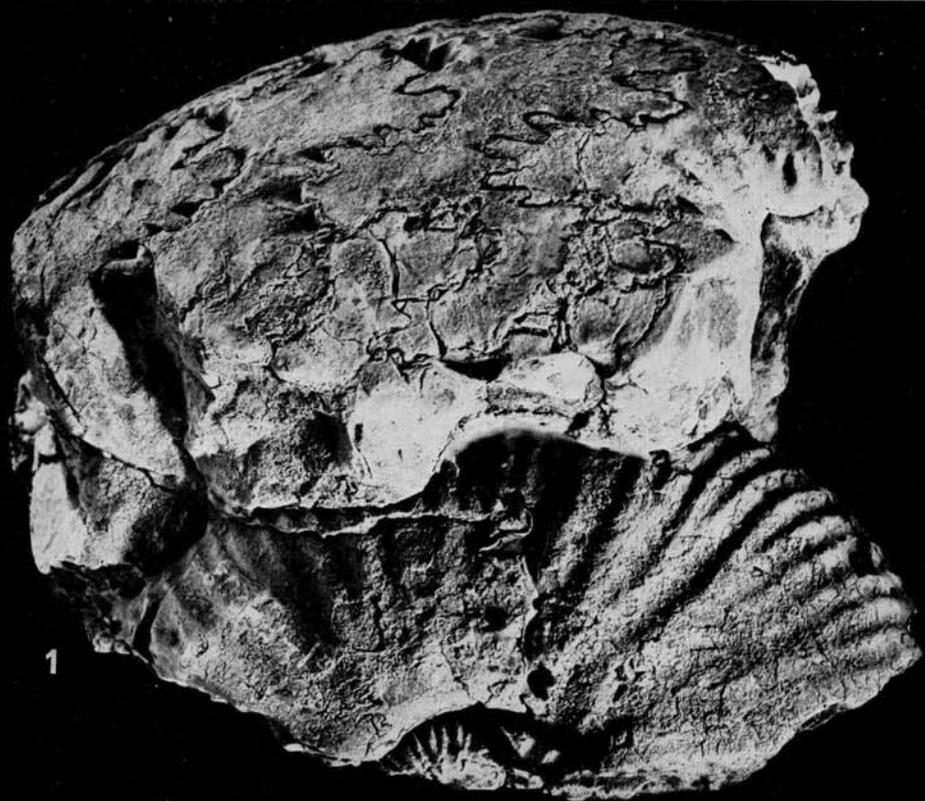
Two ammonite zones are distinguished in the Ryazan Beds (Fig. 3), the lower of which is the *Berriasella* (*Riasanites*) *rjasanensis* Zone. Because of the long-reported but insufficiently appreciated association of the index species with *B. (P?) boissieri* in the basal Cretaceous rocks of the northern Caucasus (e.g. Rengarten 1951; Luppov 1956a; Mordvilko 1956), both Casey (1963) and Jeletzky (1965a, 1968) suggested that the *rjasanensis* Zone of the Ryazan horizon may be of *boissieri* Zone age, and therefore younger than the basal Berriasian (*Berriasella grandis* Zone) of southwest Europe. The following data support this suggestion. According to Sazonova (1971 p. 6) (writer's translation from the Russian): "The association of ammonites of the genus *Neocomites* with *Riasanites* in the Berriasian deposits of central areas of the Russian Platform is especially significant. It indicates a direct connection of the Middle Russian and North-Caucasian basins in the Berriasian and permits a direct correlation of the *rjasanensis* Zone with the *boissieri* Zone of the Mediterranean Berriasian. These data permit one to conclude that the deposits of the *grandis* Zone are absent on the Russian Platform. In this region this time is represented by an interruption of sedimentation. This explains the absence of ammonites ancestral to *Riasanites* among the local fauna of the Volgian sea."

Unfortunately, these conclusions are not reflected in the accompanying correlation table (Sazonova 1971, opposite p. 4) where the *rjasanensis* Zone is placed in the early Berriasian and correlated with the upper part of the *grandis* Zone.

An important North Caucasian fauna, described by Grigorieva (1938) in a paper which was virtually ignored by later Soviet and European workers, includes such diagnostic forms of the *rjasanensis* Zone as *Berriasella* (*Riasanites*) *rjasanensis* var. *maikopensis* Grigorieva and *Protacanthodiscus* (*Euthymiceras*) *transfigurabilis*

Plate 3.

1. *Polyptychites* (*Dichotomites*) aff. *bidichotomus* (Leymerie).
Lateral view of specimen reproduced in Plate 1, figs 1 a-b.
 - 2 a-b. *Polyptychites* (*Polyptychites*) *keyserlingi* (Neumayr and Uhlig).
Same specimen as reproduced in Plate 1, fig 2.
 - a. Lateral view: rib-pattern and suture-line outlined in white.
 - b. Ventral view and cross-section of outer whorl.
- all figs x 1.



(Bogoslovsky). These ammonites are either associated with such diagnostic late Berriasian species as *Protacanthodiscus* (*Pomeliceras*) *breveti* (Pomel) and *P.* (*Malbosiceras*) *malbosi* (Pictet) or occur in beds overlying those containing these species (Grigorieva 1938 pp. 87–88). According to the latest data available (Le Hégarat in Le Hégarat and Remane 1968) forms referable to or comparable with *P.* (*P.*) *breveti* and *P.* (*M.*) *malbosi* are only known from the upper beds of the type Berriasian, well above the beds containing the *Berriasella grandis* fauna. It should be pointed out that according to Le Hégarat (in Le Hégarat and Remane 1968), the typical *B.* (*P?*) *boissieri* appears to have a much more restricted time range than was believed by Busnardo, Le Hégarat and Magné (1965). It is apparently confined to the Subzones of *Berriasella callisto* and *B. picteti* immediately beneath the assigned Berriasian/Valanginian boundary and stratigraphically well above the basal Berriasian *grandis* Zone.

The North Caucasian representatives of *B.* (*P?*) *boissieri* listed in the Soviet literature have not been described or figured, to the best of the writer's knowledge. There is thus no direct way of knowing whether or not they represent typical forms. However, the other above-mentioned data indicate the late Berriasian age of the basal Ryazan Beds (*rjasanensis* Zone) and suggest that they represent a level high in the Upper Berriasian of the type area. Contrary to the opinion of the majority of recent Soviet workers (e.g. Saks and Shulgina 1964, 1969; Saks *et al.* 1965; Saks, Mesezhnikov and Shulgina 1968a) there is no justification for correlating the *rjasanensis* Zone with the north Siberian *Chetaites sibiricus* and/or *Hectoroceras kochi* Zones; it is correlated here (Fig. 3) with the lowest part of the *Surites analogus* Zone of that region.

The correlation of the *rjasanensis* Zone with the bulk of the Canadian *Buchia okensis* and *Craspedites* (*Subcraspedites*) aff. *suprasubditus* Zone is equally improbable. No representatives of either the giant forms of *B. okensis* f. typ. or of *B. okensis* var. *canadiana* (Crickmay) were figured or mentioned in any of the Russian and Soviet publications dealing with the genus *Buchia*. The lectotype of *B. okensis*, found in the Ryazan Beds on the River Oka (see Pavlow 1907 pl. 1 figs 11a–11c), is a late form comparable with specimens from the topmost part of the Canadian *Buchia okensis* Zone or from the basal part of the *Buchia uncitoides* Zone (Jeletzky 1965a). Its best Canadian match (see Jeletzky 1965a pl. 10 fig. 2) was found in beds apparently representing the basal part of the *Buchia uncitoides*

Plate 4.

1 a-d. *Praetollia antiqua* n. sp. Paratype.

Latest Upper Volgian (Upper Jurassic), Deer Bay Formation, 128 metres above the base. Axel Heiberg Island, GSC loc. 52488, 6.4 kilometres southwest of Buchanan Lake. GSC cat. no. 32594.

a, b. Ventral views (a, b) and whorl-section (b) of the last whorl (body chamber).
c, d. Lateral views.

2 a-d. *Buchia terebratuloides* var. *subunctoides* (Bodylevsky).

Horizon and locality as above. GSC cat. no. 32595. Partially preserved left valve.

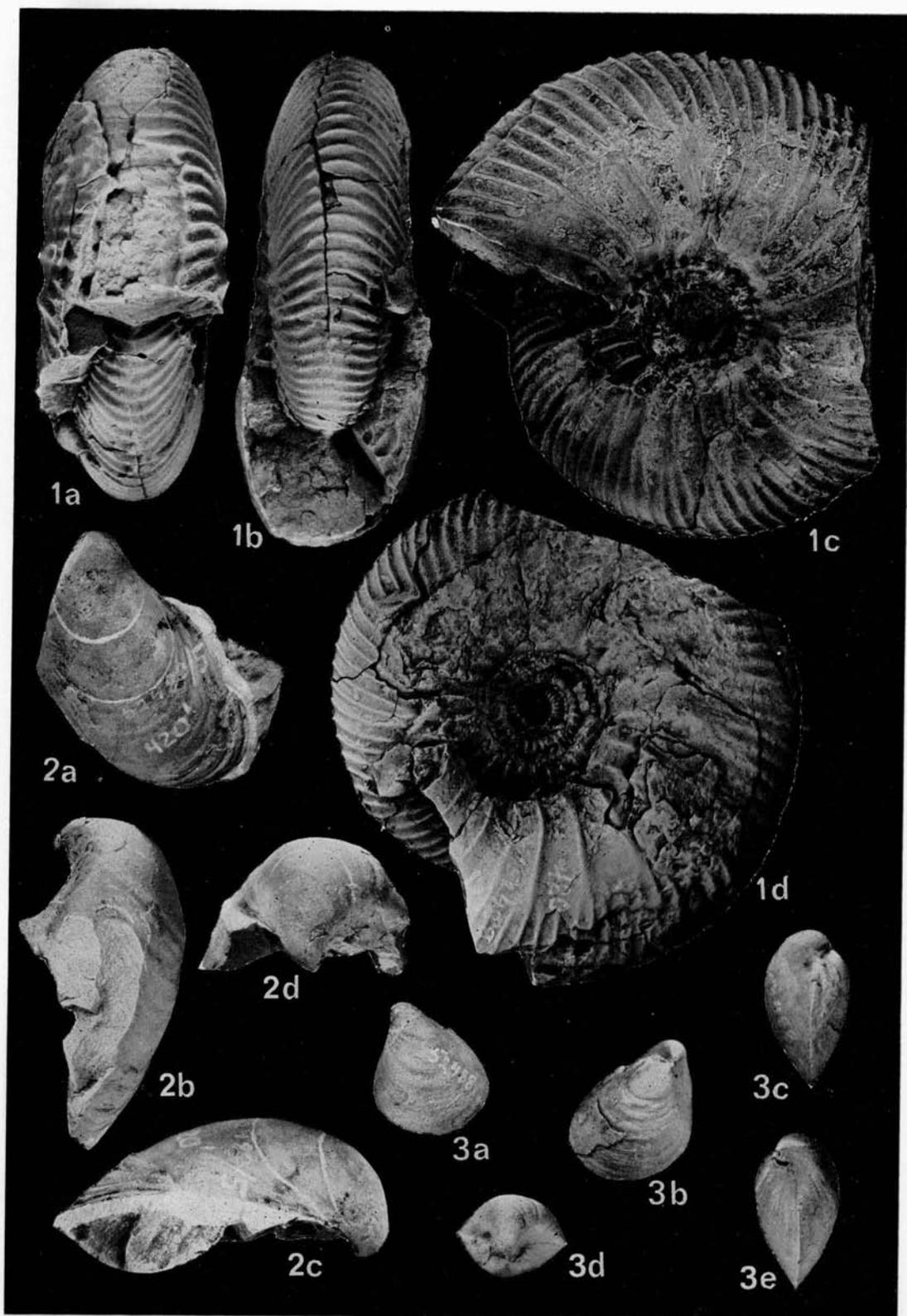
a. Lateral view of exterior. Two earlier, *B. terebratuloides*-like growth-stages outlined in white.
b. Anterior view. c. Posterior view. d. Hinge margin and beak.

3 a-e. *Buchia terebratuloides* (Lahusen) f. typ.

Horizon and locality as above.

a, b. External lateral views of left (a) and right (b) valves.
c. Posterior view. d. Hinge line and beaks. e. Anterior view.

all figs. x 1.



Zone. The same is true of small to medium-sized *B. okensis* var. *subokensis* and *B. uncitoides* var. *spasskenoides*-like forms figured by Gerasimov (1955, 1969) and Pozhariskaya (1971 pl. 27 figs 1–4, pl. 28 figs 1–2, pl. 29 figs 2–4). The *rjasanensis* Zone is here correlated tentatively with the basal beds of the *Buchia* sp. nov. aff. *volgensis* Zone (Fig. 3). However, it may also correspond to unfossiliferous beds separating the *Surites*-bearing lower part of that zone from the topmost beds containing a *Buchia okensis* fauna in Northern Yukon (Jeletzky 1961, corr. table) or to the basal part of the unfossiliferous beds separating the *B. keyserlingi* and *B. okensis* Zones in the Sverdrup Basin.

The regional hiatus separating the basal Ryazan Beds from the latest Upper Volgian beds known (*nodiger* Zone) apparently embraces also the topmost Jurassic rocks of other regions such as the *Praetollia antiqua* beds of the Sverdrup Basin, the *Chetaites chetae* Zone of northern Siberia, and the upper part of the *Buchia terebratuloides* s. lato—*B. n. sp. aff. okensis* Zone of the northern Yukon and Western British Columbia (Jeletzky 1971b fig. 2; this paper Fig. 3).

5d. The Valanginian stage

The writer subdivides the restricted boreal Valanginian stage (i.e. the beds confined between the boreal facies of the Berriasian stage and that of the Hauterivian stage) into three substages (e.g. Jeletzky 1965a, 1968). The Lower/Middle Valanginian boundary is placed at the top of the German Platylenticeras Beds, slightly above the base of the *Polyptychites* (*Polyptychites*) *keyserlingi* Zone and the Middle/Upper Valanginian boundary is placed at the base of *Polyptychites* (*Polyptychites*) *polyptychus* Zone (Jeletzky 1965a) or *Dichotomites* Beds of Kemper (1961, 1968). It does not seem practical to switch to the subdivision of the restricted boreal Valanginian into two substages as proposed by Saks and Shulgina (1962) and Kemper (1968) and now widely adopted in Soviet literature. This is difficult as *Polyptychites* (*Polyptychites*) *michalskii* and *Polyptychites* (*Polyptychites*) *polyptychus*, the index species of the topmost Lower Valanginian and basal Upper Valanginian zones of the Soviet scheme (e.g. Saks *et al.* 1965; Saks and Shulgina 1969) are unknown in North America. In addition, the reliability of *P. (P.) michalskii* as a zonal index is rather doubtful, judging by the considerable variation of its time ranges in different regions of the northern U.S.S.R. and northwest Germany.

(i) *The Buchia keyserlingi* Zone

As far as is known, *Buchia keyserlingi* (Lahusen) is connected by transitions with the next older *Buchia* n. sp. aff. *volgensis* and with the next younger *Buchia* ex gr. *inflata-sublaevis* species groups. Mixed *Buchia* faunas are known to be present near the upper and lower boundaries of the *Buchia keyserlingi* Zone and the zonal index is known to range, rarely, way above its zone (probably right to the top of the *Homolosomes* aff. *quatsinoensis* Subzone; see Figs 2, 3).

In the Porcupine Plateau-Richardson Mountain Trough the *Buchia keyserlingi* Zone begins in the uppermost part of the Buff Sandstone Member of the Lower Sandstone Division and its shale equivalents (Jeletzky 1961) and continues into the basal beds of the overlying White Sandstone Member of the division and into its shale equivalents. The *Buchia keyserlingi* Zone is widespread in this region but it rarely yields any fossils other than the index form.

One locality in the Bonnet Lake area (GSC loc. 38788 and 39825), presumably situated low in the *Buchia keyserlingi* Zone, has yielded: *Tollia* (*Tollia*) aff. *mutabilis*

(Stanton), *Partschiceras* sp. indet. and various non-diagnostic pelecypods in addition to *B. keyserlingi* f. typ. and *Buchia* allied to *B. n. sp. aff. volgensis* (Lahusen). This fauna indicates the correlation of the lower part of the *Buchia keyserlingi* Zone with some part of the *Buchia tolmatschowi* Zone of Western British Columbia (Jeletzky 1965a) the main part of which can be confidently dated as early Lower Valanginian in terms of the international standard stages. ?*Tollia* (*Tollia*) *anabarensis* (Pavlow), found in the *Buchia keyserlingi* Zone on the eastern slope of Richardson Mountains (Jeletzky 1958, 1968), appears to be of about the same age as the *Tollia* (*Tollia*) aff. *mutabilis* fauna of the Bonnet Lake area.

Rare, poorly preserved fragments of *Polyptychites* (*Euryptychites*)—and *Polyptychites* (*Polyptychites*)-like ammonites found at several localities in the north-eastern and northwestern Richardson Mountains (Jeletzky 1961, 1968, and unpublished) are invariably too poorly preserved to serve as the basis for a definite ammonite subzone(s) comparable to one or more of the subzones of the Sverdrup Basin. As the suture lines are either absent or poorly preserved on all available fragments, they may be referable to the more inflated forms of the craspeditid genus *Thorsteinssonoceras* rather than to any of the polyptychitid forms they were previously compared with (Jeletzky 1968). This may account for their association with *Tollia* forms comparable to *T. (T.) anabarensis* (Pavlow).

The Zone of *Polyptychites* (*Euryptychites*) n. sp. aff. *Polyptychites latissimus* and *Polyptychites anabarensis*?, tentatively proposed by Jeletzky (1968) for beds containing these fragments is withdrawn herewith pending the clarification of their generic nature through further collecting. It seems probable, however, that some at least of these poorly preserved ammonites are true *Polyptychites* (*Polyptychites*) ex gr. *keyserlingi* (Neumayr and Uhlig) as they were found in the topmost beds of *Buchia keyserlingi* Zone containing a mixed fauna of *B. keyserlingi* and *B. ex gr. inflata-sublaevis*.

In the Sverdrup Basin, beds in the Deer Bay Formation containing a *Buchia keyserlingi* f. typ. and *B. k. var. sibirica* (Sokolov) fauna (Jeletzky 1964) locally contain well-preserved craspeditid ammonites. The *Tollia* (*Tollia*) *tolli*, *Tollia* (*Temnoptychites*) *novosemelica* and *Thorsteinssonoceras ellesmerensis* faunal horizons treated herein as Subzones of the *Buchia keyserlingi* Zone, can be distinguished in the area (in ascending order; see Fig. 3). The separate existence of the *Tollia* (*Tollia*) *tolli* Subzone characterized by the presence of *T. (T.) tolli* Pavlow (including *T. (T.) tolmatschowi* Pavlow and *T. (T.) latelobata* Pavlow) was recently confirmed by the discovery of an unmixed fauna of *Tollia* (*Tollia*) *tolli* var. *tolmatschowi* Pavlow at GSC loc. 52491 occurring 46.5 metres stratigraphically above the *Buchia okensis* Zone in the Buchanan Lake section (see previous section). The second, *Tollia* (*Temnoptychites*) *novosemelica* Subzone fauna was found unmixed at GSC loc. 52489 in the Greely Fiord (Ellesmere Island) section closely beneath the *Thorsteinssonoceras ellesmerensis* Subzone (see Jeletzky 1965b). Although they were not found in a direct superposition in the same continuous section, the *Tollia* (*Tollia*) *tolli* Subzone is believed to occur immediately beneath that of *Tollia* (*Temnoptychites*) *novosemelica* throughout the Sverdrup Basin (Figs 2, 3).

The Subzone of *Tollia* (*Temnoptychites*) *novosemelica* is locally characterized by the association of its name fossil with more coarsely ribbed representatives of the subgenus *Temnoptychites*, formerly identified as *T. (Temnoptychites) simplex* (Bogoslovsky) (Jeletzky 1964 pl. 5 fig. 3) but possibly better referred to *T. (T.) simplex* var. *grandiosus* Voronets because of the large size of its smooth outer whorls.

Bodylevsky's (1967) denial of the *Temnoptychites* nature of the Canadian examples of *T. (T.) novosemelica* (Sokolov) is mistaken as the ribs are clearly interrupted in the middle of the venter at least on the penultimate whorl (see Jeletzky 1964 p. 38, description of figs 1, 4 and in fig. 4d). In at least one instance *Tollia (Tollia) tolli* var. *latelobata* Pavlow was found in association with *T. (Temnoptychites) novosemelica* and *T. (T.) simplex* var. *grandiosus*, though this could reflect indiscriminate collecting from the outcrop and the scree.

In two sections in Greely Fiord the *Thorsteinssonoceras ellesmerensis* fauna was found stratigraphically above the *Tollia (Temnoptychites) novosemelica* fauna (Jeletzky 1965b). This craspeditid homeomorph of *Polyptychites* has not been found anywhere else in the Canadian boreal region with the possible exception of poor fragments found in the Porcupine Plateau-Richardson Mountain trough. However, it occurs in the early Valanginian rocks of Spitsbergen and apparently in the glacial boulders on Novaya Zemlya (Jeletzky 1965b), though the latter record was disputed by Bodylevsky (1967) who interpreted it as *Temnoptychites* (?) aff. *vytkoi* Bodylevsky. The occurrence of *Thorsteinssonoceras ellesmerensis* in both the Canadian and European Arctic justifies the recognition of a distinct *T. ellesmerensis* Subzone in the *Buchia keyserlingi* Zone.

True polyptychitid ammonites have not been found in the above discussed three ammonite subzones, all such previous records (Jeletzky 1968 and unpublished reports) possibly representing *Thorsteinssonoceras* fragments. However, elements of the *Polyptychites (Polyptychites) keyserlingi* fauna have sometimes been seen in fossil collections from the Deer Bay Formation, associated with a *Buchia keyserlingi* fauna devoid of, or poor in, the representatives of the *Buchia inflata-B. sublaevis* species group. Like some of the previously mentioned, poorly preserved polyptychitid ammonites found in the Porcupine Plateau-Richardson Mountain trough in association with the *Buchia keyserlingi* fauna, such collections appear to be referable to the topmost part of the *Buchia keyserlingi* Zone, overlying the *T. ellesmerensis* Subzone (Figs 2, 3).

The external correlation of the *Buchia keyserlingi* Zone depends almost exclusively on its ammonite-bearing Sverdrup Basin sections. The *Tollia (Tollia) tolli* Subzone should be correlated with the early Lower Valanginian of southwestern Europe (Jeletzky 1965a, 1971b), following Bodylevsky (1956), Luppov (1956b) and Kemper (1961). This is supported by the discovery of various *Tollia (Tollia)* forms and *Platylenticeras?* cf. *gevrili* (d'Orb.) in lithologically identical glacial boulders on

Plate 5

1 a-d. *Praetollia antiqua* n. sp. Holotype.

Latest Upper Volgian (Upper Jurassic). Horizon and locality as Plate 4, figs 1 a-d. GSC cat. no. 32597.

a, b. Cross-section of early part of the last whorl and ventral view of part of the septate penultimate whorl. Part of the last whorl removed in fig. b.

c, d. Lateral views. The internal mould of the penultimate whorl shows well-preserved, strongly ascendant sutures.

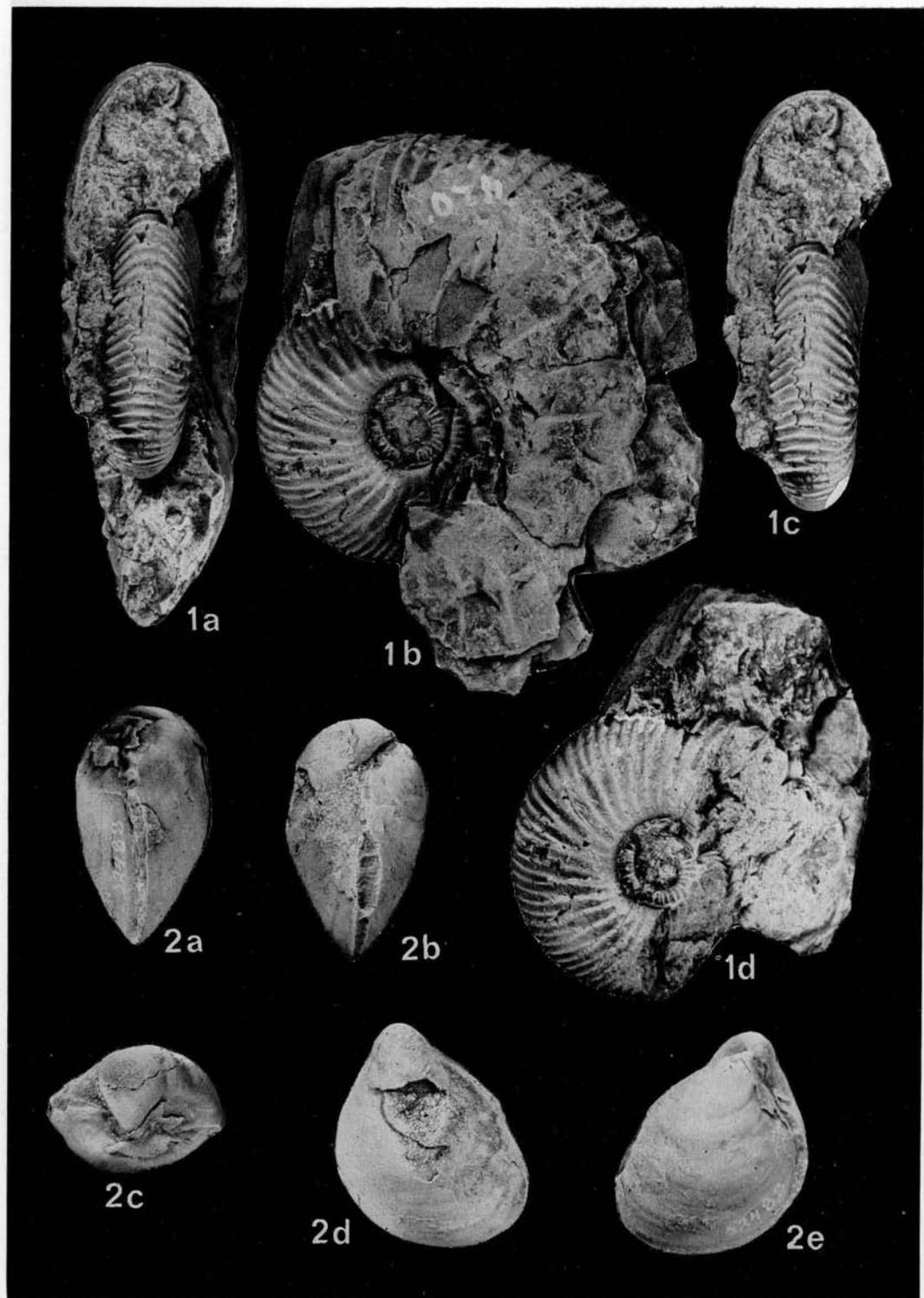
2 a-e. *Buchia terebratuloides* var. *obliqua* (Tullberg).

Horizon and locality as Plate 4, figs 1 a-d. GSC cat. no. 32598.

a. Anterior view. b. Posterior view. c. Hinge line and beaks of both valves.

d, e. Lateral views of left (d) and right (e) valves.

all figs x 1.



Novaya Zemlya (Bodylevsky 1967). More important is the recent description and illustration of *Platylenticeras* aff. *marcouisianum* (Koenen) from the *Pseudogarnieria undulatoplicatilis* Zone of the Central Russian Platform (Sazonova 1971 pl. 22 fig. 1), which suggest a correlation with the basal part of the *Platylenticeras* Beds of northwest Germany, to which *P. (Tolypeceras) marcouisianum* is restricted (Kemper 1968).

Sazonova's (1971) confirmation of the association of the *P. undulatoplicatilis* fauna with *Tollia (Tollia) pseudostenomphala* supports the correlation of the *P. undulatoplicatilis* Zone with the Siberian *Tollia (Tollia) tolli* Zone, as *T. (T.) pseudostenomphala* appears to be a typical representative of the subgenus *Tollia*. However, like the North Siberian and Canadian representatives of the *Tollia (T.) tolli* group, *T. (T.) pseudostenomphala* does range down into the uppermost Berriasian (upper beds of the *Surites spasskensis* Zone: Sazonova 1971).

The *Tollia (Tollia) tolli* Zone can be correlated with the basal part of the *Kilianella roubaudi* Zone (i.e. *K. aff. pexiptycha* Subzone) of southeastern France because of the occurrence of *Platylenticeras (Tolypeceras) marcouisianum* and allied species in this part of the French zone. Kemper (1968 table 5) recognised a *P. (T.) marcouisianum* Subzone at the base of the *roubaudi* Zone and the relevant section of Figure 3 follows this interpretation. Thus, there is good reason for thinking that the base of the *K. roubaudi* Zone corresponds approximately with that of the *P. undulatoplicatilis* and *Tollia (Tollia) tolli* Zones (Fig. 3).

The *Tollia (Temnoptychites) novosemelica* Subzone of Arctic Canada is approximately equivalent to the lower part of the *T. (T.) syzranicus* Zone of Northern Siberia and the Northern Urals (Saks and Shulgina 1969) and to the lower part of the *T. (T.) hoplitoides* Zone of the Russian Platform (Sazonova 1971). Bodylevsky (1967) pointed out that the widespread and biochronologically important *Temnoptychites* Zone is also represented in East Greenland. The dating of this zone varies according to the subdivision of the Valanginian stage favoured by individual workers and whether the workers concerned place the *Tollia (Tollia) tolli* Zone in the basal Valanginian or the uppermost Berrasian. Because of its stratigraphic position in the Russian Platform region between beds equivalent to those containing *Pseudogarnieria* and earliest Valanginian *Platylenticeras* and those containing the widespread Middle Valanginian *Polyptychites (P.) keyserlingi* fauna, the *Temnoptychites* spp. Zone of the Boreal Realm is here assigned to the upper part of the Lower Valanginian (Fig. 3). The zone appears to be equivalent to the lower, but not the basal, part of the *Kilianella roubaudi* Zone of southeastern France (Fig. 3).

The *Thorsteinssonoceras ellesmerensis* Subzone was tentatively assigned a late Lower or Middle Valanginian age (Jeletzky 1965b p. 14) and considered as "either slightly older than or about contemporary with some part of the *Polyptychites keyserlingi* and *Polyptychites michalskii* zone of Central and Northern Russia". The writer has since studied several collections of the *Polyptychites (P.) keyserlingi* fauna from the upper part of the Deer Bay Formation (some associated with the *B. keyserlingi* fauna, other with the overlying *B. inflata-sublaevis* fauna), in which *Thorsteinssonoceras* is absent. For this reason, and because of its occurrence closely above beds containing *Tollia (Temnoptychites) novosemelica*, the *T. ellesmerensis* Subzone is tentatively considered older than the Canadian *P. (P.) keyserlingi* fauna and equivalent to the middle part of the *Temnoptychites syzranicus* Zone rather than to the *Astieriptychites astieriptychus* Subzone of Northern Siberia (cf. Saks *et al.* 1965 table 1). It is believed to correspond to the middle part of the *T. (Temnoptychites) hoplitoides* Zone of the Central Russian Platform (cf. Fig. 3 and Sazonova

1971 table opposite p. 4). The dating and correlation of the *T. ellesmerensis* Subzone is made difficult by the apparent absence of *Astieriptychites* in Canada and an uncertainty concerning the stratigraphical range of *A. astieriptychus* in Northern Siberia.

Some of the above-mentioned collections of the *P. (P.) keyserlingi* fauna (e.g. GSC loc. 85025) are associated with *Buchia keyserlingi* rather than with the younger *Buchia ex gr. inflata-sublaevis* fauna. Because of this and the absence of any earlier Lower Valanginian ammonites, these collections are tentatively placed in the topmost part of the *Buchia keyserlingi* Zone, overlying its *T. ellesmerensis* Subzone (Fig. 3). This is supported by the association of *P. (P.) cf. keyserlingi* with *Buchia cf. keyserlingi* in the lower part of the Beattie Peaks Formation (outside the report area), stratigraphically below beds containing the *Buchia ex gr. inflata-sublaevis* fauna (Jeletzky 1968). The same relationships were noted in the Porcupine Plateau-Richardson Mountains trough (see above, p. 63).

The beds characterised by the *P. (P.) keyserlingi*-*B. keyserlingi* association are placed in the latest Lower Valanginian because of the occurrence of the earliest representatives of *P. (P.) keyserlingi* (and *P. (P.) michalskii*) in association with the latest *Tollia (Tollia)* forms in the upper part of the Platylenticeras Beds of northwest Germany (Kemper 1968). A similar fauna described by Donovan (1953) from East Greenland greatly puzzled the writer (Jeletzky 1965a pp. 42-43). However, it too can now be placed in the latest Lower Valanginian and correlated with the uppermost part of the Canadian *B. keyserlingi* Zone and with the uppermost Platylenticeras Beds. For these reasons, the Lower/Middle Valanginian boundary in Canada is placed at the top of the *B. keyserlingi* Zone rather than at the first appearance of polyptychitid ammonites (Fig. 3).

The correlation of the *P. (P.) keyserlingi* beds of the *B. keyserlingi* Zone with the upper part of the Platylenticeras Beds indicates their approximate correspondence to beds in the middle part of the *Kilianella roubaudi* Zone of the European Tethys, corresponding to the top part of its *Platylenticeras heteropleurum* Subzone (compare Kemper 1961 table 2, 1968 table 5, and Fig. 3 here).

(ii) *The Buchia ex gr. inflata-sublaevis* Zone

In the Porcupine Plateau-Richardson Mountains trough this zone begins closely above the base of the White Sandstone Member of the Lower Sandstone Division and extends into its middle part. In the central part of the trough it occurs in the upper part of the equivalent bluish-grey shale unit (Jeletzky 1961), stratigraphically above the *Buchia keyserlingi* fauna. The zone is also widespread in the uppermost Husky Shale (equivalent to the White Sandstone Member) in the Bonnet Lake-Barn Mountain area (Jeletzky 1971d), as well as in the uppermost Husky Shale and in the Lower Sandstone Division of the north-western part of the Ogilvie Mountains (Jeletzky 1971d).

In the Sverdrup Basin the zone is apparently restricted to the uppermost 100 to 130 metres of the Deer Bay Formation (Tozer *in* Thorsteinsson and Tozer 1970) in those Ellef Ringnes Island sections where the stratigraphical position of its fossils in relation to the overlying Isachsen Formation is reasonably well known. Some stratigraphically unassigned collections are assumed to represent approximately the same level. Elements of the *B. ex gr. inflata-sublaevis* fauna ascend into marine interbeds in the basal part of the overlying Isachsen Formation (Tozer *in* Thorsteinsson and Tozer 1970).

The *Buchia ex gr. inflata-sublaevis* fauna is widespread throughout the Canadian

boreal region. It is characterised by the prevalence of strongly swollen *Buchia* which include *B. inflata* (Toula) and varieties, *B. sublaevis* (Keyserling) and varieties, *B. n. sp. aff. inflata* and *B. bulloides* (Lahusen) (see Jeletzky 1964 for illustrations of these). Of these forms, the taxonomic status of which is still obscure, *B. n. sp. aff. inflata* is by far the most common. In spite of the strong specific and subspecific variability of these *Buchia*, both horizontally and vertically, no way has yet been found to utilize this variation for regionally or inter-regionally valid zones or subzones.

Zonal subdivision and external correlation is, therefore, dependent on ammonites. In the Porcupine Plateau-Richardson Mountains trough, the *B. ex gr. inflata-sublaevis* Zone rarely yields any fossils other than *Buchia*, but in the Sverdrup Basin the zone is locally rich in well-preserved craspeditid and polyptychitid ammonites, belemnites and gastropods. Here it is possible to recognise a *Polyptychites* (*P.*) *keyserlingi* fauna in the lower part of the zone and a *Homolomites* aff. *quatsinoensis* fauna in the upper, though not the topmost, part. These ammonite faunal horizons are treated as subzones of the *B. ex gr. inflata-sublaevis* Zone.

The *P. (P.) keyserlingi* fauna, of which the *P. (Euryptychites) stubendorfi* fauna (Jeletzky 1964) appears to be but a lateral facies, is unique in the diversity of its polyptychitid ammonites, which include *P. (P.) keyserlingi* (Neumayr and Uhlig) (see Pl. 1, fig. 2; Pl. 3, fig. 2a,b), *P. (P.) ex aff. tschekanowskii* Pavlow (possibly only an extreme variant of *P. (P.) keyserlingi*), *P. (P.) cf. densicosta* Pavlow, *P. (P.) cf. densicosta* or *ramulicosta* Pavlow, *P. (E.) stubendorffi* (Schmidt) f. typ., *P. (E.) stubendorffi* var. *middendorffi* Pavlow, *P. (Dichotomites) ex aff. ascendens* Koenen, a generically indeterminate craspeditid and *Acroteuthis (Acroteuthis) cf. arctica* Blüthgen var. *elata* Saks and Nalnyaeva. This subzone is known on Ellef Ringnes Island (GSC loc. 37867), Amund Ringnes Island (GSC loc. 85023, 82695), North Amund Ringnes Island (GSC loc. 85059) and Axel Heiberg Island (GSC loc. C-4749). Not all of the polyptychitid ammonites listed above have been found at each locality, but there are enough species in common to conclude that all five localities contain partial faunules of the same Middle Valanginian fauna. This is referable to the principal part of the *P. (P.) keyserlingi* Zone of northwest Europe (Koenen 1902; Kemper 1968) and to the *P. (P.) michalskii* Zone of the Russian Platform (Sazonov 1956; Sazonova 1961, 1967; Gerasimov *et al.* 1962) and Northern Siberia (Saks and Shulgina 1962, 1969; Saks *et al.* 1963; Saks *et al.* 1965). Judging by data provided by Koenen (1902) and Kemper (1961, 1968) the mid-Valanginian bulk of the *P. (P.) keyserlingi* Zone (or "Polyptychites Schichten") corresponds

Plate 6

1 a-d. *Craspedites (Subcraspedites) aff. suprasubditus* (Bogoslovsky).

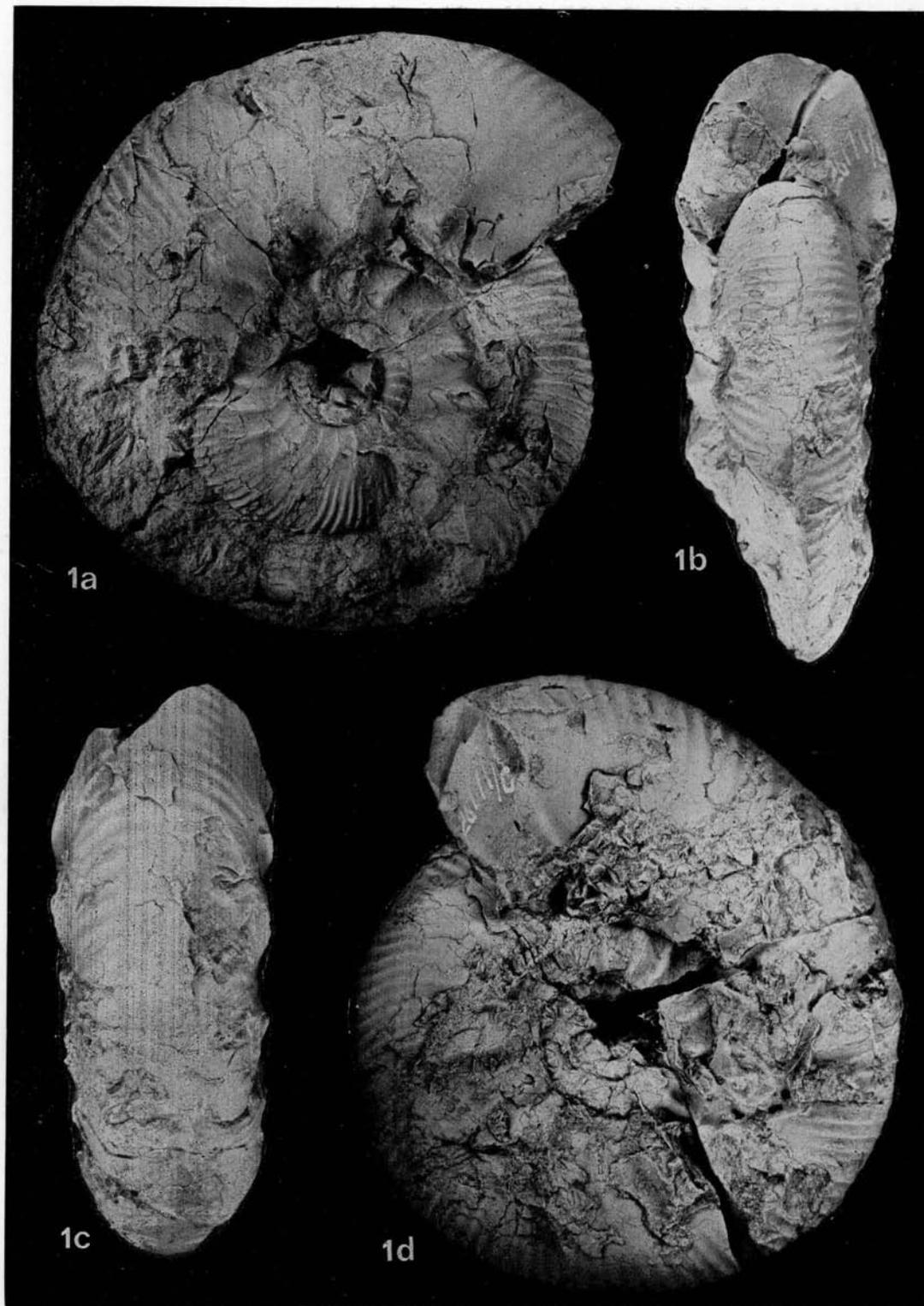
Lower Berrisian (*Buchia okensis* and *C. (S.) aff. subprasubditus* Zone), Deer Bay Formation, 136.6–140 metres above base. Axel Heiberg Island, GSC loc. 26171, 6.4 kilometres southwest of Buchanan Lake. GSC cat. no. 32599 (collected by Dr. J. Souther, 1955).

a. Lateral view showing the fine, dense, *Craspedites*-like ribbing of the inner whorls, closely similar to that of *Subcraspedites plicomphalus* var. *sowerbyi* Spath (see J. de C. Sowerby 1923, pl. 404). The fragmentary penultimate whorl and the last whorl (living chamber) have considerably coarser, more bullate ribs resembling those of the holotype of *S. plicomphalus* (J. Sowerby 1822). Only the beginning of the living chamber is preserved.

b, c. Ventral views (b, c) and whorl section (b) of last preserved whorl.

d. Lateral view of last preserved whorl (including the very beginning of the body chamber).

all figs x 1.



roughly to the upper part of the *Kilianella roubaudi* Zone of southwest Europe (Fig. 3).

Prior to the discovery of typical, well-preserved representatives of *P. (P.) keyserlingi* in the lower part of the *Buchia* ex gr. *inflata-sublaevis* Zone of the Sverdrup Basin, these beds were named the *Euryptychites stubendorffi* s. lato. Zone (Jeletzky 1964). This zonal term is now replaced by that of the *P. (P.) keyserlingi* Subzone (Fig. 3). In addition to needlessly complicating the zonal nomenclature, the use of *P. (E.) stubendorffi* is inappropriate because of its longer time-range. Fragments resembling *P. (E.) stubendorffi* have been seen in association with *Homolsomites* aff. *quatsinoensis* in the uppermost beds of the Deer Bay Formation. This species appears, furthermore, to range down into the late Lower Valanginian *Temnoptychites syzranicus* Zone in Northern Siberia (Saks and Shulgina 1969).

The writer disagrees with Bodylevsky's (1956) proposal to rename the Russian Middle Valanginian *P. (P.) keyserlingi* figured by Pavlow (in Pavlow and Lamplugh 1892 pl. 8 (5) fig. 13) and Bogoslovsky (1902 pl. 1 fig. 1) as *P. (P.) volgensis* and *P. (P.) okensis* respectively. Such extreme splitting does not serve any useful taxonomic purpose, needlessly complicates the zonal nomenclature and obscures the true geographical range of a polytypic mid-Valanginian index species which retains its basic morphological characteristics from England and northwest Europe to Arctic Canada. The replacement of *P. (P.) keyserlingi* by *P. michalskii* as the zonal index in the European and Asiatic parts of the U.S.S.R. does not appear to be necessary either, especially as these two species co-exist in northwest Germany (Kemper 1968) as well as in the U.S.S.R. The writer endorses Kemper's (1968 pp. 31–32) recent complaint that it is now impossible to identify most *Polyptychites* specimens because of such extreme splitting.

Ammonites diagnostic of the *Homolsomites* aff. *quatsinoensis* Subzone are rare. In the Sverdrup Basin this subzone has so far been found only on Ellef Ringnes Island (GSC loc. 21899, 48835 and 80752) where all its occurrences appear to be in the uppermost 65 metres of the Deer Bay Formation (see Tozer in Thorsteinsson and Tozer 1970).

In the Porcupine Plateau-Richardson Mountain Trough the subzone occurs in the northwestern part of the Ogilvie Mountains (Jeletzky 1971d) and in the Bonnet Lake—Blow Pass area (GSC loc. 88281). In both instances the zonal fossils occur in the uppermost beds of the Husky Formation which in these areas replaces laterally most or all of the Lower Sandstone Division, including its mid to late Valanginian beds (Jeletzky 1971d).

Plate 7

1 a-d. *Praetollia antiqua* n. sp. Paratype.

Latest Upper Volgian (Upper Jurassic). Horizon and locality as Plate 4, figs. 1 a-d. Largest specimen studied, with most (almost one half of the last whorl) of the adult living chamber preserved.

a. Lateral view showing the gradual coarsening of the ribs and the equally gradual replacement of sharp-topped primaries by obtuse bullae on the last (adult) whorl. The ribbing persists to the end.

b. Ventral view and whorl section of last whorl.

c. Whorl sections across the line of breakage shown in fig. 1a. The smooth, globose, innermost whorl is visible.

d. Lateral view, showing well-preserved ribbing at the beginning of the last whorl.

all figs x 1.



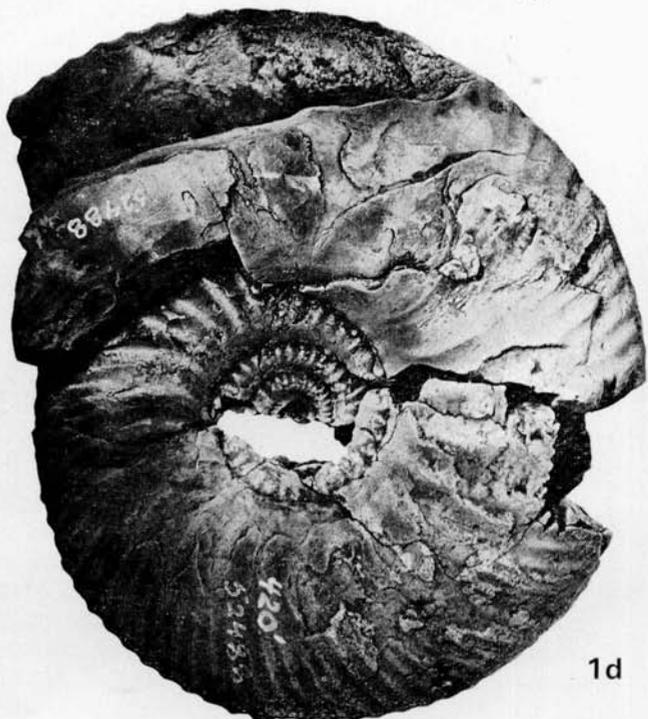
1a



1b



1c



1d

In the Sverdrup Basin the *H. aff. quatsinoensis* fauna includes the name fossil (Jeletzky 1964 pl. 11 fig. 5, pl. 12 fig. 4, pl. 13 fig. 6), *Polyptychites* (*Dichotomites*) aff. *bidichotomus* (Leymerie) (this paper, Pl. 1 figs 1a, b, Pl. 2 figs 1a-c, Pl. 3, fig. 1), *P. (Euryptychites?)* sp. indet. juv., *Acroteuthis subquadratus* (Roemer) emend. Swinnerton (Jeletzky 1964 pl. 11 fig. 2) and probably *Cylindroteuthis (Communicobelus)* n. sp. (Jeletzky 1964 pl. 10 fig. 1). In the Porcupine Plateau-Richardson Mountain Trough the *H. aff. quatsinoensis* Subzone includes *H. quatsinoensis* (Whiteaves) s. str., *P. (D.) aff. bidichotomus*, *Buchia crassicollis* (Keyserling) s. str. and *B. crassicollis* var. *solida* (Lahusen), in addition to the ubiquitous *B. ex gr. inflata-sublaevis* group.

The late Valanginian age of the *H. aff. quatsinoensis* Subzone is established by the presence of typical *H. quatsinoensis*, *B. crassicollis* f. typ. and var. *solida* in its southernmost known exposures. All these fossils are diagnostic of the *B. crassicollis* Zone of western British Columbia and the Pacific seaboard of the United States (Jeletzky 1965a; Imlay 1960; Imlay and Jones 1970). The reasons for assigning a general late Valanginian age to the *B. crassicollis* Zone of western North America have been discussed by Jeletzky (1965a) and Imlay and Jones (1970). This assignment is supported by the discovery of *Valanginites* aff. *nucleus* (Roemer) (see Pl. 1 figs a-d) in the Taseko Lakes map-area in western British Columbia (Jeletzky and Tipper 1968). This was found in beds lying immediately and apparently gradationally beneath early Hauterivian beds with *Homolomites oregonensis* (Anderson) in a continuous but overturned section. The *V. aff. nucleus* beds (which did not yield *Buchia*) are evidently younger than any part of the *Buchia crassicollis* Zone of the Pacific slope because of their stratigraphical position closely below the lowest occurrence of *H. oregonensis*. They are presumably equivalent to the unfossiliferous "Latest Valanginian Rocks" occurring between the *B. crassicollis* and *H. oregonensis* Zones in Quatsino Sound (Jeletzky 1965a).

Valanginites appears to be restricted to the basal part of the Upper Valanginian in southeast France (Thieuloy, this volume) and northwest Germany (Kemper 1968, this volume). However, the Mexican representatives from the upper member of the Taraises Formation (Imlay 1938) are younger, though apparently still Valanginian in the writer's opinion. A late Valanginian age is therefore suggested for the *V. aff. nucleus* beds of Western British Columbia.

The *H. aff. quatsinoensis* Subzone of Arctic Canada probably represents the lower part only of the North Pacific *B. crassicollis* Zone, as *H. quatsinoensis* is restricted to the lower part of this zone in the Quatsino Sound sections (Jeletzky 1965a) and elsewhere in western British Columbia. This, and the association of *P. (D.) aff. bidichotomus* with *H. aff. quatsinoensis*, suggests that the *H. aff. quatsinoensis* Subzone is entirely of early Upper Valanginian age and roughly equivalent to the early Upper Valanginian *Dichotomites* Beds of northwest Germany, the *Polyptychites polyptychus* Zone of the Russian Platform, and the *Dichotomites* spp. Zone of northern Siberia (Fig. 3).

The uppermost part of the *B. ex gr. inflata-sublaevis* Zone, lying above the *H. aff. quatsinoensis* Subzone, is confined to the marine interbeds in the basal beds of the predominantly non-marine Isachsen Formation of the Sverdrup Basin, and to the equivalent, middle, part of the White Sandstone Member of the Lower Sandstone Division in the Porcupine Plateau-Richardson Mountain Trough (Fig. 3). These beds appear to be equivalent to the upper part of the *Buchia crassicollis* Zone of western North America and correlative with the lower part of the "Astieria" Beds of northwest Germany, the "*Dichotomites*" *petschorensis* Zone of the Russian

Platform, and the *Homolsomites bojarkensis* Zone of northern Siberia. Because of the above discussed occurrence of *V. aff. nucleus* in beds younger than the *B. crassicollis* Zone, this uppermost part of the *B. ex gr. inflata-sublaevis* Zone probably does not include the uppermost Valanginian of southwest Europe (Fig. 3).

The Siberian *Homolsomites bojarkensis* Zone was tentatively dated as early Hauterivian by Shulgina (1965), but its late Upper Valanginian age is indicated by its stratigraphical position immediately above the early Upper Valanginian *Dichotomites* spp. Zone and a much greater similarity of *H. bojarkensis* Shulgina and *H. indistinctus* Shulgina to the early Upper Valanginian *H. quatsinoensis* (Whiteaves) and *H. aff. quatsinoensis* than to the early Lower Hauterivian *H. oregonensis* (Anderson) and *H. packardi* (Anderson). Shulgina's tentative dating may have been caused by the tendency (incorrect in the writer's opinion) of Soviet workers to place beds with *Lyticoceras* s. lato (i.e. *Lyticoceras cryptoceras* Zone of Fig. 3) in the basal Hauterivian (e.g. Saks *et al.* 1965). An early Hauterivian dating of these beds was recommended by Debelmas and Thieuloy (1965) but subsequently the majority of western workers have included them in the late Valanginian (e.g. Moullade and Thieuloy 1967; Thieuloy, this volume). In East Greenland the highest *Buchia*-bearing beds of the Mount Niesen section have been placed in the latest Valanginian because of the presence of *Lyticoceras* (e.g. Spath 1946; Donovan 1957; Jeletzky 1965a).

The importance of this conflict of opinions is stressed by the fact that all of the allegedly early Hauterivian records of *P. (D.) bidichotomus* on the Russian Platform, in the Crimea, and in the Caucasus (see Shulgina 1965) are of late Valanginian age in terms of the placement of the Valanginian/Hauterivian boundary adopted here (Fig. 3).

The Central Russian Platform Zones of *Polyptychites polyptychus* and "*Dichotomites*" *petschorensis* (Bogoslovsky) appear to be correlative respectively with the *Dichotomites* spp. and *Homolsomites bojarkensis* Zones of Northern Siberia, rather than with the *Dichotomites* spp. Zone alone as proposed by Saks *et al.* (1965) and Shulgina (1965). In the writer's opinion *Olcostephanus petschorensis* Bogoslovsky (1902 pl. 12 figs. 1a–d) is not a *Dichotomites* but a *Homolsomites* closely allied to *H. indistinctus* and *H. quatsinoensis*. This is clearly indicated by its distinctive, strongly ascendant, craspeditid external suture-line consisting of two lateral and at least four auxiliary lobes (Bogoslovsky 1902 pl. 12 fig. 1d). The true *Dichotomites bidichotomus*, also occurring in European Russia, is a polyptychitid characterised by a different suture line, suspensive in the auxiliary part and consisting of two lateral and no more than three auxiliary lobes (Bogoslovsky 1902 pl. 13 fig. 1c; Arkell *et al.* 1957 fig. 458, 1c). Like the traditional misidentification of *Homolsomites* with *Dichotomites* in North America (e.g. Anderson 1938; Jeletzky 1965a *pars.*), the generic misidentification of *O. petschorensis* appears to be caused by an underestimation of the taxonomic value of the suture line coupled with an overestimation of that of the ribbing habit. The latter is most unreliable at generic level, being apt to recur in almost identical form in a number of homoeomorphic polyptychitids and craspeditids (Jeletzky 1965b, 1966).

The extension of the geographical range of *Homolsomites* of the *H. quatsinoensis*—*H. bojarkensis* group from western North America to the European part of the U.S.S.R. indicates the late upper (but not the latest) Valanginian age of the *H. petschorensis* and *H. bojarkensis* Zones and their approximate contemporaneity with the upper part of the *Buchia crassicollis* Zone of western North America.

6. Systematic palaeontology

Genus *Praetollia* Spath 1952 (= *Pronjaites* Sazonova 1971, subj.)

Type-species. Praetollia maynci Spath 1952 (original designation).

Diagnosis. *Tollia*-like, discoidal, involute to moderately evolute phragmocones with a craspeditid external suture-line that is approximately straight and strongly ascendant through most or all of the distance between the ventral lobe and the umbilical seam and has four to five auxiliary lobes in addition to two lateral lobes; the fine, dense, *Tollia*-like ribbing on the early and intermediate whorls gradually becomes coarser and more widely spaced on the adult ultimate (or penultimate) whorl. The primary ribs on the last (adult) whorl resemble those of fully-ribbed *Craspedites* or *Surites* in becoming thickened, shortened, and more strongly elevated (sometimes faintly to distinctly bullate).

Remarks. The genus *Praetollia* was based on execrably preserved intermediate and early whorls which do not seem to differ materially from the corresponding whorls of more densely ribbed, involute *Tollia* forms. The Canadian *P. antiqua* is important in providing, for the first time, such intermediate whorls in an undistorted state (Pl. 5 figs 1a-d) and in association with well-preserved penultimate whorls and what appear to be parts of an adult living chamber (Pl. 4 fig. 1b; Pl. 7 figs 1a, d). This necessitates a reappraisal of the morphology and taxonomic position of *Praetollia*.

According to Spath (1952 p. 13), *Tollia* differs from *Praetollia* "chiefly in its more sigmoidal costation, with thickening of the primary stems which are more distantly spaced, and there is an increase in the peripheral projection of the secondaries . . ." To these distinctions Spath (1952 p. 14) added that "There is no indication of the constrictions, so characteristic of *Tollia*, and the ribbing on the whole is much straighter". These minor distinctions only apply to the corresponding growth stages of *Tollia tolli* Pavlov (1914 pl. 12 fig. 2a) and other comparably coarsely-ribbed *Tollia* forms (e.g. *Tollia payeri* Toula 1874 pl. 1 fig. 1, or *T. emelianzevi* Voronets 1962 pl. 32 fig. 2). Already the comparable growth stages of *T. tolmatschowi* Pavlov (1914 pl. 13 fig. 1), which in the writer's opinion is only a variant of *T. tolli*, are indistinguishable from *Praetollia maynci* in the spacing and relative straightness of the ribbing and in the appearance of primary stems. Other representatives of *Tollia*, such as *T. mutabilis* (Stanton) var. *mutabilis* (see Imlay 1960 pl. 28 figs 5-11) are characterised by even denser and straighter ribbing than that of *P. maynci*. The morphological features discussed above are, furthermore, known to be extremely variable at infraspecific level (as, for example, in *T. mutabilis*: see Imlay 1960) and so are unsuitable for the erection of even a subgenus, let alone a full genus. The presence or absence of constrictions is an equally unreliable distinction. Donovan (1964) was therefore justified in treating *Praetollia* as a junior synonym of *Tollia* on the evidence then available. The Canadian specimens of *P. antiqua* show, however, that the intermediate and adult stages of *Praetollia* differ from the comparable growth-stages of *Tollia*.

The primary ribs of *Tollia* remain thin, long and pinched until they disappear altogether on the outer whorls. In contrast, those of *Praetollia* become markedly shortened, and thickened, although still pinched and sharp-crested, on the last, and sometimes on the penultimate, whorl. They may also become distinctly bullae-like and rounded in cross-section (as in *Craspedites canadensis pseudosubditus*) on part or all of the living chamber of the largest specimens (e.g. pl. 7 figs 1a, d). The similarity of sculpture and shell-shape of fully-grown *P. antiqua* (Pl. 4 figs 1a-d, Pl. 7 figs 1a-d) to those of the strongly sculptured variant of *Craspedites (Taimyroceras?) canadensis*, i.e. the subspecies *pseudosubditus* (see Jeletzky 1966 pl. 2 figs 3, 4), is so close that there is every reason to accept the derivation of *P. antiqua* (and hence that of *Praetollia*) directly from such uppermost Volgian forms of *Craspedites (Taimyroceras?)*. The latter differ from *Praetollia* in their radial or only slightly ascendant, simpler suture-line (Jeletzky 1966 fig. 1J) and in the interruption of secondaries in the middle of the venter.

The similarity of ribbing in *Tollia* and *Praetollia* appears therefore to be limited to the early and intermediate growth-stages. The adult *Praetollia* reverts to a more *Craspedites*-like morphology.

The external suture-line of all known *Praetollia* species (i.e. *P. maynci* Spath, *P. bidevexa* (Bogoslavsky), *P. nikitinoense* (Sazonova) and *P. antiqua*) appears to differ from that of many late Berriasian and Valanginian representatives of *Tollia*, including *T. tolli*, in being more strongly ascendant and approximately straight throughout or almost throughout the distance between the ventral lobe and the umbilical seam (see Spath 1952 figs 1a, 1b, pl. 4 fig. 2, this paper, Pl. 5 figs 1a, b, d). Thus, it is more like that of *Surites* ex gr. *spasskensis*. The external sutures of many *Tollia* species (see figs in Pavlov 1914; Saks and Shulgina 1969; Imlay and Jones 1970; Toula 1874) are either less ascendant throughout or are only comparably strongly ascendant in their adventral parts. The strongly ascendant parts of the latter sutures embrace either the first and second lateral lobes or these two lobes plus the first auxiliary lobe (or, rarely, the first and second auxiliary lobes). The remaining, adumbilical, part of the

external suture-line is for the most part either only feebly ascendant or subradially directed. It may be feebly suspensive in some forms. Strongly ascendant adventral parts of such suture-lines may grade into their less ascendant to feebly suspensive parts, causing a more-or-less regularly adorally arched appearance in some *Tollia* suture-lines. In other *Tollia* each of the two parts of the external suture is more-or-less straight. Consequently an adorally directed knick occurs at their junction.

Further research is required to evaluate the constancy of these distinctions of the *Praetollia* suture-line, as some *Tollia* external suture-lines (e.g. Pavlow 1914 pl. 4 fig. 3a) appear indistinguishable from those of *Praetollia*.

Praetollia antiqua sp. nov. Pl. 4 figs 1a–d; Pl. 5 figs 1a–d; Pl. 7 figs 1a–d.

1966 Undescribed craspeditid ammonite: Jeletzky, pp. 20, 43.

1970 *Subcraspedites* n. sp. Jeletzky, table XI–8.

1971b *Tollia* (*Subcraspedites*?) n. sp. Jeletzky, p. 4, fig. 2.

Holotype. GSC Cat. no. 32597 (figured Pl. 5 figs a–d).

Material. Ten fragmentary to almost complete specimens, mostly undeformed but in part strongly weathered, from a horizon 129.5 metres above the base of the Deer Bay Formation in the Buchanan Lake section (see p. 47 for geographical detail); GSC loc. 52488.

Diagnosis. *Praetollia* characterised by a moderately evolute (umbilicus 34% to 35% of the diameter), shell; the biplicate, fine, dense (33–38 primary ribs per whorl) sculpture lasts to whorl heights of 20–25 mm; in subsequent growth stages it is replaced by coarser and more widely spaced, predominantly triplicate ribbing. In this triplicate growth-stage, many secondaries are either indistinctly attached to sigmoidally bent and pinched but heavy primary ribs, or are intercalated between them; as the ribbing coarsens, primary ribs may become blunt, somewhat swollen and bullate on the adult body-chamber.

Measurements. Holotype (GSC Cat. no. 32597) 81.5; 40; 34; 34.

Figd specimens: GSC 32600 91 (approximately); 43; 35; 35.

GSC 32594 74 (approximately); 40; 38; 34.

(Dimensions are in the order: diameter of shell in mm, whorl height in mm, whorl height as percentage of diameter, width of umbilicus as percentage of diameter).

Description. The earliest whorls (up to 6–7 mm diameter) are almost globose, with rounded whorl section. At higher diameters the whorl is higher than wide (1.1–1.2), the whorl section oval with a narrowly rounded venter and slightly to feebly convex flanks, which gradually contract all the way towards the venter from an ill-defined and rounded umbilical shoulder (Pl. 5 figs 1a, c). Each whorl covers from two-thirds to three-quarters of the preceding whorl. Variation of whorl shape is restricted to slight changes in convexity of the flanks and equally slight changes in the relative height of the whorl.

The earliest whorls are seen only in exposed parts of larger shells. They appear to remain completely smooth to a whorl height of about 3–4 mm. Fine, dense, biplicate ribs then appear. The primary ribs are closely spaced, straight to feebly flexed, and usually moderately inclined forward. They begin on the upper half of the umbilical wall and bifurcate at mid-flank or slightly higher. The secondary ribs are generally slightly flexed and invariably strongly inclined forward; they cross the venter in a pronounced forward bend and without any mid-ventral weakening (Pl. 5 figs 1a, c). All ribs are high, pinched and sharp-topped, in well-preserved, shell-covered specimens (Pl. 4 figs 1a–d) but have a considerably more subdued, round-topped appearance on internal moulds (Pl. 5 figs 1a–d). The secondaries are almost invariably firmly attached to the primaries, and intercalated secondaries are rare. The number of primaries varies from 33 to 38 per whorl; an estimate of 76–78 secondaries per whorl is based on counting 38 or 39 secondaries on a half whorl of the holotype between whorl-heights of about 14 and 20 mm. The best preserved specimen of *P. maynci* figured by Spath (1952 pl. 3 fig. 2), has an estimated 40 primaries and 92 secondaries.

This biplicate sculpture persists to whorl-heights of 20 to 25 mm, where triplicate rib bundles begin to intercalate with the biplicate ones (Pl. 5 fig. 1d). The triplicate bundles may have a fasciculate appearance. After another fifth or quarter of a whorl biplicate rib bundles become rare to absent, the well-formed triplicate bundles begin to alternate with unattached single ribs (which begin at about mid-flank) and some quadriplicate bundles appear. Connections between primaries and secondaries become indistinct, and in many instances the primary ribs are only clearly connected with one or two secondaries, the others being indistinctly connected or intercalated between adjacent bundles. In this growth-stage, primary ribs tend to become more markedly flexed and forwardly inclined. Simultaneously, they become distinctly shorter (between one-third and two-fifths of the whorl's height), heavier and much more widely spaced (20–21 primaries per whorl above 25 to 30 mm whorl height). They remain sharp-topped and

pinched to the adoral part of the adult bodychamber, when they may become round-topped and somewhat swollen (Pl. 5 fig. 1b). Secondary ribs also retain their fine, high, pinched and sharp-topped appearance (Pl. 4 figs 1a, c, d) except on internal moulds where they have a subdued, rounded, *Craspedites*-like aspect. Unlike the primary ribs, the secondaries do not seem to decrease in number per whorl during growth. As in the biplicate stage, they are flexed and strongly forwardly inclined, crossing the venter in a pronounced forward bend without any mid-ventral weakening (Pl. 4 figs 1a, b). Because of its persistence without weakening to the end of the largest, presumably adult, living chambers (Pl. 7 figs 1a, d) the triplicate ribbing is presumed to be the adult habit of *P. antiqua*. The weakening of sculpture on one flank of the largest body-chamber available (Pl. 7 fig. 1a) appears to be the result of weathering.

The suture-line of *P. antiqua* is typical of the genus.

Comparison with other species. *P. bidevexa* (Bogoslovsky 1897 pl. 3 figs 1–3) resembles *P. antiqua* in its similarly evolute whorl and in the coarsening, wider spacing and indistinct connection of primary and secondary ribs on the intermediate and outer whorls (the living chamber of *P. bidevexa* is unknown), but the biplicate growth-stage ends earlier (at a whorl-height of 10–12 mm). *P. bidevexa* has a relatively higher and more slender whorl with a disc-shaped section (instead of the oval section of *P. antiqua*) and a considerably more narrowly-rounded venter.

P. maynci differs from comparable growth-stages of *P. antiqua* in having an involute whorl, considerably finer and denser ribbing, and predominantly biplicate ribbing to a greater whorl-diameter (to at least 30 mm in the specimen figured on pl. 3 fig. 2 of Spath 1952). It is difficult to compare whorl sections as all Spath's (1952) figured *P. maynci* are strongly distorted. However, *P. maynci* apparently has a higher-whorled, more slender, and narrowly-ventered shell, in this respect being closer to *P. bidevexa*.

P. nikitinoense (Sazonova 1971) differs from *P. antiqua* in its lower whorl-section (Sazonova 1971 pl. 9 fig. 5a) with blunt venter, and in the prevalence of triplicate rib-bundles at a whorl diameter of only 12 mm, and possibly less. This poorly-known form is placed in *Praetollia* only tentatively, because of the close similarity of its ribbing to that of *P. bidevexa*. "*Praetollia*" *nikitinoense* may be an early *Tollia*-like growth-stage of a large *Craspedites* (*Subcraspedites*) species.

Genetic relationships. *P. antiqua* is believed to be an endemic form which evolved in the Sverdrup Basin from a late Upper Volgian *Craspedites* (see generic discussion, above) through the modification of the suture-line and disappearance (or primary absence) of the interruption of ribs on the venter. Transitional forms are as yet unknown, as *Craspedites* of the *canadensis* group and *P. antiqua* have not yet been found in the same continuous section.

Ammonites closely similar to *P. antiqua* in ribbing, whorl-section and suture-line occur in the (younger) basal Berriasian beds of the Sverdrup Basin (e.g. "*Tollia* (*Subcraspedites*) aff. *spasskensis*": Jeletzky 1964 pl. 2 fig. 4). These forms are, however, intermediate whorls of large, low-whorled, heavily bullate adults properly referred to *Craspedites* (*Subcraspedites*) ex gr. *suprasubditus* (see Pl. 6, figs 1a–d). Their close similarity to *P. antiqua* is ascribed to their direct derivation from the same root-stock (*Craspedites* (*Taimyroceras*?) *canadensis*).

The apparent absence of *Praetollia*-like craspeditids in the Berriasian rocks of the Sverdrup Basin and the presence of *Praetollia* in coeval rocks of East Greenland, North Siberia and the Russian Platform suggests the emigration of this stock soon after its naissance in the Sverdrup Basin during the latest Jurassic. It is too early to say whether *Praetollia* is a direct ancestor of *Tollia* as suggested by Spath (1952 p. 13) or an unrelated, strongly homoeomorphic offshoot of the more persistent *Craspedites* stock.

Acknowledgements. The growth of ideas presented here was greatly facilitated by discussion with many colleagues both within and outside the Geological Survey of Canada and by the study of numerous museum collections in North America, Western Europe and England during the last 20 years or so. Sincere thanks are expressed to all the colleagues, too numerous to mention by name, in Canada, the United States, Great Britain, Western Europe and the Soviet Union.

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