Early Jurassic Bivalvia of western Canada.

Part I. Subclasses Palaeotaxodonta, Pteriomorphia, and Isofilibranchia

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ABERHAN, M. 1998. Early Jurassic Bivalvia of western Canada. Part I. Subclasses Palaeotaxodonta, Pteriomorphia, and Isofilibranchia. - Beringeria 21: 57-150, 15 text-figs., 1 table, 19 pls.; Würzburg.

Abstract. More than 4000 bivalve specimens from the Lower Jurassic of western Canada are assigned to 72 taxa representing 47 genera and subgenera of the bivalve subclasses Palaeotaxodonta, Pteriomorphia, and Isofilibranchia. *Canadonectites* is established as a new genus, and *Striatoamussium* is established as a new subgenus of *Propeamussium*; new species are *Mytiloperna charlottensis*, *Canadonectites paucicostatus*, *Ochotochlamys aequistriata*, and *Weyla (Lywea) yukonensis*. The study area includes the allochthonous terranes Wrangellia, Stikinia, Quesnellia, and Cadwallader Terrane, as well as the Western Canada Sedimentary Basin on the autochthonous craton. Hettangian to Aalenian ammonites that co-occur with the bivalves provide an excellent biostratigraphic control. Where ammonites are absent, several bivalve species proved useful for relative age determinations.

■ *Jurassic, bivalves, taxonomy, Canada*

Zusammenfassung: Aus dem Unterjura des westlichen Kanada werden 72 Muscheltaxa, die 47 Gattungen und Untergattungen der Unterklassen Palaeotaxodonta, Pteriomorphia und Isofilibranchia angehören, beschrieben. *Canadonectites* wird als neue Gattung und *Striatoamussium* als neue Untergattung von *Propeamussium* aufgestellt. Die folgenden Arten sind neu: *Mytiloperna charlottensis*, *Canadonectites paucicostatus*, *Ochotochlamys aequistriata* und *Weyla (Lywea) yukonensis*. Das Arbeitsgebiet umfaßt die allochthonen Terranes Wrangellia, Stikinia, Quesnellia und Cadwallader Terrane, sowie das Western Canada Sedimentary Basin auf dem autochthonen Kraton. Ammoniten des Hettang bis Aalen, die mit der Muschelfauna vergesellschaftet sind, ermöglichen eine ausgezeichnete biostratigraphische Kontrolle. In einigen Fällen wo Ammoniten fehlten, waren verschiedene Muschelarten bei der Altersbestimmung von Nutzen.

■ *Jura, Muscheln, Taxonomie, Kanada*

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Contents

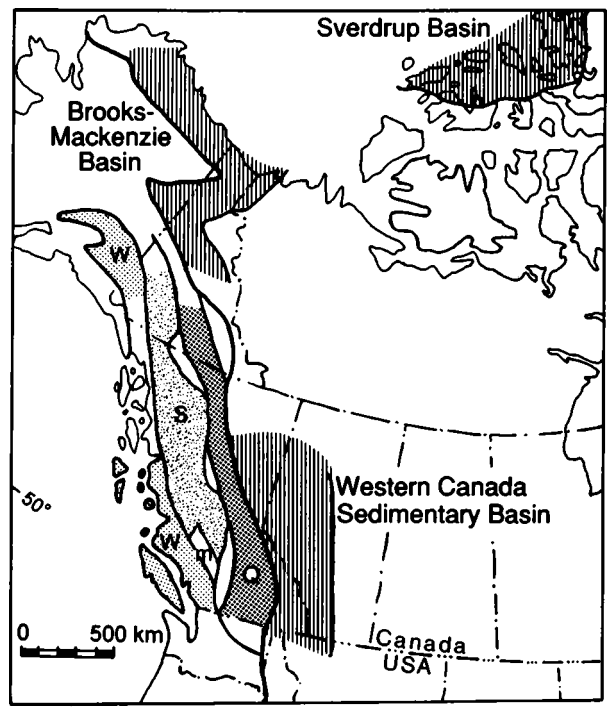
1 Introduction

The present study is part of a comprehensive palaeontological and palaeobiogeographic analysis of the Early Jurassic bivalve fauna of western Canada. Intense field work by the Geological Survey of Canada for nearly a century, combined with the stratigraphically controlled sampling of fossils, resulted in extensive Jurassic bivalve collections. Whilst some of the available material housed in the collections of the Geological Survey of Canada was documented in several, usually relatively short, taxonomic accounts (e.g. LEES 1934, FREBOLD 1957a, b, 1959, 1964, FREBOLD & TIPPER 1969, FREBOLD & POULTON 1977, POULTON 1991), a modern and comprehensive taxonomic treatment of Early Jurassic bivalves from western Canada is lacking up to now. In order to provide a sound taxonomic basis for palaeobiogeographic and palaeoecological studies, I attempt to describe, document, and revise the complete bivalve fauna from the Lower Jurassic of western Canada. The present report is the first part of this monograph and deals with the subclasses Palaeotaxodonta, Pteriomorphia, and Isofilibranchia.

2 Geological framework and localities

The geotectonic history of western Canada reflects the complex evolution of a mosaic of numerous allochthonous terranes that became attached to the western margin of the autochthonous North American craton at different times and today form a major portion of the North American Cordillera (e.g. CONEY et al. 1980). The timing of collision and accretion as well as migratory routes of terranes prior to docking are still poorly understood and several different tectonic models have been proposed (e.g. MONGER et al. 1991, VAN DER HEYDEN 1992, MIHALYNUK et al. 1994). In addition to palaeomagnetically derived estimates of palaeolatitudinal positions, also biogeographic data have proved useful for constraining pre-collision displacements of terranes (e.g. TAYLOR et al. 1984, SMITH & TIPPER 1986, ABERHAN 1998).

The three tectonostratigraphic terranes of western Canada that yielded most of the specimens analysed in the present paper are, from west to east: (1) Wrangellia (extending from the Coast Ranges and islands of British Columbia to south-central Alaska); (2) Stikinia (comprising much of interior British Columbia and central and southern Yukon); and (3) Quesnellia (south-central British Columbia and extending into the Yukon) (Text-fig. 1). They have a relatively complete Lower Jurassic rock record with fossil-bearing lithofacies comprising primarily shale, volcaniclastic siltstone and sandstone, fine- and coarse-grained mixed siliciclastic-carbonate sediments, and very rarely wacke- to packstones. Fossiliferous Lower Jurassic siliciclastic rocks have also been identified on a further, small terrane of the Canadian Cordillera, the Cadwallader Terrane. This terrane is from a tectonically complex region, the so-called 'Methow' Basin in south-western British Columbia (Text-fig. 1), and its geological relationship to other terranes is still controversial. Compared to Wrangellia, Stikinia, and Quesnellia, the known bivalve faunas of the Cadwallader Terrane are far less abundant and diverse.



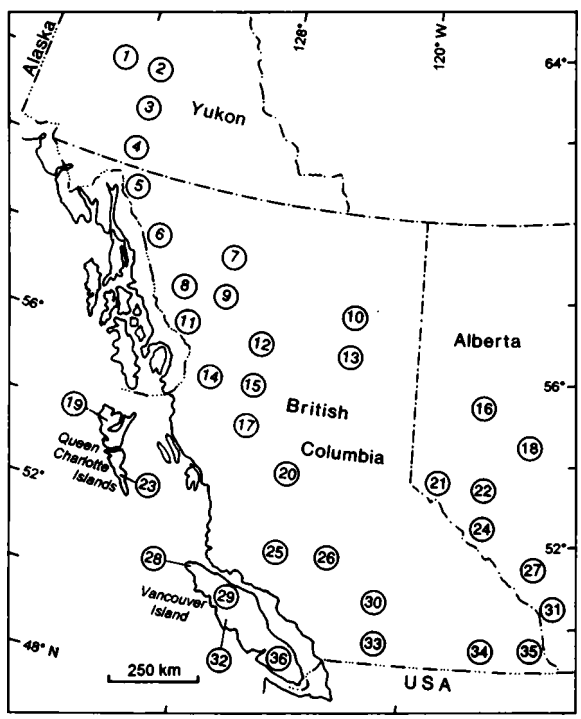
Text-fig. 1. Present position of selected Early Jurassic sedimentary basins of western and northern Canada. Stippled: allochthonous terranes, which were not yet accreted to the craton by Early Jurassic times; m = 'Methow' Basin, which includes the Cadwallader Terrane; Q = Quesnellia; S = Stikinia; W = Wrangellia. Hatched: autochthonous sedimentary basins of the western Canadian craton. (Modified after SMITH & TIPPER 1986, POULTON et al. 1993.)

At the western and northern margins of the stable Canadian craton, Lower Jurassic sedimentation occurred in three independent basins (Text-fig. 1; e.g. POULTON 1991, 1993, POULTON et al. 1993): (1) the Western Canada Sedimentary Basin of the central and southern Canadian Rockies and the foothills of Alberta and British Columbia; (2) the Brooks-Mackenzie Basin in northern and central Yukon and adjacent Northwest Territories and Alaska; and (3) the Sverdrup Basin of the Canadian Arctic Islands. In these epicontinental basins largely siliciclastic sediments were deposited. These comprise shelf sandstones at the basin margins, which are replaced by shales and siltstones in off-shore basinal areas; carbonate sedimentation played a very minor role. All autochthonous bivalves described in the present paper are from the Western Canada Sedimentary Basin. Its Sinemurian basin fill exhibits a variety of different lithofacies and a moderately diverse bivalve fauna. In contrast, all Pliensbachian and Toarcian samples of the Western Canada Sedimentary Basin are from poorly fossiliferous black shales and dark calcareous mudstones of the basin center, suggesting oxygen-deficient environments with adverse living conditions in and on the sea floor. Contemporaneous bivalves from more marginally located, well aerated, shallow water settings are not known.

Due to the huge number of fossil localities covered in this monograph, it is not reasonable to provide detailed maps of every locality. Rather, short descriptions of the various localities, including information on latitude and longitude, are presented in Appendices I and II. Appendix I lists all cited localities of the Geological Survey of Canada and also includes information on the relative age of each sample point based on the co-occurrence of bivalves with ammonoid faunas. For the purpose of this study age determinations have been up-dated by two specialists of Jurassic ammonites from the Geological Survey of Canada, TERRY P. POULTON and HOWARD W. TIPPER. The main collecting areas and their corresponding terranes are shown in Text-fig. 2 and Tab. 1.

3 Material and methods

This study is based on more than 4000 specimens from the extensive collections of the Geological Survey of Canada (GSC) housed in Calgary and Vancouver, and from the Royal Tyrrell Museum of Palaeontology (TMP) in Drumheller, Alberta. The material is from the mentioned allochthonous terranes of British Columbia and south-central Yukon, and from the Western Canada Sedimentary Basin on the autochthonous craton. A report on Hettangian through Aalenian bivalves from the Brooks-Mackenzie Basin was recently published by POULTON (1991), and those from the Sverdrup Basin are currently under study (HRUDKA, in preparation).



Text-fig. 2. Locality index map for main occurrences of Early Jurassic bivalves in western Canada. For information on localities see Table 1.

In addition, type material of previous studies on Early Jurassic bivalves from North America, now kept in the Geological Survey of Canada, Ottawa, the British Museum of Natural History (BMNH), London, the Natural History Museum Basel (NHMB), and the University of California Museum of Paleontology (UCMP), Berkeley, has been examined. For comparison with coeval bivalves from the South American Pacific margin abundant material from northern Chile, housed in the Servicio Nacional de Geología y Minería, Santiago, and in the collections of the Institut für Paläontologie, Würzburg, was available.

Specimens were cleaned in the laboratory and prepared mechanically by means of vibrotools and needles. Due to varying intensities of shell breakage, shell dissolution, and postdepositional distortion, preservation quality varies considerably. Shell preserva-

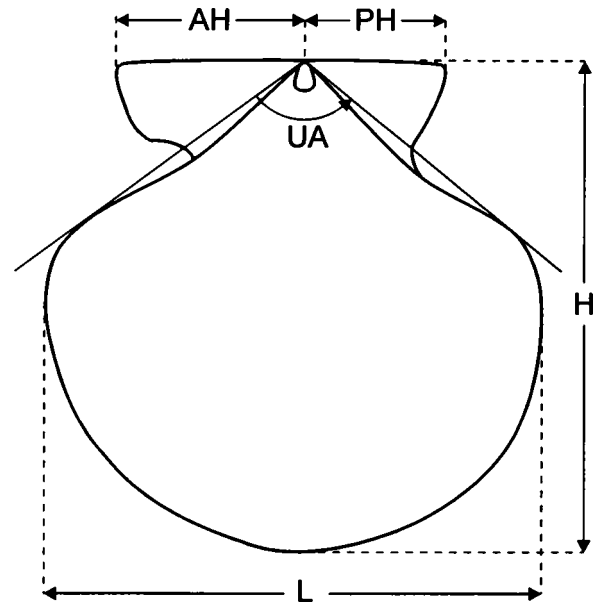
Table 1. Main collecting areas (1:250000 scale map sheets) of Early Jurassic bivalves in western Canada and their corresponding terranes; -- = craton.

Loc. number	Locality name (map-area)	Terrane
1	Carmacks	Stikinia
2	Glenlyon	Stikinia
3	Laberge	Stikinia
4	Whitehorse	Stikinia
5	Skagway	Stikinia
6	Tulsequah	Stikinia
7	Cry Lake	Stikinia
8	Telegraph Creek	Stikinia
9	Spatsizi River	Stikinia
10	Trutch	--
11	Iskut River	Stikinia
12	McConnell Creek	Stikinia
13	Halfway River	--
14	Nass River	Stikinia
15	Hazelton	Stikinia
16	Winagami	--
17	Smithers	Stikinia
18	Whitecourt	--
19	Graham Island	Wrangellia
20	Nechako River	Stikinia
21	Mount Robson	--
22	Edson	--
23	Moresby Island	Wrangellia
24	Brazeau	--
25	Mount Waddington	Cadwallader
26	Taseko Lakes	Cadwallader
27	Calgary	--
28	Cape Scott	Wrangellia
29	Alert Bay	Wrangellia
30	Ashcroft	Quesnellia
31	Kananaskis Lakes	--
32	Nootka Sound	Wrangellia
33	Hope	Wrangellia
34	Nelson	Quesnellia
35	Fernie	--
36	Cape Flattery	Wrangellia

tion occurs in some bivalves with calcitic shells. However, internal and external moulds are far more common and several hundreds of latex casts were produced from external moulds. Compressional deformation often resulted in the accentuation of those parts of the ornament that are aligned perpendicularly to the strain axis. Depending on the relative position of a specimen with regard to the stress-field orientation, riblets and commarginal folds became accentuated on different parts of the shell surface. This effect is particularly evident, for example, in radially and commarginally ornamented pectiniform bivalves such as *Posidonotis* and *Ochotochlamys*.

The classification of higher taxa follows the scheme of CARTER (1990), which is largely based on shell microstructure. The use of open nomenclature essentially follows BENGTSON (1988). The term "aff." indicates a probably new species that I cannot name, mainly because of small sample size. Use of "cf." denotes a provisional identification, mainly due to poor preservation of the available material. A question mark indicates uncertainty at the genus-level.

The synonymy lists focus on the most important references. They usually contain the first reference of a taxon and those referring to North American records with illustrations. Additional references are provided where it appeared necessary or when a modern revision of the respective taxon was available. The symbol "v" to the left of the date means that I have seen the specimens of the cited reference. The symbol "pv" indicates that I have seen some of the cited specimens. The term "non" implies that none of the cited specimens is regarded conspecific with the species under discussion. Uncertainty is expressed by a "cf." and the use of "aff." signifies that the cited specimens are closely related but not conspecific with the species under discussion.



Text-fig. 3. General dimensions of bivalves measured in this study. For key of abbreviations see text.

Under "Stratigraphic range" the age of the taxon under discussion in western Canada is given. The type specimens of all new species were measured. Measurements are in millimetres with approximate figures preceded by "~". The used abbreviations are as follows (Text-fig. 3):

L length
H height

I	inflation of specimen
AH	anterior hinge length
PH	posterior hinge length
UA	umbonal angle
NR	number of ribs
lv	left valve
rv	right valve
2v	articulated specimen

All fossil material from western Canada referred to in this report is housed in the collections of the Geological Survey of Canada and, to a far less extent, in the Royal Tyrrell Museum of Palaeontology. Each figured specimen is assigned a Geological Survey of Canada (GSC) or Royal Tyrrell Museum of Palaeontology (TMP) type number.

4 Taxonomy

Class Bivalvia LINNÉ 1758

Subclass Palaeotaxodonta KOROBKOV 1954

Order Nuculoida DALL 1889

Remarks. A large number of nominal species exists for Jurassic nuculid bivalves. Because many of them are poorly defined and/or may be synonyms, identification at the species level is often rendered impossible. As a rule, a prerequisite for a successful identification of species is the availability of well preserved material, which allows the observation of external and internal features alike. In order to assess the whole morphological range of a species comparisons within single populations are required. These conditions are not realized in the material available from western Canada and therefore assignment to particular species was rarely possible.

Family Nuculidae GRAY 1824

Genus *Palaeonucula* QUENSTEDT 1930

Type species. *Nucula hammeri* DEFRANCE 1825.

Palaeonucula sp. A

Pl. 1, Fig. 9

Material. 1 left valve (GSC 112359) from GSC locality 93252.

Stratigraphic range. Late Pliensbachian (probably Kunae Zone).

Description. This species is characterized by a short, trigonal outline and a prominent umbo, which is placed slightly posterior to median. The evenly convex rounded ventral margin reaches its lowest position slightly anterior to midlength. The lanceolate escutcheon is bordered by a rounded ridge. Due to poor preservation, presence of a lunule is uncertain. *Palaeonucula* sp. A is ornamented with fine, somewhat irregular, closely set commarginal growth lines. Only the anterior series of hinge teeth can be observed. It consists of at least 9 faintly chevron-shaped hinge teeth, whose convexities are directed towards the umbo.

Remarks. General form and dentition allow assignment of the specimen to the genus *Palaeonucula*. As only a single left valve is available for study the range of intraspecific variation remains unknown. Therefore, identification at the species level is not possible at present.

Palaeonucula sp. B

Pl. 1, Figs. 1-4

Material. 1 right valve and 1 steinkern (GSC 112360) from GSC locality C-80812; 1 steinkern (GSC 112362) from GSC locality C-156378; 1 right valve from GSC locality C-156885, 2 steinkerns (including GSC 112361) from GSC locality C-157706; 1 left valve, 1 right valve, and 1 steinkern from GSC locality C-158027; 1 steinkern (GSC 112363) from GSC locality C-158036; 1 steinkern from GSC locality C-158040; 2 left valves and 2 steinkerns from GSC locality C-158043; 4 steinkerns from GSC locality C-158059. All preserved as internal moulds.

Stratigraphic range. Early or Middle Toarcian to Late Toarcian.

Description. The shell of *Palaeonucula* sp. B is rounded triangular in outline and strongly inequilateral. The slightly ophistogyrate umbones are placed about one-fourth of shell length from the posterior end. The ventral margin is evenly convex and merges into the sharply rounded anterior and posterior margins. Antero-dorsal and postero-dorsal margins are straight to slightly concave. A large lunule and escutcheon are present. As all available specimens are internal moulds, the sharpness of the bordering ridges of both lunule and escutcheon cannot be observed. For the same reason, the external ornament is unknown.

The hinge consists of up to 15 anterior teeth; number of posterior teeth and details of the dentition cannot be observed. The internal moulds demonstrate that anterior and posterior muscle scars formed distinct but uneven depressions on the shell interior; a pallial sinus is absent.

Remarks. *Palaeonucula* sp. B can be clearly distinguished from *Palaeonucula* sp. A by its more rounded-triangular shape and inequilateral shell. Similar species from Europe include *Palaeonucula hausmanni* (ROEMER 1836) (e.g. ROEMER 1836: 98, pl. 6, figs. 12a-d; KUHN 1935: 120, pl. 8, figs. 33a-b, 41a-d) and the type species *Palaeonucula hammeri* (DEFRANCE 1825) (e.g. QUENSTEDT 1851: 527, pl. 44, figs. 4-5; 1856: 313, pl. 43, figs. 7-12; 1884: 802, pl. 63, figs. 14-15; LISSAJOUS, 1910: 374, pl. 11, fig. 10). These European species apparently resemble *Palaeonucula* sp. B from western Canada in terms of general outline, presence of a relatively pronounced postero-ventral margin and a large lunule, and the number of anterior teeth. Possibly all three are synonyms.

EXPLANATION OF PLATE 1

Figs. 1-4. *Palaeonucula* sp. B. 1a, b. Figured specimen GSC 112360 from GSC locality C-80812; Toarcian of Maude Island, British Columbia. a, internal mould of right valve; b, internal mould of left valve; x 2. 2a, b. Figured specimen GSC 112361 from GSC locality C-157706; Middle Toarcian of Graham Island, British Columbia. a, internal mould of right valve; b, internal mould of left valve; x 2. 3a, b. Figured specimen GSC 112362 from GSC locality C-156378; Toarcian of Graham Island, British Columbia. a, internal mould of left valve; b, internal mould of right valve; x 2. 4a, b. Figured specimen GSC 112363 from GSC locality C-158036; Toarcian of Graham Island, British Columbia. a, internal mould of right valve; b, internal mould of left valve; x 2.

Figs. 5-7. *Nuculana?* sp. A. 5. Figured specimen GSC 112364 from GSC locality 20306; Pliensbachian-Toarcian boundary of Whitehorse area, southern Yukon. Internal mould of left valve; x 2. 6. Figured specimen GSC 112365 from GSC locality 20306; Pliensbachian-Toarcian boundary of Whitehorse area, southern Yukon. Internal mould of left valve; x 2. 7. Figured specimen GSC 112366 from GSC locality 20306; Pliensbachian-Toarcian boundary of Whitehorse area, southern Yukon. Internal mould of left valve; x 2.

Fig. 8. *Ryderia* sp. A. Figured specimen GSC 112367 from GSC locality C-81950; Upper Pliensbachian of Tulsequah area, British Columbia. Internal mould of right valve with relict shell material attached; x 2.

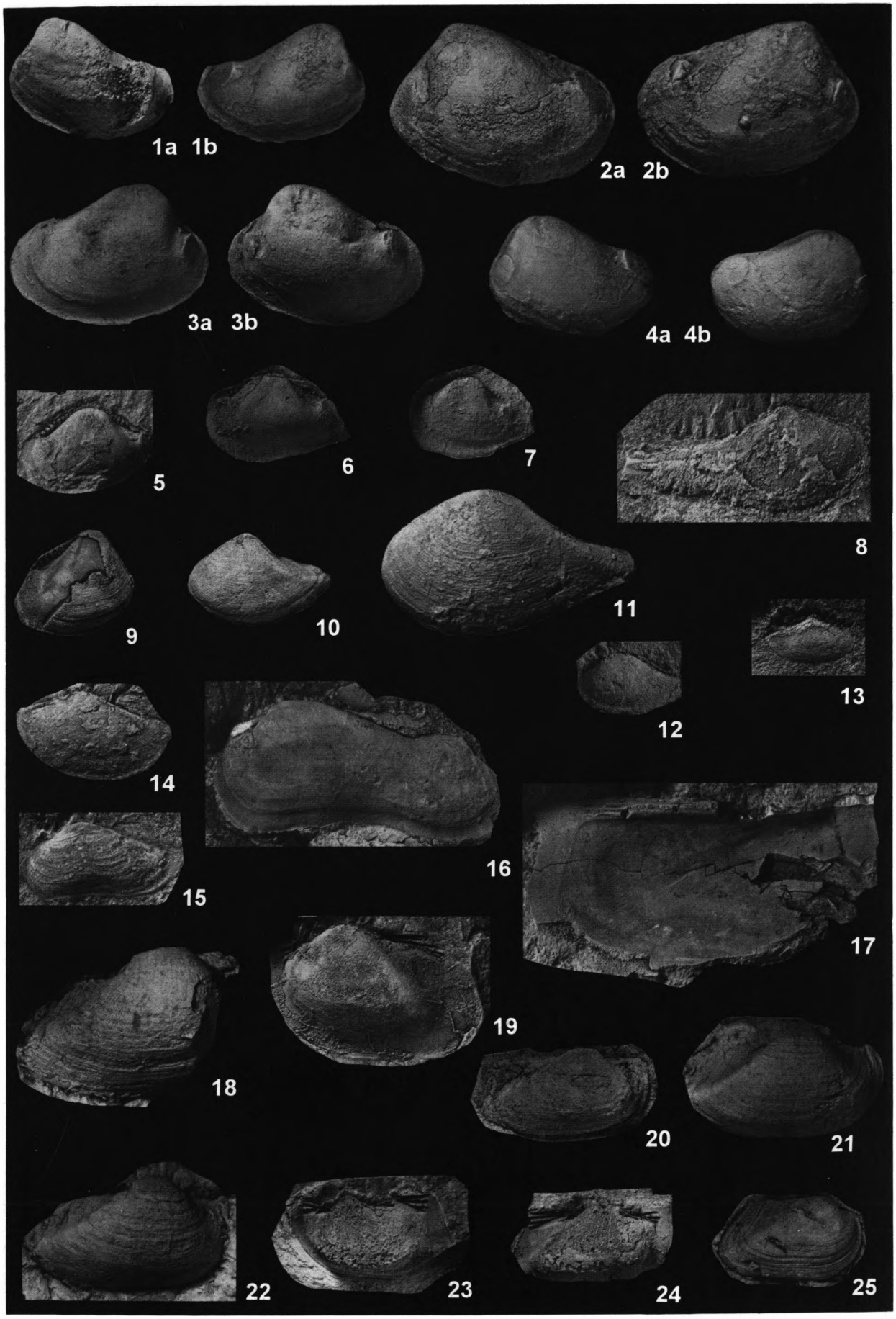
Fig. 9. *Palaeonucula* sp. A. Figured specimen GSC 112359 from GSC locality 93252; Upper Pliensbachian of McConnell Creek area, British Columbia. Exterior view of left valve; x 2.

Figs. 10-11. *Nuculana (Praesaccella)* cf. *ovum* (J. DE C. SOWERBY 1825). 10. Figured specimen GSC 112368 from GSC locality 95015; Sinemurian of Cry Lake area, British Columbia. Exterior view of left valve; x 2. 11. Figured specimen GSC 112369 from GSC locality C-157720; Middle Toarcian of Graham Island, British Columbia. Exterior view of left valve; x 2.

Figs. 12-14. *Palaeoneilo* sp. A. 12. Figured specimen GSC 112370 from GSC locality C-86682; Upper Pliensbachian of Tulsequah area, British Columbia. Internal mould of left valve; x 2. 13. Figured specimen GSC 112371 from GSC locality 19303; Lower Jurassic of Nootka Sound area, British Columbia. Internal mould of right valve; x 2. 14. Figured specimen GSC 112372 from GSC locality 91774; Upper Pliensbachian of Carmacks area, southern Yukon. Internal mould of left valve; x 2.

Figs. 15-17. *Parallelodon groeberi* DAMBORENEA 1987. 15. Figured specimen GSC 112373 from GSC locality C-86513; Upper Pliensbachian of Tulsequah area, British Columbia. Composite mould of left valve; x 1. 16. Figured specimen GSC 112374 from GSC locality C-90901; Lower Pliensbachian of Spatsizi area, British Columbia. Internal mould of left valve; x 1. 17. Figured specimen GSC 112375 from GSC locality C-90901; Lower Pliensbachian of Spatsizi area, British Columbia. Interior view of left valve; x 1.

Figs. 18-25. *Grammatodon (Grammatodon)* aff. *concinnus* (PHILLIPS 1829). 18. Figured specimen GSC 112376 from GSC locality 19374; Pliensbachian of Nootka Sound area, British Columbia. Internal mould of right valve; x 1.5. 19. Figured specimen GSC 112377 from GSC locality 20306; Pliensbachian-Toarcian boundary of Whitehorse area, southern Yukon. Internal mould of left valve; x 1.5. 20. Figured specimen GSC 112378 from GSC locality C-81323; Sinemurian of Laberge area, southern Yukon. Latex cast of right valve; x 1.5. 21. Figured specimen GSC 112379 from GSC locality 19374; Pliensbachian of Nootka Sound area, British Columbia. Internal mould of right valve; x 1.5. 22. Figured specimen GSC 112380 from GSC locality 19374; Pliensbachian of Nootka Sound area, British Columbia. Exterior view of abraded right valve; x 1.5. 23. Figured specimen GSC 112381 from GSC locality 20306; Pliensbachian-Toarcian boundary of Whitehorse area, southern Yukon. Internal mould of left valve; x 1.5. 24. Figured specimen GSC 112382 from GSC locality 20306; Pliensbachian-Toarcian boundary of Whitehorse area, southern Yukon. Internal mould of right valve; x 1.5. 25. Figured specimen GSC 112383 from GSC locality C-81311; Sinemurian of Laberge area, southern Yukon. Latex cast of right valve; x 1.5.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Family Nuculanidae ADAMS & ADAMS 1858

Genus *Nuculana* LINK 1807

Type species. *Arca rostrata* CHEMNITZ 1774.

Nuculana? sp. A

Pl. 1, Figs. 5-7

Material. 4 left valves (including GSC 112364 to 112366) and 2 right valves from GSC locality 20306. All preserved as internal moulds.

Stratigraphic range. Pliensbachian-Toarcian boundary.

Remarks. The specimens assigned to *Nuculana?* sp. A are internal moulds, which have suffered post-depositional distortion. For this reason, their precise shape cannot be observed. Presence of a produced posterior end and a narrow, oblique ligamental pit suggest that the specimens belong to *Nuculana*.

Subgenus *Praesaccella* COX 1940

Type species. *Nuculana (Praesaccella) juriana* COX 1940.

Nuculana (Praesaccella) cf. *ovum* (J. DE C. SOWERBY 1825)

Pl. 1, Figs. 10-11

cf. 1825 *Nucula ovum* sp. nov. - J. DE C. SOWERBY: 118, pl. 476, fig. 1.

cf. 1987a *Nuculana* cf. *ovum* (J. DE C. SOWERBY 1824) - DAMBORENEA: 59, pl. 1, figs. 7-9, text-fig. 9 (see for synonymy list).

Material. 1 left valve (GSC 112368) from GSC locality 95015; 1 left valve from GSC locality C-86807; 1 right valve from GSC locality C-86819; 1 left valve (GSC 112369) from GSC locality C-157720.

Stratigraphic range. Sinemurian to late Middle Toarcian.

Remarks. In general external morphology *Nuculana (Praesaccella)* cf. *ovum* has strong affinities to the genus *Dacryomya* AGASSIZ, which, however, exhibits sharp carinae bounding a deep escutcheon. As this feature is absent in the studied specimens from Chile and Canada, the species is rather assigned to *Nuculana (Praesaccella)* (see also ABERHAN 1994). The western Canadian specimens correspond reasonably well to those recently described and figured from Argentina (DAMBORENEA 1987a: 59, pl. 1, figs. 7-9, text-fig. 9) and northern Chile (ABERHAN 1994: 10, pl. 1, figs. 5-12, text-fig. 3) and no further comments are needed here.

Genus *Ryderia* WILTON 1830

Type species. *Leda renevieri* OPPEL; by subsequent designation (COX 1936).

Ryderia sp. A

Pl. 1, Fig. 8

Material. 1 internal mould of a right valve (GSC 112367) from GSC locality C-81950.

Stratigraphic range. Late Pliensbachian.

Remarks. *Ryderia* sp. A is only represented by the internal mould of a single right valve. The assignment to *Ryderia* is based on the diagnostic long and narrow rostrum. The relics of shell material attached to the internal mould are strongly corroded so that the outer surface of the shell is unknown.

In shell outline *Ryderia* sp. A strongly resembles *Ryderia doris* (D'ORBIGNY 1850) from the Lower Jurassic of Europe (e.g. COX 1936: 466, pl. 34, fig. 16, see also for a list of synonyms; PEDERSEN 1986: 150, pl. 6, fig. A) and south-eastern Asia (e.g. CHEN 1988: 39, pl. 1, figs. 15-18).

Family Malletiidae ADAMS & ADAMS 1858

Genus *Palaeoneilo* HALL & WHITFIELD 1873

Type species. *Nuculites constricta* CONRAD 1842; by subsequent designation (HALL 1885).

Remarks. There is some confusion about the assignment of Mesozoic members of the group to *Mesosaccella* CHAVAN and *Palaeoneilo* HALL & WHITFIELD respectively. In both genera a resilifer is absent. DUFF (1978) suggested that *Palaeoneilo* is primarily a Palaeozoic genus, characterized by a faint radial posterior sulcus and lack of even a slight depression beneath the umbo. In contrast, presence of such a faint depression between the two rows of hinge teeth, foreshadowing a resilifer, is typical of *Mesosaccella*. In a more recent study, DAMBORENEA (1987a) follows COX (1937) and recognizes two species-groups within *Palaeoneilo*. They can be distinguished by the presence of a posterior sulcus in one group and its absence in the other and each group has Mesozoic and Palaeozoic members. Apparently, a feature common to both species-groups of *Palaeoneilo* is the tendency of the posterior teeth to pass above the anterior row of teeth in the area below the umbo. This second view is followed here.

Palaeoneilo sp. A

Pl. 1, Figs. 12-14

Material. 1 right valve (GSC 112371) from GSC locality 19303; 1 right valve from GSC locality 43660; 1 left valve (GSC 112372) from GSC locality 91774; 4 left valves (including GSC 112370) and 1 right valve from GSC locality C-86682. Predominantly preserved as internal moulds.

Stratigraphic range. Late Pliensbachian.

Description. *Palaeoneilo* sp. A has a sub-elliptical shell with a pointed, slightly rostrate posterior end. The umbones are situated about two-fifth to one-third of total shell length from the anterior end. The hinge consists of two rows (anterior and posterior) of short, straight teeth, which meet without break beneath the beak.

Remarks. Due to the lack of a resilifer or even the slightest indication of a faint depression, the Canadian specimens are assigned to *Palaeoneilo* rather than *Mesosaccella*. Apparently, they belong to the species-group of *Palaeoneilo* that lacks a posterior radial sulcus.

Similar species of the same age are *Palaeoneilo galatea* (D'ORBIGNY 1850) from the Pliensbachian of Europe (e.g. DUMORTIER 1869: pl. 19, fig. 56; COX 1937: 191, pl. 15, figs. 4-7; TROEDSSON 1951: 264, pl. 16, figs. 1-2, 6, 9-11), South America (DAMBORENEA 1987a: 56, pl. 1, fig. 4, text-fig. 7), and China (e.g. CHEN 1988: 41, pl. 1, figs. 11-14) and *Palaeoneilo patagonidica* (LEANZA 1942: 151, pl. 1, figs. 1-2, 4; DAMBORENEA 1987a: 54, pl. 1, figs. 1-3, text-fig. 6) from the Pliensbachian of Argentina. Compared to the Canadian specimens both species are more elliptical in outline and exhibit a less acute postero-dorsal angle.

Subclass Pteriomorphia BEURLEN 1944

Order Arcoida STOLIZKA 1871

Family Parallelodontidae DALL 1898

Genus *Parallelodon* MEEK & WORTHEN 1866

Type species. *Macrodon rugosus* BUCKMAN 1845.

Parallelodon groeberi DAMBORENEA 1987

Pl. 1, Figs. 15-17

1987a *Parallelodon groeberi* sp. nov. - DAMBORENEA: 62, pl. 2, figs. 1-8, text-figs. 11, 13c.

v 1994 *Parallelodon groeberi* DAMBORENEA 1987 - ABERHAN: 11, pl. 1, figs. 13-14.

Material. 1 composite mould of a left valve (GSC 112373) from GSC locality C-86513; 2 left valves (GSC 112374, 112375) and 1 right valve from GSC locality C-90901 in shell preservation and as internal moulds.

Stratigraphic range. Pliensbachian.

Description. The specimens assigned to *Parallelodon groeberi* are medium-sized to large and sub-rectangular in outline. The posterior margin meets the dorsal margin at an approximately right angle. A low umbonal ridge is running to the postero-ventral corner of the shell. Anteriorly, the umbonal ridge is preceeded by a wide, shallow sulcus. The position of the byssal gape is located where the sulcus meets the ventral margin and the latter becomes sinuous in outline. The outer surface of the shell is covered with weak radial riblets. The hinge platform is very narrow and only the posterior teeth are preserved. They are finely crenulated and are pointing downward in a posterior direction. In an anterior direction they end near the dorsal margin of the hinge plate (see Pl. 1, Fig. 17).

Remarks. According to these diagnostic morphological features the Canadian material cannot be distinguished from *P. groeberi* from the Pliensbachian of Argentina (DAMBORENEA 1987a: 62, pl. 2, figs. 1-8, text-figs. 11, 13c) and northern Chile (ABERHAN 1994: 11, pl. 1, figs. 13-14). *Parallelodon?* sp. (FREBOLD & POULTON 1977: 97, pl. 2, fig. 20) from the Hettangian of northern Yukon is much smaller, has a more elliptical outline, and lacks a pronounced sinus where the sulcus meets the ventral margin. As the hinge of that specimen is not preserved, its generic position is questionable.

Genus *Grammatodon* MEEK & HAYDEN 1861

Subgenus *Grammatodon* MEEK & HAYDEN 1861

Type species. *Arca (Cucullaea) inornata* MEEK & HAYDEN 1859.

Grammatodon (Grammatodon) aff. *concinnus* (PHILLIPS 1829)

Pl. 1, Figs. 18-25

aff. 1829 *Cucullaea concinna* sp. nov. - PHILLIPS: pl. 5, figs. 9, 31.

aff. 1978 *Grammatodon (Grammatodon) concinnus* (PHILLIPS, 1829) - Duff: 36, pl. 2, figs. 7, 11-17, 19, text-fig. 11 (see for synonymy list).

Material. 1 left valve from GSC locality 10243; 8 left valves and 8 right valves (including GSC 112376, 112379, 112380) from GSC locality 19374; 2 left valves (GSC 112377, 112381) and 2 right valves (including GSC 112382) from GSC locality 20306; 1 right valve from GSC locality 95096; 1 left valve and 1 right valve (GSC 112383) from GSC locality C-81311; 2 right valves (including GSC 112378) and 1 left valve from GSC locality C-81323. Predominantly preserved as internal and external moulds.

Stratigraphic range. Sinemurian to Early Toarcian.

Description. The shell of *Grammatodon* aff. *concinnus* is sub-rectangular in outline and inequilateral with the umbones situated anterior of the median. A rounded carina runs from the umbo to the postero-ventral corner of the shell. The kind of ornament is difficult to assess as most specimens are abraded. It appears to be quite variable, even in specimens from a single population. The anterior of the shell is covered with radial striae. Commonly, the striae are equal in strength but in several specimens some of them are distinctly coarser than the others. On well preserved specimens, the part posterior to the carina bears very faint radial striae but usually these are not preserved. The flank of the shell may or may not be covered with very fine radial striae which, if present, give rise to a cancellate pattern where they cross commarginal growth lines.

Remarks. With respect to the external ornament the Canadian specimens resemble *G. concinnus* from the Jurassic of Europe (e.g. DUFF 1978: 36, pl. 2, figs. 7, 11-17, 19; FÜRSICH & WERNER 1988: 116, pl. 2, figs. 4-5) and the Toarcian of northern Chile (ABERHAN 1994: 12, pl. 2, figs. 1-5, text-fig. 6). They differ in being more elongate and by a posterior carina that is well rounded rather than sharp as in *G. concinnus*.

Grammatodon subrhomboidalis TROEDSSON (1951: 158, pl. 18, fig. 2) from the Pliensbachian of southern Sweden and *Grammatodon schourovskii* (ROUILLIER & VOSSINSKY 1847) (e.g. ROUILLIER & VOSSINSKY 1848: 287, pl. H, figs. 39A-B; BORISSJAK 1905: 12-13, pl. 2, figs. 10-14; FÜRSICH 1982: 15, figs. 4N-P, R) from the Middle and Upper Jurassic of Russia, Greenland, the Arctic, and England are similar in outline to *G.* aff. *concinnus* and exhibit a rounded posterior ridge, but both lack a radial ornament.

FREBOLD (1957a: 12, pl. 2, fig. 6, pl. 3, figs. 7-8) described *Cucullaea* sp. from the Toarcian of Prince Patrick Island. According to hinge characters and general shape the specimens most likely belong to *Grammatodon (Grammatodon)*. Apparently, they can be separated from *G.* aff. *concinnus* by their more rectangular outline and the presence of distinct radial riblets on the flanks of the shell.

EXPLANATION OF PLATE 2

Figs. 1-3. *Grammatodon (Grammatodon)* sp. A. 1. Figured specimen GSC 112384 from GSC locality C-86684; Upper Pliensbachian of Tulsequah area, British Columbia. Internal mould of left valve with relict shell material attached; x 1.5. 2. Figured specimen GSC 112385 from GSC locality C-86684; Upper Pliensbachian of Tulsequah area, British Columbia. Internal mould of right valve with relict shell material attached; x 1.5. 3. Figured specimen GSC 112386 from GSC locality C-86682; Upper Pliensbachian of Tulsequah area, British Columbia. Internal mould of right valve; x 1.5.

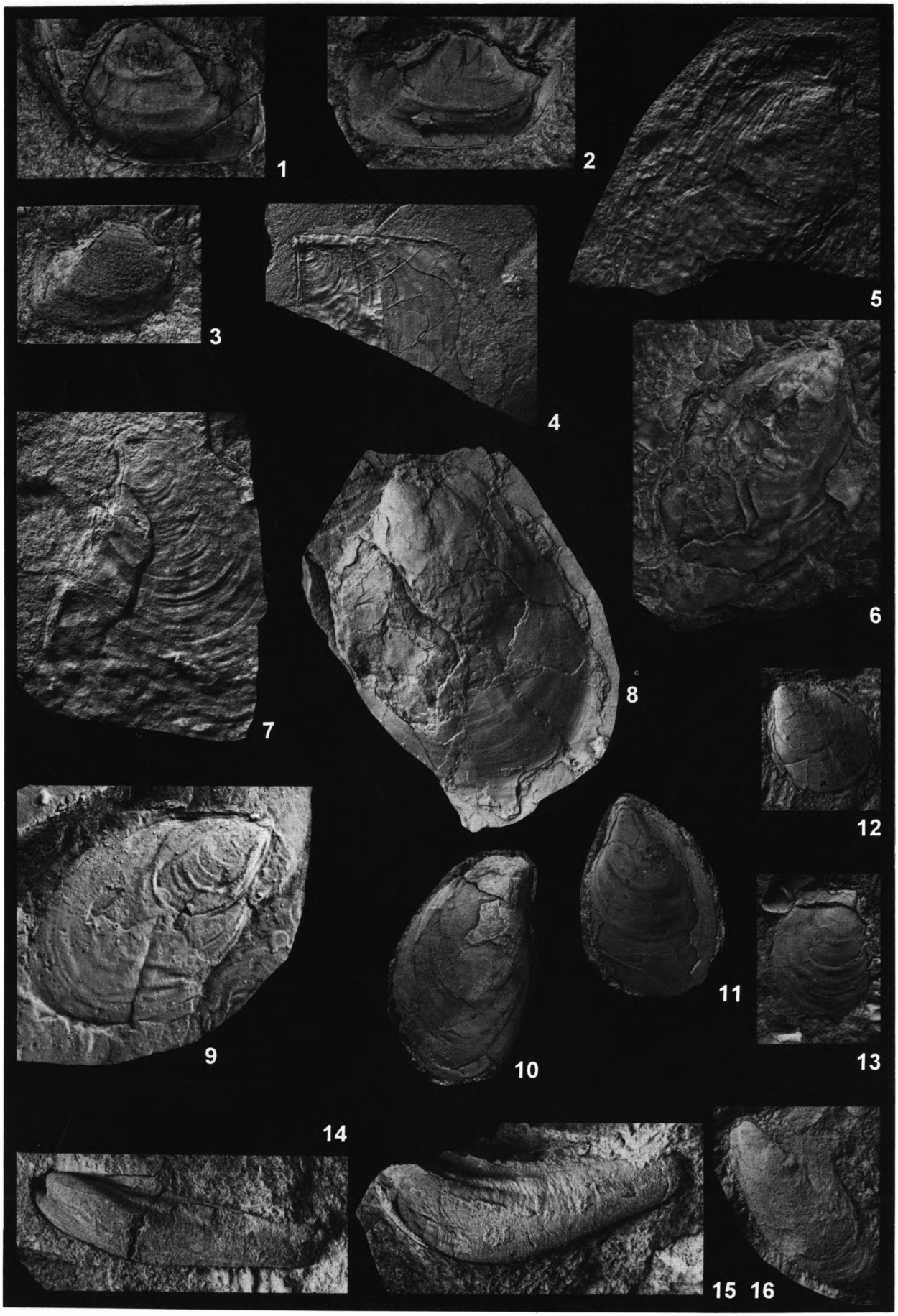
Figs. 4-8. *Parainoceramus* sp. A. 4. Figured specimen GSC 112387 from GSC locality C-156317; Hettangian of Graham Island, British Columbia. Interior view of right valve; x 1.2. 5. Figured specimen GSC 112388 from GSC locality C-159259; Hettangian-Sinemurian boundary of Graham Island, British Columbia. Interior view of left valve (upper part of specimen) and exterior view of right valve (central and lower part); x 1.2. 6. Figured specimen GSC 112389 from GSC locality C-156434; Lower Sinemurian of Graham Island, British Columbia. Internal mould of right valve with relict shell material attached; x 1.2. 7. Figured specimen GSC 112390 from GSC locality C-159259; Hettangian-Sinemurian boundary of Graham Island, British Columbia. Interior view of right valve; x 1.2. 8. Figured specimen GSC 112391 from GSC locality C-156319; Hettangian of Graham Island, British Columbia. Internal mould of left valve with relict shell material attached; x 1.2.

Fig. 9. *Arctomytiloides?* cf. *rassochaensis* (POLUBOTKO 1968). Figured specimen TMP 83.168.10; Toarcian of Fernie area, Alberta. Exterior view of right valve; x 1.2.

Figs. 10-13. *Arctomytiloides?* cf. *turomtchensis* POLUBOTKO 1992. 10. Figured specimen GSC 112393 from GSC locality C-143329; Lower Pliensbachian of Taseko Lakes area, British Columbia. Internal mould of right valve with relict shell material attached; x 1.2. 11. Figured specimen GSC 112394 from GSC locality C-143329; Lower Pliensbachian of Taseko Lakes area, British Columbia. Internal mould of left valve with relict shell material attached; x 1.2. 12. Figured specimen GSC 112395 from GSC locality 10080; Upper Sinemurian of Taseko Lakes area, British Columbia. Internal mould of left valve; x 1.2. 13. Figured specimen GSC 112396 from GSC locality 10080; Upper Sinemurian of Taseko Lakes area, British Columbia. Internal mould of right valve; x 1.2.

Figs. 14-15. *Gervillella araucana* DAMBORENEA 1987. 14. Figured specimen GSC 112326 from GSC locality 88495; Upper Sinemurian of Smithers area, British Columbia. Internal mould of left valve; x 1.5. 15. Figured specimen GSC 112325 from GSC locality 88495; Upper Sinemurian of Smithers area, British Columbia. Internal mould of left valve; x 1.5.

Fig. 16. *Bakevellia (Bakevellia) waltoni* (LYCETT 1863). Figured specimen GSC 112334 from GSC locality C-81311; Sinemurian of Laberge area, southern Yukon. Latex cast of left valve; x 1.5.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Grammatodon (Grammatodon) sp. A

Pl. 2, Figs. 1-3

Material. 2 left valves and 1 right valve from GSC locality C-81947; 1 right valve and 1 steinkern from GSC locality C-81950; 7 left valves from GSC locality C-81978; 1 right valve (GSC 112386) from GSC locality C-86682; 3 left valves (including GSC 112384) and 2 right valves (including GSC 112385) from GSC locality C-86684; 1 left valve from GSC locality C-90843. Predominantly preserved as internal moulds.

Stratigraphic range. Late Pliensbachian.

Remarks. *Grammatodon* sp. A can be distinguished from *G.* aff. *concinnus* by a relatively asymmetrical ventral margin, an acute antero-dorsal corner, and the posterior and dorsal margin meeting at an approximately right angle. This combination of morphological features is not known from any other established species of *Grammatodon* I am aware of. The exterior of the shell is covered with strong commarginal growth lines and rugae. The kind of radial ornament is hard to examine, since, when rock material is broken up, the outermost shell layer usually remains attached to the rock sample. However, one specimen, which is partly preserved as an external mould, shows faint radial striae on the anterior region of the shell and on parts of the shell flank. As knowledge of shell sculpture and hinge characters is still incomplete, erection of a new species must await better material.

Order Pterioida NEWELL 1965

Suborder Pteriina NEWELL 1965

Family Inoceramidae GIEBEL 1852

Remarks. Due to poor definition of genera and subgenera and the wealth of nominal species, the taxonomy of Jurassic inoceramids is rather confused at present. A systematic revision of the group would probably reveal that many species and possibly also some higher taxonomic units are synonymous.

Genus *Parainoceramus* COX 1954

Type species. *Parainoceramus bulkurensis* VORONETZ 1936; by subsequent designation (COX 1954).

Remarks. Since its original description by VORONETZ (1936), the concept of *Parainoceramus* was extended several times by subsequent workers (e.g. COX 1954, HAYAMI 1960, DUFF 1978; see DAMBORENEA (1987b) for a summary). Here, *Parainoceramus* is considered in its wide sense, including the possibility that an anterior auricle and anterior and/or posterior teeth are present in some forms.

Parainoceramus sp. A

Pl. 2, Figs. 4-8

Material. 2 right valves (including GSC 112387) from GSC locality C-156317; 1 left valve and 1 right valve from GSC locality C-156318; 1 left valve (GSC 112391) and 1 articulated specimen from GSC locality C-156319; 1 left valve from GSC locality C-156320; 1 right valve (GSC 112389) from GSC locality C-156434; 2 right valves (including GSC 112390) and 1 articulated specimen (GSC 112388) from GSC locality C-159259; 1 left valve from GSC locality C-175208. In shell preservation and as internal moulds.

Stratigraphic range. Hettangian to Early Sinemurian (Arnouldi Assemblage).

Description. The medium-sized, moderately inflated shell of *Parainoceramus* sp. A is sub-rhomboidal in outline and consistently higher than long. The beaks are terminal and only slightly protrude above the dorsal margin. The dorsal margin is straight and usually extends for less than half the total shell length. The postero-dorsal angle is obtuse and well rounded. The posterior margin is evenly convex and passes smoothly into the convex ventral margin. The most anteriorly placed point is placed in the dorsal half of the shell where the straight or weakly concave antero-dorsal margin passes into the evenly convex antero-ventral margin. The anterior part of the shell is short and steep and forms a high angle with the plane of commissure; an anterior lobe or auricle is absent. The posterior part of the shell is at a low angle to the commissure. The shell surface is covered with growth lines and irregular commarginal folds.

The ligamental area is narrow and bears a low number (between 5 and 7) of ventrally rounded pits with slightly narrower interspaces (e.g. Pl. 2, Fig. 4). The anterior end of a right valve exhibits two projections immediately below the umbo. This part of the shell, however, is too poorly preserved to decide if these projections are anterior hinge teeth.

Remarks. A genus closely related to *Parainoceramus* is *Pseudomytiloides* KOSCHELKINA, and with some species it is difficult to decide, to which genus they belong. As *Pseudomytiloides* is characterized by a rather small, well inflated shell with regular commarginal folds and lack of hinge teeth, the studied specimens can be referred to *Parainoceramus* without hesitation. *Parainoceramus* sp. A probably belongs to a new species, but the fragmented and/or distorted condition of the available specimens prevent the formal

erection of a new name. It can be distinguished from most other species of *Parainoceramus* by its sinuous anterior margin, with the most anteriorly placed point being in the dorsal half of the shell anterior to beaks, and by the absence of an anterior lobe.

A closely allied form is *Parainoceramus?* sp. from the Aalenian of Argentina (DAMBORENEA 1990: 742, fig. 6.1-6.2), which has a longer dorsal margin and a less obtuse postero-dorsal angle. The same holds true for *P. subtilis* (LAHUSEN) from the Callovian of England and Russia (e.g. DUFF 1978: 49, pl. 3, figs. 12, 17-18, 21-22, pl. 4, figs. 1-2, 12, text-figs. 15-16). Strong affinities also exist to *Inoceramus? rectangulus* MEEK from the Jurassic of California (MEEK 1864: 47, pl. 7, fig. 1). This poorly known species, however, has a longer dorsal margin than *Parainoceramus* sp. A and a straight rather than sinuous anterior margin. *P. substriatus* (MÜNSTER) from the Pliensbachian of Europe (e.g. GOLDFUSS 1835: 108, pl. 109, fig. 2, pl. 115, fig. 1; OPPEL 1853: 81, pl. 4, fig. 14; FUCINI 1920: 88, pl. 5, figs. 10-11) exhibits a small anterior lobe and its shell is strongly inflated. *P. lunaris* HAYAMI from the Upper Pliensbachian and its probable synonym *P. matsumotoi* HAYAMI from the Toarcian of Japan (HAYAMI 1960: 295, pl. 15, fig. 1 and HAYAMI 1960: 297, pl. 15, figs. 2-8) are smaller and have a small anterior auricle. Similarly, *P. apollo* (LEANZA) from the Sinemurian and Pliensbachian of northern Chile and Argentina (LEANZA 1942: 157, pl. 2, fig. 1; DAMBORENEA 1987b: 143, pl. 4, figs. 1-6, text-fig. 11; ABERHAN 1994: 18, text-fig. 12) is smaller, exhibits a distinct anterior lobe, and has a more broadly rounded umbo.

Genus *Arctomytiloides* POLUBOTKO 1992

Type species. *Pseudomytiloides rassochaensis* POLUBOTKO in EFIMOVA et al. 1968.

Arctomytiloides? cf. *rassochaensis* (POLUBOTKO 1968)

Pl. 2, Fig. 9

cf. 1968 *Pseudomytiloides rassochaensis* sp. nov. - POLUBOTKO in EFIMOVA et al.: 61, pl. 6, figs. 1-7.
1987 Unidentified bivalve - HALL: pl. 3, fig. M; in text (p. 1690) as *Inoceramus*.
cf. 1991 *Inoceramus (Mytiloides)* sp. cf. *M. rassochaensis* (POLUBOTKO) - POULTON: 30, pl. 4, fig. 1.
cf. 1992 *Arctomytiloides rassochaensis* (POLUBOTKO, 1968) - POLUBOTKO: 64, pl. 24, figs. 9-15.

Material. 1 right valve (TMP 83.168.10).

Stratigraphic range. Toarcian.

Remarks. The Canadian specimen has strong affinities to *Arctomytiloides rassochaensis* from the Sinemurian of North-East Russia with which it shares an obliquely ovate and elongated shape, a short dorsal margin, presence of a small anterior auricle, and a similar style of ornamentation. As internal features are unknown and the shell is compressed due to compaction, both generic and specific identification is preliminary.

Arctomytiloides? cf. *turomtchensis* POLUBOTKO 1992

Pl. 2, Figs. 10-13

cf. 1992 *Arctomytiloides* (?) *turomtchensis* sp. nov. - POLUBOTKO: 65, pl. 24, figs. 16-17.

Material. 1 left valve (GSC 112395) and 1 right valve (GSC 112396) from GSC locality 10080; 1 left valve (GSC 112394) and 2 right valves (including GSC 112393) from GSC locality C-143329. All preserved as internal moulds.

Stratigraphic range. Late Sinemurian to Early Pliensbachian.

Remarks. The specimens from western Canada very closely resemble coeval specimens of *Arctomytiloides? turomtchensis* from North-East Russia, which are characterized by a mytiliform outline, moderately well inflated valves and presence of a prominent umbo with anteriorly directed beaks. As ligamental characters cannot be observed in both the Canadian specimens and the type material, this species is questionably referred to *Arctomytiloides* at present.

Family Bakevelliidae KING 1850

Remarks. The family Bakevelliidae was recently revised by MUSTER (1995) and most Early Jurassic bakevelliid bivalves from western Canada were studied in detail by ABERHAN & MUSTER (1997). Therefore, only the main diagnostic features of these species are repeated here. In addition, two species, *Gervillaria?* aff. *montanaensis* (MEEK) and *Kedonella mytileformis* (POLUBOTKO) are reported from North America for the first time herein.

Genus *Bakevellia* KING 1848

Subgenus *Bakevellia* KING 1848

Type species. *Avicula antiqua* MÜNSTER in GOLDFUSS 1836; by subsequent designation (KING 1850).

Bakevellia (Bakevellia) waltoni (LYCETT 1863)

Pl. 2, Fig. 16; Pl. 3, Figs. 5-7

1863 *Gervillia waltoni* sp. nov. - LYCETT: 110, pl. 32, fig. 4.
v 1934 *Gervillia* ? cf. *inflata* SCHAFH. - LEES: 42, pl. 4, fig. 2.
v 1995 *Bakevellia (Bakevellia) waltoni* (LYCETT 1863) - MUSTER: 38, pl. 5, figs. 1-13 (see for extensive synonymy list).
v 1997 *Bakevellia (Bakevellia) waltoni* (LYCETT, 1863) - ABERHAN & MUSTER: 801, text-fig. 2D-G.

Material. 2 left valves from GSC locality 10246; 1 right valve from GSC locality 19376; 1 left valve from GSC locality C-81309; 1 left valve from GSC locality C-81310; 2 left valves (GSC 112331, 112334) from GSC locality C-81311; 1 left valve from GSC locality C-81317; 1 left valve and 1 right valve (GSC 112333) from GSC locality C-81322; 3 left valves and 1 steinkern from GSC locality C-81323; 1 left valve from GSC locality C-90924; 1 fragmentary right valve (GSC 112332) from GSC locality C-90925; 1 left valve from GSC locality C-90930. Predominantly preserved as internal and external moulds.

Stratigraphic range. Sinemurian to Early Pliensbachian.

Remarks. All studied specimens from western Canada that can be attributed to the genus *Bakevellia* show the main diagnostic features of *B. waltoni* as outlined by MUSTER (1995). These are a rhombic shape, the presence of an acute anterior ear, a sharply pointed posterior wing, and a hinge consisting of 1 to 4 anterior teeth pointing downward in a posterior direction and 1 to 2 elongated posterior teeth.

Genus *Gervillaria* COX 1954

Type species. *Modiola* ? *alaeformis* J. SOWERBY 1819.

Gervillaria pallas (LEANZA 1942)

Pl. 3, Figs. 1-4

v 1942 *Gervillia pallas* sp. nov. - LEANZA: 155, pl. 4, fig. 1.
1987b *Gervillaria* ? *pallas* (A. LEANZA 1942) - DAMBORENEA: 135, pl. 2, figs. 1-5, text-fig. 7.
1992 *Gervillaria*? sp. - THOMSON & SMITH: pl. 1, fig. 8.
v 1995 *Gervillaria pallas* (LEANZA 1942) - MUSTER: 60, pl. 10, figs. 3-5, text-fig. 43.
v 1997 *Gervillaria pallas* (LEANZA, 1942) - ABERHAN & MUSTER: 803, text-fig. 2A-C, H (see for synonymy list).

Material. 1 left valve (GSC 112327) from GSC locality 14333; 1 left valve from GSC locality 19365; 1 left valve from GSC locality 19373; 1 right valve from GSC locality 19374; 1 steinkern from GSC locality 19395; 1 left valve from GSC locality 19397; 3 left valves, 3 right valves, and 1 steinkern from GSC locality 19398; 1 left valve from GSC locality 85333; 1 steinkern from GSC locality 93327; 1 left valve from GSC locality 93328; 2 left valves from GSC locality C-53514; 2 left valves from GSC locality C-81975; 2 left valves from GSC locality C-90524; 1 left valve from GSC locality C-90664; 2 left valves and 1 steinkern from GSC locality C-90902; 1 left valve and 1 right valve from GSC locality C-90903; 6 left valves and 1 steinkern from GSC locality C-90905; 1 left valve (GSC 112328) and 1 steinkern from GSC locality C-90909; 1 left valve from GSC locality C-90924; 4 left valves and 4 steinkerns from GSC locality C-90925; 3 left valves from GSC locality C-90926; 3 left valves from GSC locality C-90928; 1 left valve from GSC locality C-103198; 2 left valves from GSC locality C-103305; 1 left valve and 1 steinkern (GSC 112329, 112330) from GSC locality C-103307. Preserved as internal and external moulds; only rarely is relict shell material attached to the moulds.

Stratigraphic range. Pliensbachian.

Description. *Gervillaria pallas* has a strongly inequivalve, twisted shell. Whilst the left valve is strongly convex, the right valve is concave. *G. pallas* is further characterized by the presence of a small anterior ear and a pointed posterior wing. In the left valve, a double carina extends from the umbo to the postero-ventral region of the shell.

Remarks. *Gervillaria pallas* can be distinguished from all other Jurassic *Gervillaria* by the presence of two carinae in the left valve.

EXPLANATION OF PLATE 3

Figs. 1-4. *Gervillaria pallas* (LEANZA 1942). 1. Figured specimen GSC 112329 from GSC locality C-103307; Pliensbachian of Spatsizi area, British Columbia. Latex cast of left valve (corresponding right valve figured on Pl. 3, fig. 4); x 1. 2. Figured specimen GSC 112328 from GSC locality C-90909; Lower Pliensbachian of Spatsizi area, British Columbia. Exterior view of left valve; x 1. 3. Figured specimen GSC 112327 from GSC locality 14333; Pliensbachian of McConnell Creek area, British Columbia. Internal mould of left valve with relict shell material attached; x 1. 4. Figured specimen GSC 112330 from GSC locality C-103307; Pliensbachian of Spatsizi area, British Columbia. Internal mould of right valve (corresponding left valve figured on Pl. 3, fig. 1); x 1.

Figs. 5-7. *Bakevellia (Bakevellia) waltoni* (LYCETT 1863). 5. Figured specimen GSC 112332 from GSC locality C-90925; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of hinge area of right valve; x 1.5. 6. Figured specimen GSC 112333 from GSC locality C-81322; Sinemurian of Laberge area, southern Yukon. Composite mould of right valve; x 1.5. 7. Figured specimen GSC 112331 from GSC locality C-81311; Sinemurian of Laberge area, southern Yukon. Latex cast of shell interior of left valve; x 1.5.

Figs. 8-11. *Gervillella leesi* ABERHAN & MUSTER 1997. 8. Paratype GSC 112321 from GSC locality 83995; Upper Sinemurian of Smithers area, British Columbia. Exterior view of left valve of articulated specimen; x 1. 9. Paratype GSC 112322 from GSC locality 88602; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1. 10. Paratype GSC 112320 from GSC locality C-157663; Hettangian of Tyaughton Creek area, British Columbia. Internal mould of left valve; x 1. 11. Holotype GSC 112324 from GSC locality 84187; Upper Sinemurian of Smithers area, British Columbia. Exterior view of left valve; x 1.


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Gervillaria? aff. *montanaensis* (MEEK 1873)

Pl. 4, Figs. 2-4

aff. 1873 *Gervillia montanaensis* sp. nov. - MEEK: 472.
aff. 1967a *Gervillia* ? *montanaensis* MEEK - IMLAY: 77, pl. 1, figs. 1, 7-10 (see for synonymy list).
aff. 1968 *Gervillia montanaensis* MEEK - PATERSON: 44, pl. 13, fig. 5.

Material. 3 left valves (GSC 112398, 112399) from GSC locality C-175233; 4 left valves and 1 right valve (GSC 112397) from GSC locality C-175234. In shell preservation and as external mould.

Stratigraphic range. Sinemurian to Sinemurian-Pliensbachian boundary.

Description. *Gervillaria?* aff. *montanaensis* exhibits an acute anterior auricle and a moderately sized posterior wing, whose posterior margin is more or less straight. Radial riblets and commarginal rugae on the exterior of the main body of the shell produce a cancellate ornament.

Remarks. Due to diagenetic compaction the specimens assigned to *Gervillaria?* aff. *montanaensis* are completely compressed and their original convexity and shape cannot be determined. *Gervillaria? montanaensis* (MEEK) (e.g. IMLAY 1967a: 77, pl. 1, figs. 1, 7-10; PATERSON 1968: 44, pl. 13, fig. 5) from the Bajocian of the western United States is a very closely allied species. In contrast to the studied specimens, however, *G.? montanaensis* has a sharply pointed posterior wing. In both species, presence of a ligament and hinge characters are not known. It therefore remains questionable, whether both taxa belong to the family Bakevelliidae or to the family Pteriidae.

Genus *Gervillella* WAAGEN 1907

Type species. *Perna aviculoides* J. SOWERBY 1814.

Gervillella araucana DAMBORENEA 1987

Pl. 2, Figs. 14-15

pv 1987b *Gervillella araucana* sp. nov. - DAMBORENEA: 133, pl. 1, figs. 6-10, text-fig. 6.
v 1994 *Gervillella araucana* DAMBORENEA 1987 - ABERHAN: 18, pl. 3, figs. 8-10.
v 1995 *Gervillella araucana* DAMBORENEA 1987 - MUSTER: 61, pl. 12, figs. 3-4.
v 1997 *Gervillella araucana* DAMBORENEA, 1987 - ABERHAN & MUSTER: 807, text-figs. 4F-G, 5C.

Material. 3 left valves from GSC locality 85335; 2 left valves (GSC 112325, 112326) from GSC locality 88495. All preserved as internal moulds.

Stratigraphic range. Late Sinemurian.

Remarks. *Gervillella araucana* has a very elongated shell, which is twisted. It can be separated from all other *Gervillella* by the presence of a single carina, which is only developed on the left valve.

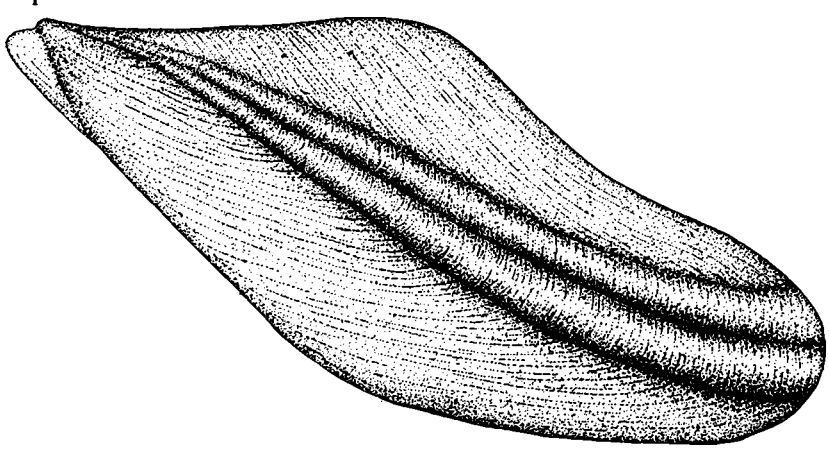
Gervillella leesi ABERHAN & MUSTER 1997

Pl. 3, Figs. 8-11; Pl. 4, Fig. 1; Text-fig. 4

v 1934 *Gervillia* sp. nov. - LEES: 41, pl. 4, fig. 1.
v 1997 *Gervillella leesi* sp. nov. - ABERHAN & MUSTER: 805, text-figs. 4A-E, 5D.

Material. 2 left valves and 1 articulated specimen (GSC 112321) from GSC locality 83995; 1 articulated specimen from GSC locality 83998; 4 left valves (including GSC 112324) from GSC locality 84187; 2 left valves and 1 steinkern from GSC locality 88495; 5 left valves (including GSC 112322) from GSC locality 88602; 1 left valve from GSC locality 88604; 5 fragmentary valves from GSC locality 94993; 4 left valves (including GSC 112323) from GSC locality 95015; 3 left valves and 1 right valve from GSC locality C-143287; 1 left valve (GSC 112320) from GSC locality C-157663. Predominantly preserved as internal and external moulds; rarely is relict shell material attached to the moulds.

Stratigraphic range. Hettangian to Late Sinemurian.



Text-fig. 4. *Gervillella leesi* ABERHAN & MUSTER 1997. Reconstruction of exterior view of left valve. Approximately x 1.

Description. The shell of *G. leesi* is sub-equivalved and not twisted. Its main diagnostic feature are two well rounded carinae that extend from the umbo to the postero-ventral corner of the shell on both valves.

Remarks. Other bakevelliid bivalves with carinae are *Gervillella araucana* and *Gervillaria pallas*. The latter can be distinguished from *G. leesi* by being strongly inequivalved and twisted, less elongated, and by the

presence of a pointed posterior wing. Similarly, *G. araucana* is inequivalved and twisted. It also carries only one carina on the left valve and is more strongly elongated.

Genus *Kedonella* POLUBOTKO 1992

Type species. *Pseudomytiloides mytileformis* POLUBOTKO 1968.

Remarks. *Kedonella* was recently erected as a new genus of the Bakevelliidae by POLUBOTKO (1992) to accommodate four, partly new species from the Toarcian of North-East Russia. *Kedonella* is separated from the closely related bakevelliid *Lenella* by the lack of cardinal teeth in the former and differences in the arrangement of muscle scars (POLUBOTKO 1992).

Kedonella mytileformis (POLUBOTKO 1968)

Pl. 4, Fig. 5

1968 *Pseudomytiloides mytileformis* sp. nov. - POLUBOTKO in EFIMOVA et al.: 63, pl. 40, figs. 1-3.
1992 *Kedonella mytileformis* (POLUBOTKO, 1968) - POLUBOTKO: 62, pl. 25, figs. 8-11.

Material. 1 left valve and 2 right valves (GSC 112400) from GSC locality C-86506. All preserved as external moulds.

Stratigraphic range. Early Toarcian.

Description. *Kedonella mytileformis* is characterized by a mytiliform shape and the presence of a relatively broad anterior lobe. The shell is covered with fine commarginal growth lines and irregularly spaced rugae. Internal features cannot be observed.

Remarks. The Canadian specimens correspond very well to coeval shells of *Kedonella mytlileformis*, figured and described from the Lower Toarcian of North-East Russia by POLUBOTKO (in EFIMOVA 1968: 63, pl. 40, figs. 1-3, 1992: 62, pl. 25, figs. 8-11). According to POLUBOTKO (1992), *K. mytileformis* exhibits a very narrow ligamental area, which carries two to three ligamental pits, and a single lateral tooth. Presence of a distinct ligamental area and hinge teeth, which may vary considerably in number and shape, are characteristic features of the Bakevelliidae. Despite its mytiliform shape, *K. mytiliformis* therefore can be assigned to the Bakevelliidae with certainty.

Family Isognomonidae WOODRING 1925

Genus *Isognomon* SOLANDER in LIGHTFOOT 1786

Subgenus *Isognomon* SOLANDER in LIGHTFOOT 1786

Type species. *Ostrea perna* LINNÉ 1767.

Isognomon (Isognomon) sp. A

Pl. 4, Fig. 6

Material. 1 steinkern (GSC 112401) from GSC locality C-127477.

Stratigraphic range. Sinemurian.

Remarks. Based on overall outline and shape, the terminal position of beaks, and a poorly differentiated posterior wing the specimen can be referred to *Isognomon (Isognomon)*. Species of *Isognomon* commonly show a great intraspecific variability of shape and marked changes in outline during ontogeny. With only one internal mould available for study and without information on internal and external shell characters assignment to a particular species is impossible.

Genus *Mytiloperna* VON IHERING 1903

Type species. *Perna americana* FORBES in DARWIN 1846.

Remarks. As noted by JAITLY et al. (1995), species of *Mytiloperna* commonly have one or more actinodont teeth. Hinge teeth are commonly present in early growth stages in isognomonids but become obsolete in adults as they are overgrown by the ligamental area. This is in contrast to the bakevelliids, where the presence of hinge teeth in adults is a diagnostic feature that allows separation from the isognomonids. Consequently, it can be argued that *Mytiloperna* should be removed from the Isognomonidae and be placed in the Bakevelliidae instead. JAITLY et al. (1995), however, suggested to retain this taxon within the Isognomonidae pending a revision of the whole family. They argued that a slow growth of the ligamental area would result in the continued presence of teeth from the juvenile stage to the adult stage.

An externally very similar genus is the bakevelliid *Aguilerella* which, however, can be separated from *Mytiloperna* by internal features. In *Aguilerella* the ligamental area ends before reaching the posterior margin and one or two posterior teeth occur posterior to the ligamental area. In *Mytiloperna* the ligamental area extends to the posterior margin and posterior hinge teeth are absent in adults.

Mytiloperna charlottensis sp. nov.

Pl. 4, Figs. 7-10; Text-fig. 5

Derivation of name. The species name is derived from the Queen Charlotte Islands, British Columbia, where the type material originates.

Holotype. GSC 112405 from GSC locality 19040, left valve, figured on Pl. 4, Fig. 9.

Additional material. 6 left valves (including GSC 112403), 4 right valves (including GSC 112404), and 2 articulated specimens from GSC locality 19040; 3 left valves (including GSC 112402), 3 right valves, and 2 articulated specimens from GSC locality 19376; 1 left valve from GSC locality C-90901. In shell preservation and as internal moulds.

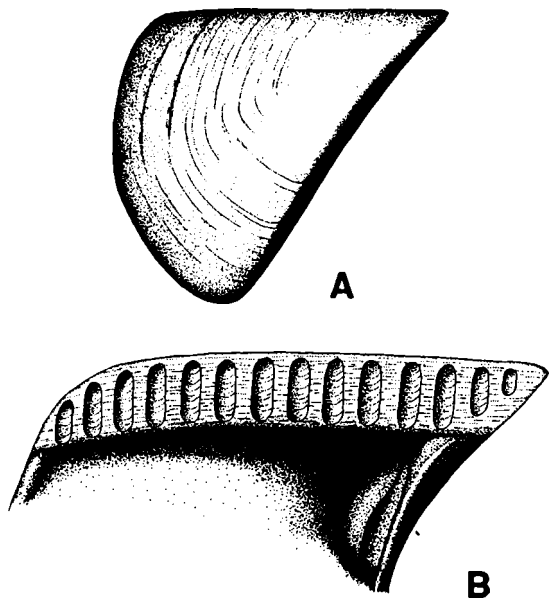
Measurements (in mm).

	L	H
GSC 112403 (lv)	44	38
GSC 112404 (rv)	~45	~42
GSC 112405 (lv)	35	32

Stratigraphic range. Pliensbachian.

Diagnosis. Sub-trigonal *Mytiloperna*; sharp carina running from umbo to antero-ventral corner of shell; ligamental area with relatively large number of ligamental pits; well-defined groove ventral of ligamental area in left valve receives elongated, antero-ventrally directed tooth of right valve.

Description. Medium-sized, sub-trigonal, equivalved shell. Umbones terminal, directed anteriorly. Sharp, slightly curved carina extending from umbo to antero-ventral corner of shell. Carina divides shell surface into two parts which meet at an approximately right angle. Part anterior to carina weakly concave, except for antero-dorsal region which is flat. Posterior part slightly convex, falling away towards posterior and dorsal margins. Outer surface of shell covered with commarginal growth lines and more or less regularly spaced folds.



Text-fig. 5. *Mytiloperna charlottensis* sp. nov. A. Reconstruction of exterior view of right valve; approximately x 1. B. Reconstruction of interior view of left valve; approximately x 1.5.

EXPLANATION OF PLATE 4

Fig. 1. *Gervillella leesi* ABERHAN & MUSTER 1997. Paratype GSC 112323 from GSC locality 95015; Sinemurian of Cry Lake area, British Columbia. Internal mould of left valve; x 1.

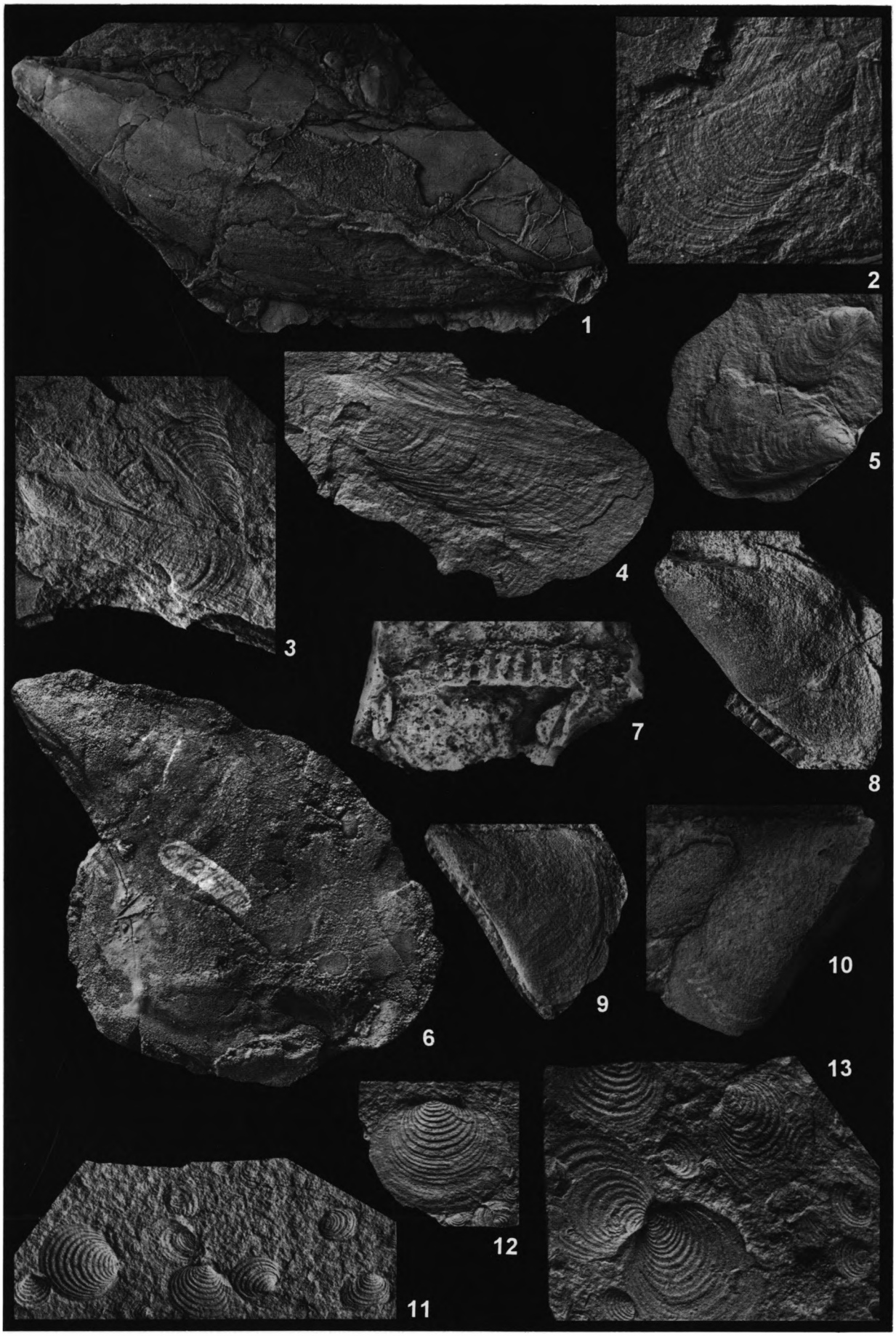
Figs. 2-4. *Gervillaria?* aff. *montanaensis* (MEEK 1873). 2. Figured specimen GSC 112397 from GSC locality C-175234; Sinemurian-Pliensbachian boundary of Graham Island, British Columbia. Exterior view of right valve; x 1.2. 3. Figured specimen GSC 112398 from GSC locality C-175233; Sinemurian of Graham Island, British Columbia. Exterior view of two left valves; x 1.2. 4. Figured specimen GSC 112399 from GSC locality C-175233; Sinemurian of Graham Island, British Columbia. Latex cast of left valve; x 1.2.

Fig. 5. *Kedonella mytileformis* (POLUBOTKO 1968). Figured specimen GSC 112400 from GSC locality C-86506; Lower Toarcian of Tulsequah area, British Columbia. Latex cast of two right valves; x 1.5.

Fig. 6. *Isognomon (Isognomon)* sp. A. Figured specimen GSC 112401 from GSC locality C-127477; Sinemurian of Fernie area, Alberta. Internal mould of left valve; x 1.

Figs. 7-10. *Mytiloperna charlottensis* sp. nov. 7. Paratype GSC 112402 from GSC locality 19376; ?Pliensbachian of Nootka Sound area, British Columbia. Latex cast of interior of left valve; x 1. 8. Paratype GSC 112403 from GSC locality 19040; Pliensbachian of Nootka Sound area, British Columbia. Internal mould of left valve; x 1. 9. Holotype GSC 112405 from GSC locality 19040; Pliensbachian of Nootka Sound area, British Columbia. Exterior view of left valve; x 1. 10. Paratype GSC 112404 from GSC locality 19040; Pliensbachian of Nootka Sound area, British Columbia. Exterior view of right valve; x 1.

Figs. 11-13. *Bositra buchi* (ROEMER 1836). 11. Figured specimen GSC 112406 from GSC locality 83477; ?Toarcian of Laberge area, southern Yukon. Slab with several densely packed valves; x 2. 12. Figured specimen GSC 112407 from GSC locality 83477; ?Toarcian of Laberge area, southern Yukon. Exterior view of left valve; x 2. 13. Figured specimen GSC 112408 from GSC locality 83477; ?Toarcian of Laberge area, southern Yukon. Slab with several densely packed valves; x 2.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Ligament multivincular. Ligamental areas of both valves diverging at an acute angle. Ligamental area extends along entire length of dorsal margin and exhibits up to 13 regular, ventrally rounded ligamental pits; interspaces between pits of approximately the same width as pits (Text-fig. 5B). Oblique, well-defined groove pointing towards antero-ventral extremity, situated ventral to anterior part of ligamental area in left valve (Text-fig. 5B), receives elongated, antero-ventrally directed tooth of right valve.

Remarks. The most similar species is *Mytiloperna patchamensis* COX, a typical element of the Ethiopian faunal province, which occurs in the Middle Jurassic of Kachchh, western India (e.g. COX 1940: 122, pl. 6, figs. 15-20; JAITLY et al. 1995: 174, pl. 8, figs. 2-5, text-fig. 19), and northern Africa (FRENEIX 1965: 20, pl. 2, fig. 14a, b; MONGIN 1967: 46, pl. 2, figs. 5-7). Morphological features common to both species include a distinctly tapering ventral end resulting in a sub-trigonal outline, presence of a sharp carina, and presence of one hinge tooth in the right valve and a corresponding groove in the left valve. Main differences are that *M. charlottensis* is less inflated, more strongly elongated, and adult individuals exhibit about twice as many ligamental pits than *M. patchamensis*.

Other species of Jurassic *Mytiloperna* such as *M. ageroensis* HAYAMI (1957a: 101, pl. 6, figs. 4-8), *M. altina* CHEN (MA et al. 1976: 299, pl. 31, figs. 1-6), *M. murchisoni* (FORBES) (e.g. YIN & FÜRSICH 1991: 128, pl. 3, figs. 7-10), and *M. mytiliformis* (SCHLIPPE) (e.g. FRENEIX 1965: 19, pl. 2, figs. 9-10) can readily be distinguished from *M. charlottensis* by a rhomboidal to mytiliform rather than a sub-trigonal outline as is typical of *M. charlottensis*.

?Family Posidoniidae FRECH 1909

Genus *Bositra* DE GREGORÍO 1886

Type species. *Posidonia ornati* QUENSTEDT 1851.

Bositra buchi (ROEMER 1836)

Pl. 4, Figs. 11-13; Pl. 5, Fig. 2

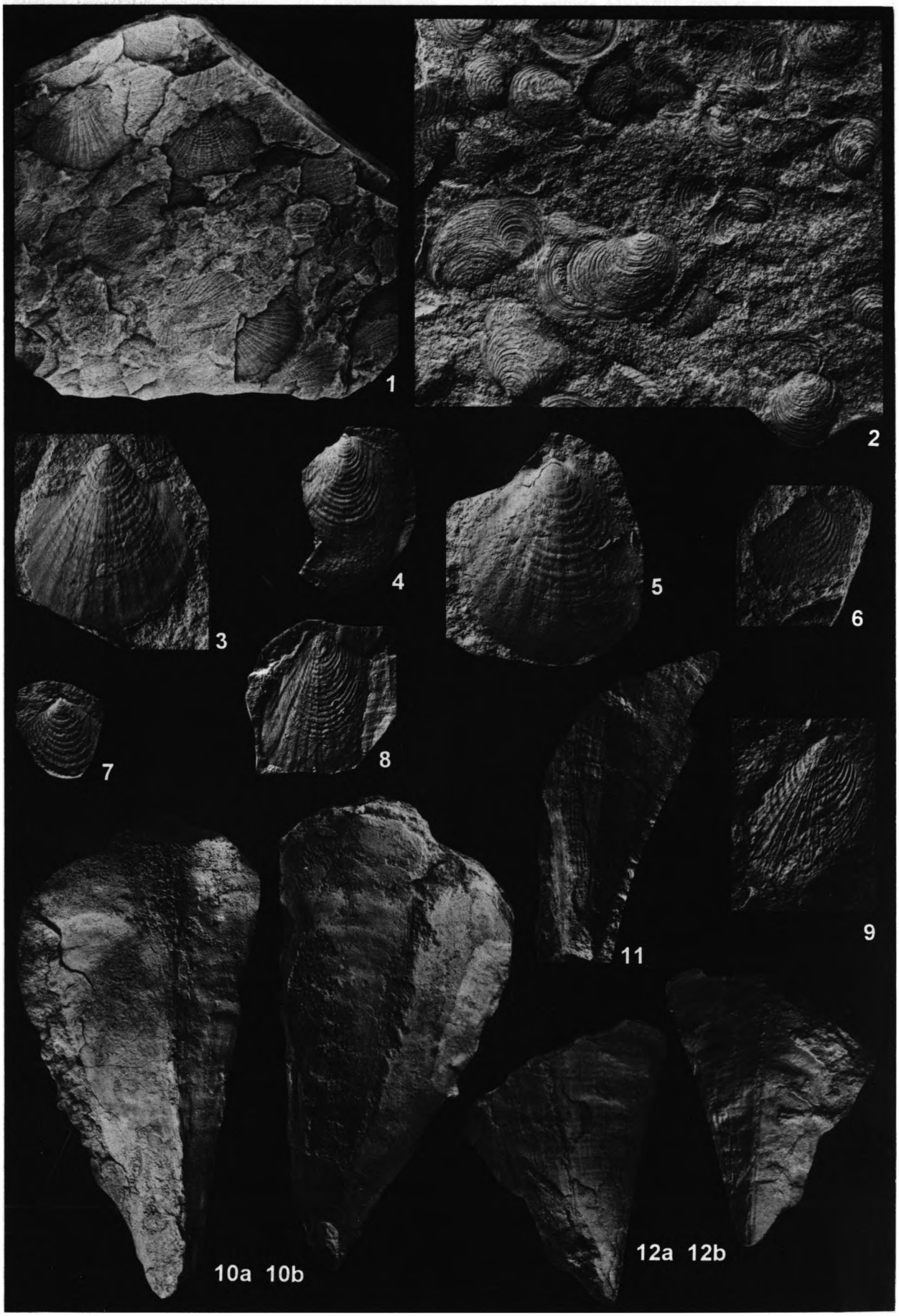
1836 *Posidonia buchii* sp. nov. - ROEMER: 81, pl. 4, fig. 8.
1851 *Posidonia ornati* sp. nov. - QUENSTEDT: 517, pl. 42, fig. 16.
1945 *Posidonia* cf. *P. ornati* QUENSTEDT - IMLAY: 264, pl. 39, figs. 22-24.
1955 *Posidonia* cf. *P. ornata* QUENSTEDT - IMLAY: 86, pl. 10, fig. 21.
1960 *Posidonia alpina* (GRAS), 1852 - SANBORN: 25, pl. 2, fig. 24.
1963 *Posidonia ornati* QUENSTEDT - IMLAY: 102, pl. 14, figs. 10-13.
1964 *Posidonia ornati* QUENSTEDT - IMLAY: 13, pl. 1, fig. 22.
1987b *Bositra ornati* (QUENSTEDT 1851) - DAMBORENEA: 164, pl. 4, fig. 7, text-fig. 16 (see for extensive synonymy list).
1992 *Bositra buchii* (ROEMER, 1836) - CONTI & MONARI: 196, pl. 1, figs. 1-4, pl. 2, figs. 3-5, text-fig. 2 (see for extensive synonymy list).

EXPLANATION OF PLATE 5

Figs. 1, 3-9. *Posidonotis semiplicata* (HYATT 1894). 1. Figured specimen GSC 111491 from GSC locality C-210911; Upper Pliensbachian of Whitehorse area, southern Yukon. Slab with several densly packed valves; x 1. 3. Figured specimen GSC 111485 from GSC locality 85333; Lower Pliensbachian of Smithers area, British Columbia. Internal mould of single valve; x 1.5. 4. Figured specimen GSC 111490 from GSC locality 91994; Lower Jurassic, not older than Late Pliensbachian, Ashcroft, British Columbia. Latex cast of single valve; x 1.5. 5. Figured specimen GSC 112409 from GSC locality 88500; Upper Sinemurian or Lower Pliensbachian of Smithers area, British Columbia. Latex cast of external mould of single valve; x 1.5. 6. Figured specimen GSC 111488 from GSC locality 95265; Lower Toarcian of Cry Lake area; British Columbia. Exterior view of right valve; x 1.5. 7. Figured specimen GSC 111487 from GSC locality 95265; Lower Toarcian of Cry Lake area; British Columbia. Latex cast of ?left valve; x 1.5. 8. Figured specimen GSC 111489 from GSC locality 91994; Lower Jurassic, not older than Late Pliensbachian, Ashcroft, British Columbia. Latex cast of single valve; x 1.5. 9. Figured specimen GSC 111486 from GSC locality 24311; Lower Pliensbachian of Nootka Sound area, British Columbia. Internal mould of single valve with relict shell material attached; x 1.5.

Fig. 2. *Bositra buchi* (ROEMER 1836). Figured specimen GSC 112410 from GSC locality 85098; Toarcian of Telegraph Creek area, British Columbia. Slab with several densely packed valves; x 2.

Figs. 10-12. *Pinna (Pinna)* cf. *folium* YOUNG & BIRD 1822. 10a, b. Figured specimen GSC 112411 from GSC locality C-81322; Sinemurian of Laberge area, southern Yukon. a, internal mould of left valve; b, internal mould of right valve; x 1. 11. Figured specimen GSC 112412 from GSC locality C-81323; Sinemurian of Laberge area, southern Yukon. Internal mould of left valve with relict shell material attached; x 1. 12a, b. Figured specimen GSC 112413 from GSC locality C-81322; Sinemurian of Laberge area, southern Yukon. a, internal mould of right valve with relict shell material attached; b, internal mould of left valve with relict shell material attached; x 1.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Material. As a rule, *B. buchi* occurs as shell pavements and was found at the following GSC localities: 13086; 13096; 14718; 18925; 19557; 20318; 31420; 45111; 79915; 79916; 83477 (including GSC 112406 to 112408); 85098 (GSC 112410); 90949; 90952; 90953; 90984; 91774; 94869; 95263; C-80897; C-81306; C-86503; C-86504; C-87450; C-153916; C-153926; C-158062; C-158063. Predominantly preserved as internal moulds.

Stratigraphic range. Late Pliensbachian to Toarcian.

Remarks. *Bositra buchi* and *B. ornati* are two nominal species that, in the past, have either been treated as separate species (e.g. DAMBORENEA 1987b; ABERHAN 1994) or were regarded to be synonyms (e.g. COX 1965, DUFF 1978). Recently, CONTI & MONARI (1992) reported a considerable variability in shape and ornament in Middle Jurassic *Bositra* from the Umbrian-Marchean Apennine, central Italy. Likewise, SZENTE (1995) observed a continuous morphological transition between *B. buchi* and *B. ornati* in specimens from the Middle Jurassic of the Mecsek Mountains, Hungary. Consequently, both species are herein considered synonyms with *B. ornati* as a junior synonym of *B. buchi*.

A wide morphological variability is also observed in the material from western Canada. Even in specimens from the same collection, shell outline ranges from sub-orbicular with a sub-central umbo to oval, the length well exceeding the height, and the umbo placed within the anterior half of the shell. This is in contrast to CONTI & MONARI (1992) and JAITLY et al. (1995), who observed that individual populations were fairly stenomorphic and a continuous range in shape and ornamentation becomes only evident when different populations are compared.

A species closely related to *B. buchi* is *Steinmannia* ex gr. *bronni* VOLTZ from the Upper Sinemurian of North-East Russia (POLUBOTKO in EFIMOVA et al. 1968: 76, pl. 8, figs. 1-4; POLUBOTKO & REPIN 1988). According to DAMBORENEA (1987b), the latter can be distinguished from *B. buchi* by having a very short hinge line and a straight posterior margin.

Genus *Posidonotis* LOSACCO 1942

Type species. *Posidonotis dainellii* LOSACCO 1942.

Posidonotis semiplicata (HYATT 1894)

Pl. 5, Figs. 1, 3-9

1894 *Monotis semiplicata* sp. nov. - HYATT: 414.
1894 *Monotis symmetrica* sp. nov. - HYATT: 414.
v 1928 *Entolium balteatum* sp. nov. - CRICKMAY: 62, pl. 4, figs. e-g.
v 1933a *Entolium semiplicatum* (HYATT) - CRICKMAY: 52, pl. 14, figs. 4-7.
v 1933a *Entolium symmetricum* (HYATT) - CRICKMAY: 52, pl. 14, figs. 1-3.
1943 *Pectinula cancellata* sp. nov. - LEANZA: 244, pl. 1, figs. 1-6.
v 1994 *Posidonotis semiplicata* (HYATT 1894) - ABERHAN: 20, pl. 6, figs. 5-6.
v 1996 *Posidonotis semiplicata* (HYATT 1894) - ABERHAN & PÁLFY: 995, pl. 1, figs. 1-14 (see for extensive synonymy list).

Material. *Posidonotis semiplicata* commonly occurs as shell pavements and was found at the following GSC localities: 24311 (including GSC 111486); 84001; 84002; 84189; 85333 (including GSC 111485); 85334; 88500; 91994 (including GSC 111489, 111490); 93707; 93716; 93728; 94934; 95265 (including GSC 111487, 111488); C-56785; C-80791; C-80793; C-80794; C-80798; C-81319; C-90532; C-159437; C-159440; C-159441; C-159442; C-175222; C-175224; C-175225; C-177610; C-203258; C-210902; C-210911 (including GSC 111491); C-210959. Predominantly preserved as internal and external moulds.

Stratigraphic range. Late Sinemurian to Early Toarcian.

Remarks. As discussed recently by ABERHAN & PÁLFY (1996), the morphological features of *Posidonotis semiplicata* are very variable with regard to the size of disc and auricles, and the surface ornament. Differences between individuals, however, do not have any taxonomic significance, but rather can be explained by intraspecific variability and (or) postdepositional distortion due to compressional deformation. For this reason, ABERHAN & PÁLFY (1996) declared the three nominal species of *Posidonotis* from the Lower Jurassic of western North America, *P. semiplicata* (HYATT), *P. symmetrica* (HYATT), and *P. balteata* (CRICKMAY), as well as *P. cancellata* (LEANZA) from the Lower Jurassic of Chile and Argentina synonyms, with *P. semiplicata* having priority. For a detailed account of the morphological variability of *P. semiplicata*, its autecology and palaeobiogeographic implications see ABERHAN & PÁLFY (1996).

Suborder Pinnina WALLER 1978

Family Pinnidae LEACH 1819

Genus *Pinna* LINNÉ 1758

Subgenus *Pinna* LINNÉ 1758

Type species. *Pinna rudis* LINNÉ 1758.

Pinna (Pinna) cf. *folium* YOUNG & BIRD 1822

Pl. 5, Figs. 10-12; Pl. 6, Fig. 1

cf. 1822 *Pinna folium* sp. nov. - YOUNG & BIRD: 243, pl. 10, fig. 6.

Material. 1 steinkern from GSC locality 10244; 1 right valve from GSC locality 23030; 1 left valve from GSC locality 85418; 1 left valve from GSC locality 88500; 1 single valve from GSC locality 93619; 1 left valve (GSC 112414) from GSC locality 94240; 1 left valve from GSC locality 94993; 1 steinkern from GSC locality C-81311; 8 left valves, 9 right valves, 13 steinkerns (including GSC 112411, 112413), and 9 fragmentary valves from GSC locality C-81322; 1 steinkern (GSC 112412) from GSC locality C-81323; 1 steinkern from GSC locality C-118954. Preserved as internal and external moulds; rarely is relict shell material attached to the moulds.

Stratigraphic range. Early Sinemurian to Early Pliensbachian.

Description. *Pinna* cf. *folium* is characterized by a relatively small apical angle, ranging from 28° to 37°, and by straight dorsal and straight to weakly concave ventral margins. As is typical of *Pinna*, the inner nacreous layer of the shell is medially subdivided into two lobes, which is clearly visible on internal moulds (e.g. Pl. 6, Fig. 1). The ornamentation of the outer surface of each valve consists of 14 to 25 narrow, slightly undulating radial riblets. Where they intersect with commarginal folds, they bear small tubercles.

Remarks. The studied specimens are regarded to belong to the same species as *P.* cf. *folium* from the Pliensbachian and Toarcian of South America (DAMBORENEA 1987a: 95, pl. 4, figs. 6, 11-14, text-fig. 24; ABERHAN 1994: 22, pl. 7, figs. 3-4). The reported tendency of commarginal folds to be stronger on the ventral portion of the shell (DAMBORENEA 1987a: 95) has been observed on some of the Canadian material. But even within a single population this is not a feature that is shared by all individuals and therefore it is not considered to be of diagnostic value.

The only other species of *Pinna* described from the Lower Jurassic of North America is *P. expansa* HYATT from the ?Pliensbachian of California (CRICKMAY 1933b: 904, pl. 24, fig. 1; SMITH et al. 1994). Its diagnostic feature is a different kind of ornament in the dorsal and ventral half of the shell. The dorsal part exhibits more or less regularly spaced radial riblets, commarginal growth lines, and commarginal folds of moderate strength. The ventral part, in contrast, lacks a radial ornament and the commarginal folds are stronger, particularly towards the ventral margin.

Pinna (Pinna) sp. A

Pl. 6, Fig. 2

Material. 1 steinkern (GSC 112415) from GSC locality C-90901.

Stratigraphic range. Early Pliensbachian.

Remarks. In terms of general shape and ribbing pattern, *Pinna (Pinna)* sp. A has certain affinities to *P. (P.)* cf. *radiata* MÜNSTER from the Pliensbachian of Chile (ABERHAN 1994: 22, pl. 7, figs. 1-2). However, given the poor preservation quality of the single available specimen, a comprehensive comparison with Jurassic species of *Pinna* cannot be carried out.

Order Limoida RAFINESQUE 1815

Family Limidae RAFINESQUE 1815

Genus *Antiquilima* COX 1943

Subgenus *Antiquilima* COX 1943

Type species. *Lima antiquata* J. SOWERBY 1818.

Antiquilima (Antiquilima) cf. *nagatoensis* HAYAMI 1959

Pl. 7, Figs. 9-10

cf. 1959 *Antiquilima nagatoensis* sp. nov. - HAYAMI: 66, pl. 7, fig. 4a-c.
v 1959 *Lima* aff. *compressa* TERQUEM - FREBOLD: 10, pl. 4, fig. 3.
v 1964 *Lima* aff. *compressa* TERQUEM - FREBOLD: pl. 3, fig. 4 (refigured from FREBOLD 1959: pl. 4, fig. 3).
cf. 1975 *Antiquilima nagatoensis* HAYAMI - HAYAMI: 86, pl. 4, fig. 1 (refigured from HAYAMI 1959: pl. 7, fig. 4b).
v 1994 *Antiquilima (Antiquilima)* cf. *nagatoensis* HAYAMI 1959 - ABERHAN: 22, pl. 8, figs. 1-3 (see for synonymy list).

Material. 1 left valve from GSC locality 43668; 1 fragmentary valve from GSC locality 85335; 1 right valve (GSC 112431) from GSC locality 88599; 1 left valve from GSC locality 94994; 1 right valve from GSC locality C-90903; 1 left valve (GSC 112432) from GSC locality C-90930; 1 left valve from GSC locality C-103318. Predominantly preserved as external moulds.

Stratigraphic range. Late Sinemurian to Late Pliensbachian (Kunae Zone).

Description. The studied specimens show the diagnostic features of *Antiquilima (Antiquilima)*, in particular an ornament consisting of sinuous radial riblets of two orders of strength. A further prominent feature is the presence of lamellae on the crests of primary and secondary riblets and irregularly spaced commarginal growth rugae. The total number of secondary riblets is highly variable and the number of secondary riblets between two main ribs ranges from 0 to 3.

Remarks. The presence of lamellae on the crests of primary ribs is characteristic of *A. (A.)* cf. *nagatoensis*, which is known from the Sinemurian of Japan (e.g. HAYAMI 1975: 86, pl. 4, fig. 1) and northern Chile (ABERHAN 1994: 22, pl. 8, figs. 1-3), and the Lower Jurassic of Argentina (*Lima succincta* in LEANZA

1942: 178, pl. 10, fig. 7; *Antiquilima* sp. in MANCEÑIDO & DAMBORENEA 1984: 425, pl. 1, fig. 18). Without any doubt, the Canadian specimens belong to the same species as those mentioned from South America. As in the Japanese holotype of *A. (A.) nagatoensis* (see HAYAMI 1959: pl. 7, fig. 4a-b; 1975: pl. 4, fig. 1) the height to length ratio is higher than in the specimens from South America and western Canada, the latter are assigned to *A. nagatoensis* with reservation.

Lima aff. *compressa* TERQUEM as described and figured by FREBOLD (1959: 10, pl. 4, fig. 3, 1964, pl. 3, fig. 4) from the Sinemurian of the Atlin District, British Columbia, certainly also belongs to *A. (A.)* cf. *nagatoensis* as it shows the characteristic lamellae on the ribs and agrees well in general shape. On the whole, ornamentation and overall shape of *Lima compressa* TERQUEM (1855: 319, pl. 22, fig. 4) from the Hettangian of France are more typical of *Plagiostoma* rather than *Antiquilima*.

In contrast, *Lima nodulosa* TERQUEM (1855: 322, pl. 22, fig. 3a-c) from the Lower Liassic of France is a very closely related species. This species also exhibits lamellae on the crests of the radial ribs. However, in the holotype, the height to length ratio is even higher than in both the Japanese specimens and the South American specimens discussed above. As little is known about the variability of populations within species of *Antiquilima* the two species are kept separate at present.

Antiquilima (Antiquilima) succincta
(VON SCHLOTHEIM 1813)

Pl. 6, Figs. 6-7

1813 *Chamites succinctus* sp. nov. - VON SCHLOTHEIM: 72.
1856 *Antiquilima succincta* (SCHL.) - QUENSTEDT: pl. 4, fig. 3, pl. 9, fig. 11.
1867 *Lima succincta* (SCHLOTHEIM) - DUMORTIER: 66, 212, pl. 47, figs. 6-7, pl. 48, fig. 1.
1869 *Lima succincta* (SCHLOTHEIM sp.) - DUMORTIER: 286, pl. 34, figs. 3-4.
1971 *Antiquilima succincta* (SCHLOTHEIM, 1813) - VÖRÖS: 184, pl. 3, fig. 3.

Material. 1 left valve and 1 articulated specimen from GSC locality 10109; 2 single valves from GSC locality 62355; 1 right valve (GSC 112421) from GSC locality 62496; 1 right valve (GSC 112420) from GSC locality 94210; 1 articulated specimen from GSC locality 94241; 1 left valve and 1 fragmentary valve from GSC locality 94242. In shell preservation and as external moulds.

Stratigraphic range. Early Sinemurian.

Description. *Antiquilima (Antiquilima) succincta* is characterized by the presence of smooth, rounded, slightly wavy radial ribs of at least two, sometimes up to three orders of strength. Between the primary ribs 0 to 3 higher order riblets are intercalated, which remain lower and narrower than the primaries through most ontogenetic stages; only in very large specimens the ribs become subequal in strength.

Remarks. In general shape and style of ribbing the Canadian material corresponds very well to specimens figured from the Lower Jurassic of Europe (see list of synonyms above). Two other Early Jurassic species of *Antiquilima*, *A. (A.) antiquata* (J. SOWERBY) (e.g. SOWERBY 1818: 25, pl. 214, fig. 2; BRONN 1836: 338, pl. 15, fig. 10) and *A. (A.) hermanni* (VOLTZ) (e.g. GOLDFUSS 1835: 80, pl. 100, fig. 5a-b; CHAPUIS & DEWALQUE 1853: 194, pl. 27, fig. 1) have been synonymized with *A. succincta* by several authors (e.g. BRONN 1836, DUMORTIER 1867, 1869). In the former species, the ornament appears to be much finer and denser than in *A. succincta*, and *A. hermanni*

EXPLANATION OF PLATE 6

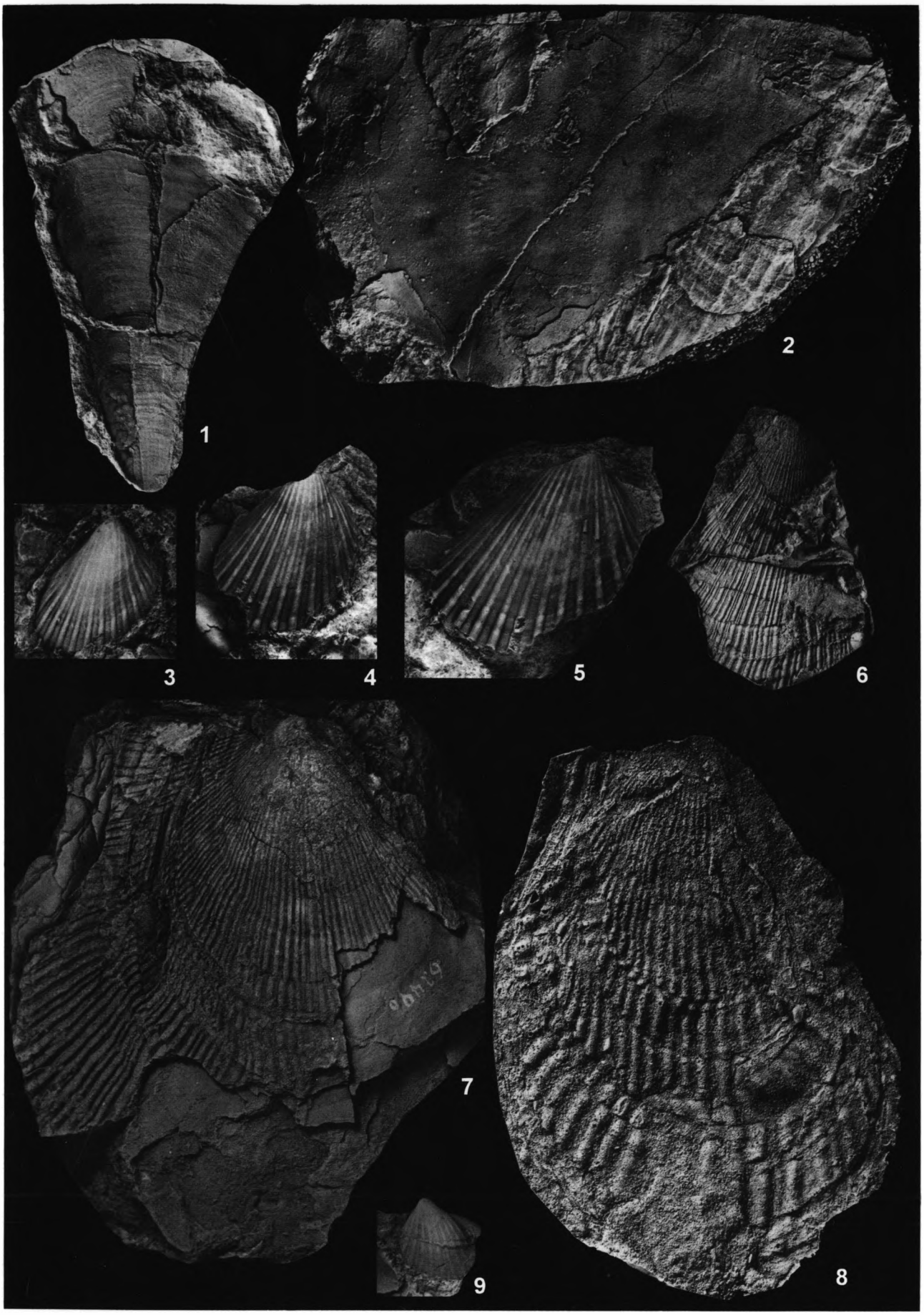
Fig. 1. *Pinna (Pinna)* cf. *folium* YOUNG & BIRD 1822. Figured specimen GSC 112414 from GSC locality 94240; Lower Sinemurian of Taseko Lakes area, British Columbia. Latex cast of left valve; x 1.

Fig. 2. *Pinna (Pinna)* sp. A. Figured specimen GSC 112415 from GSC locality C-90901; Lower Pliensbachian of Spatsizi area, British Columbia. Internal mould of ?right valve with relict shell material attached; x 1.

Figs. 3-5, 9. *Limea? (Pseudolimea?) parva* (MILOVA 1976). 3. Figured specimen GSC 112416 from GSC locality C-80834; Lower Toarcian of Maude Island, British Columbia. Internal mould of left valve; x 2. 4. Figured specimen GSC 112417 from GSC locality C-80834; Lower Toarcian of Maude Island, British Columbia. Internal mould of left valve; x 2. 5. Figured specimen GSC 112418 from GSC locality C-80834; Lower Toarcian of Maude Island, British Columbia. Internal mould of left valve; x 2. 9. Figured specimen GSC 112419 from GSC locality C-80834; Lower Toarcian of Maude Island, British Columbia. Internal mould of right valve; x 2.

Figs. 6-7. *Antiquilima (Antiquilima) succincta* (VON SCHLOTHEIM 1813). 6. Figured specimen GSC 112420 from GSC locality 94210; Lower Sinemurian of Taseko Lakes area, British Columbia. Latex cast of right valve; x 1. 7. Figured specimen GSC 112421 from GSC locality 62496; Lower Sinemurian of Taseko Lakes area, British Columbia. Latex cast of right valve; x 1.

Fig. 8. *Antiquilima?* sp. A. Figured specimen GSC 112422 from GSC locality 14269; Sinemurian of Brazeau Lake area, Alberta. Latex cast of right valve; x 1.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seems to have relatively small auricles and broadens ventrally. A clear statement on the relationship between these three forms cannot be made at present.

Antiquilima succincta can be distinguished from *A.* cf. *nagatoensis* by the lack of distinct lamellae on the rib crests.

Antiquilima? sp. A

Pl. 6, Fig. 8

Material. 1 left valve and 1 right valve (GSC 112422) from GSC locality 14269; 1 steinkern from GSC locality 14720; 1 left valve and 1 steinkern from GSC locality 40941. Preserved as external moulds and steinkerns.

Stratigraphic range. Sinemurian.

Description. The few available specimens from western Canada assigned to *Antiquilima?* sp. A attain a very large adult size. The ornament consists of coarse, undulating radial ribs, which are broadly rounded and subequal in strength and of irregularly spaced growth rugae.

Remarks. In typical *Antiquilima* the radial ribs are of two or more orders of strength. As the radial ribs of the Canadian specimens exhibit only minor variations in strength they are assigned to *Antiquilima* with reservation.

Genus *Ctenostreon* EICHWALD 1862

Type species. *Ostracites pectiniformis* VON SCHLOTHEIM 1820.

Ctenostreon cf. *rugosum* (SMITH 1817)

Pl. 7, Figs. 1-5

cf. 1817 *Ostrea rugosa* sp. nov. - SMITH: 92: 106.
cf. 1820 *Lima proboscidea* sp. nov. - J. SOWERBY: 115, pl. 264.
cf. 1820 *Ostracites pectiniformis* sp. nov. - VON SCHLOTHEIM: 231.
cf. 1878 *Ctenostreon wrighti* sp. nov. - BAYLE: pl. 125, fig. 1.
cf. 1948 *Ctenostreon rugosum* (W. SMITH) - COX & ARKELL: 18 (see for synonymy list).
cf. 1952 *Ctenostreon proboscideum* (J. SOWERBY) - COX: 64, pl. 5, figs. 13-14 (see for extensive synonymy list).
cf. 1975 *Ctenostreon pectiniforme* (SCHLOTHEIM, 1820) - YAMANI: 72, pl. 4, fig. 4 (see for extensive synonymy list).
v 1994 *Ctenostreon* cf. *rugosum* (SMITH 1817) - ABERHAN: 23, pl. 8, figs. 4-7.
v cf. 1994 *Ctenostreon wrighti* BAYLE 1878 - ABERHAN: 24, pl. 8, fig. 8, pl. 9, figs. 1-2.

EXPLANATION OF PLATE 7

Figs. 1-5. *Ctenostreon* cf. *rugosum* (SMITH 1817). 1. Figured specimen GSC 112423 from GSC locality C-90930; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of right valve; x 1.2. 2. Figured specimen GSC 112424 from GSC locality 88599; Upper Sinemurian of Smithers area, British Columbia. Internal mould of right valve; x 1.2. 3. Figured specimen GSC 112425 from GSC locality C-90519; Lower Pliensbachian of Spatsizi area, British Columbia. Exterior view of right valve; x 1.2. 4. Figured specimen GSC 112426 from GSC locality 84190; ?Sinemurian of Smithers area, British Columbia. Internal mould of left valve; x 1.2. 5. Figured specimen GSC 112427 from GSC locality 85334; Lower Pliensbachian of Smithers area, British Columbia. Latex cast of right valve; x 1.2.

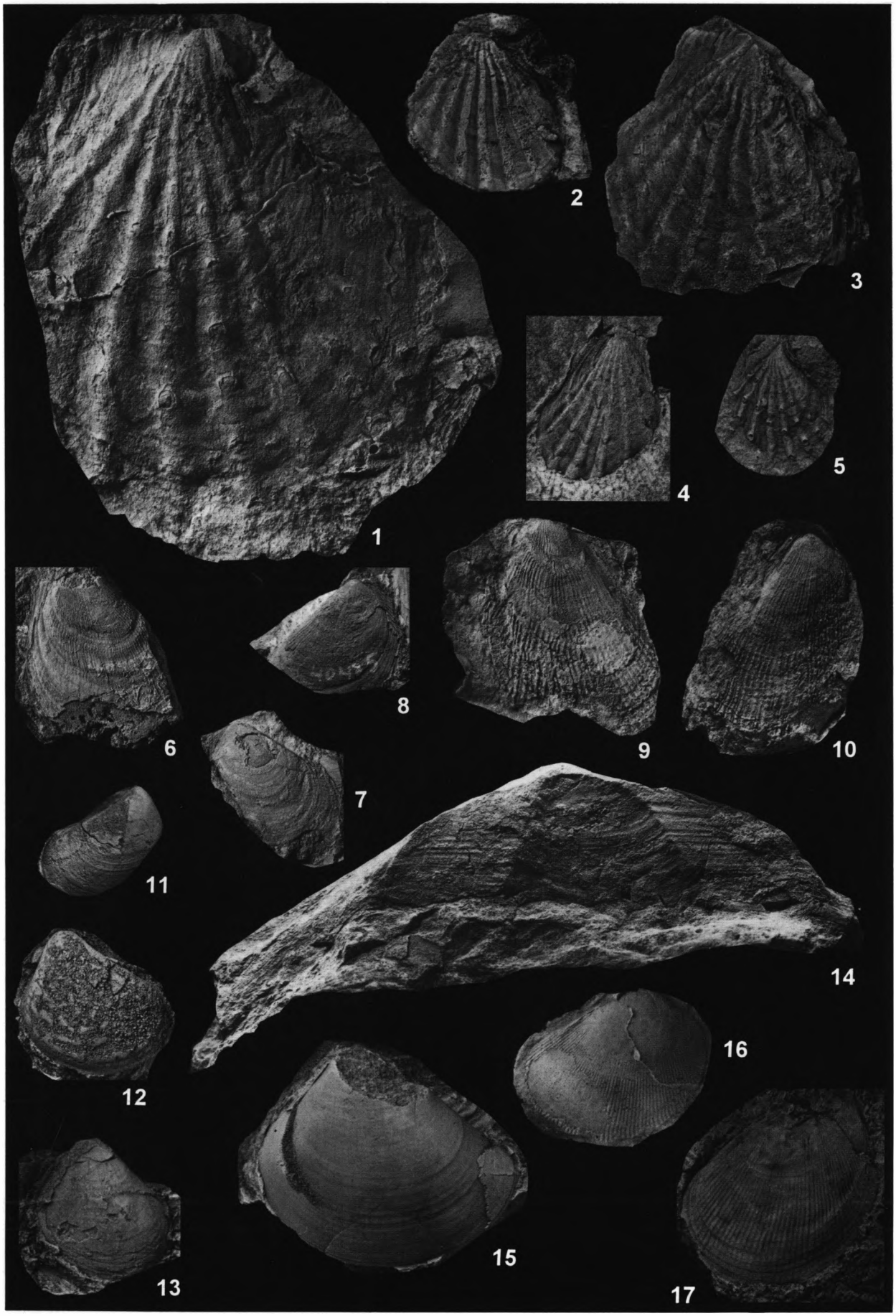
Figs. 6-8. *Plagiostoma* cf. *euximium* BAYLE 1878. 6. Figured specimen GSC 112428 from GSC locality 40425; Upper Pliensbachian of Tulsequah area, British Columbia. Exterior view of right valve; x 1. 7. Figured specimen GSC 112429 from GSC locality 40425; Upper Pliensbachian of Tulsequah area, British Columbia. Exterior view of right valve; x 1. 8. Figured specimen GSC 112430 from GSC locality 40425; Upper Pliensbachian of Tulsequah area, British Columbia. Exterior view of left valve; x 1.

Figs. 9-10. *Antiquilima (Antiquilima)* cf. *nagatoensis* HAYAMI 1959. 9. Figured specimen GSC 112431 from GSC locality 88599; Upper Sinemurian of Smithers area, British Columbia. Latex cast of right valve; x 1. 10. Figured specimen GSC 112432 from GSC locality C-90930; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of left valve; x 1.

Figs. 11-13. *Plagiostoma* sp. A. 11. Figured specimen GSC 112433 from GSC locality 94241; Lower Sinemurian of Taseko Lakes area, British Columbia. Internal mould of left valve; x 1. 12. Figured specimen GSC 112434 from GSC locality C-143319; Upper Hettangian of Taseko Lakes area, British Columbia. Internal mould of right valve; x 1. 13. Figured specimen GSC 112435 from GSC locality C-143321; Upper Hettangian of Taseko Lakes area, British Columbia. Exterior view of right valve; x 1.

Figs. 14-15. *Plagiostoma giganteum* J. SOWERBY 1814. 14. Figured specimen GSC 112436 from GSC locality C-116290; Toarcian of Telegraph Creek area, British Columbia. View of ligamental area of right valve; x 1. 15. Figured specimen GSC 112437 from GSC locality C-175695; Toarcian of Spatsizi area, British Columbia. Internal mould of right valve; x 1.

Figs. 16-17. *Plagiostoma semicirculare* (GOLDFUSS 1835). 16. Figured specimen GSC 112438 from GSC locality 93191; Early Jurassic of Hazelton area, British Columbia. Latex cast of left valve; x 1. 17. Figured specimen GSC 112439 from GSC locality 85416; Upper Sinemurian of Smithers area, British Columbia. Internal mould of left valve; x 1.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Material. 1 single valve from GSC locality 23130; 1 right valve from GSC locality 40242; 1 left valve from GSC locality 40425; 1 single valve from GSC locality 69414; 2 fragmentary valves from GSC locality 84078; 1 left valve (GSC 112426) and 1 right valve from GSC locality 84190; 1 right valve (GSC 112427) from GSC locality 85334; 1 right valve from GSC locality 85438; 1 right valve (GSC 112424) and two left valves from GSC locality 88599; 2 single valves from GSC locality 91088; 1 right valve from GSC locality C-81972; 1 fragmentray right valve from GSC locality C-86682; 1 right valve (GSC 112425) from GSC locality C-90519; 1 right valve (GSC 112423) from GSC locality C-90930; 1 right valve from GSC locality C-143307. Predominantly preserved as internal and external moulds.

Stratigraphic range. Late Hettangian to Late Pliensbachian.

Description. *Ctenostreon* cf. *rugosum* from the Lower Jurassic of western Canadian carries between 8 and 12 radial ribs, which are bearing spines. The interspaces are of about the same width as the ribs or slightly wider.

Remarks. The close relationship between the three nominal species *C. rugosum* (SMITH), *C. pectiniforme* (VON SCHLOTHEIM), and *C. proboscideum* (J. SOWERBY) has been the subject of many discussions (e.g. ARKELL 1932: 145; COX 1952: 65; YAMANI 1975: 73). As also outlined in ABERHAN (1994: 24) they most likely are synonyms of a single, variable and long-ranging species and therefore preference is given to the oldest available name, *C. rugosum*. The number of ribs in the Canadian specimens is relatively low, but still overlaps with forms described and figured from the Middle and Upper Jurassic of Europe (see references in ABERHAN 1994). Apparently, the number of ribs is a very variable feature, which seems to be of little diagnostic value. An open nomenclature has been applied, pending a thorough evaluation of holotypes and museum collections.

Strong affinities exist also to *C. wrighti* BAYLE (1878: pl. 125, fig. 1; ABERHAN 1994: 24, pl. 8, fig. 8, pl. 9, figs. 1-2) from the Jurassic of France and northern Chile. This has been distinguished from *C. rugosum* by bearing narrower and more prominent ribs and by the interspaces being wider than the ribs on most of the shell surface (ABERHAN 1994). Having studied *Ctenostreon* from Canada and the Jurassic of Kutchch, western India (material described in JAITLY et al. 1995), it is doubtful, whether *C. wrighti* can be maintained as a distinct species. As there seems to be a continuous range with respect to the width of ribs and the width of their interspaces, *C. wrighti* very likely also falls within the morphological range of *C. rugosum*.

Ctenostreon? sp. A

Pl. 8, Fig. 3

Material. 1 external mould of a right valve (GSC 112440) from GSC locality 31417.

Stratigraphic range. Early Jurassic.

Remarks. A single fragment of an external mould of a right valve can only doubtfully be referred to *Ctenostreon*. The fragment bears 12 primary ribs and the original number of primary ribs certainly has been higher. Second order riblets are intercalated during ontogeny. For these reasons the specimen differs from *C.* cf. *rugosum* and has been kept separate here.

Genus *Plagiostoma* J. SOWERBY 1814

Type species. *Plagiostoma giganteum* J. SOWERBY 1814; by subsequent designation (STOLICZKA 1871).

Plagiostoma cf. *euximium* BAYLE 1878

Pl. 7, Figs. 6-8

cf. 1878 *Plagiostoma euximium* sp. nov. - BAYLE: pl. 125, fig. 2.

Material. 1 left valve (GSC 112430) and 4 right valves (including GSC 112428, 112429) from GSC locality 40425. In shell preservation and as internal moulds.

Stratigraphic range. Late Pliensbachian.

Description. *Plagiostoma* cf. *euximium* is characterized by a very inequilateral shell, which is sub-trigonal to trapezoidal in outline. A prominent feature is its relatively large posterior auricle, which is indistinctly demarcated from the main body of the shell. The anterior umbonal ridge is sharp. The exterior is covered with about 50, sinuous radial ribs of equal strength, densely spaced commarginal growth lamellae, and irregularly spaced commarginal folds.

Remarks. The Canadian specimens agree closely with the original figure of *P. euximium* BAYLE (1878: pl. 125, fig. 2) from the Lower Jurassic of France, particularly with respect to the presence of a large posterior auricle. Moreover, general outline and style of ornamentation are very similar. Likewise, *Plagiostoma ferrugineum* BENECKE (1905: 122, pl. 4, figs. 8-9) from the upper Liassic of eastern France exhibits a fairly large posterior auricle but differs from *P. euximium* in its style of ornamentation. Due to the poor preservation of the available material I place the specimens in *P. euximium* only with doubts.

Plagiostoma giganteum J. SOWERBY 1814

Pl. 7, Figs. 14-15; Pl. 8, Fig. 5

1814 *Plagiostoma gigantea* sp. nov. - J. SOWERBY: 176, pl. 77.
1935 *Lima (Plagiostoma) gigantea*, J. SOWERBY - COX: 4, pl. 1, fig. 6 (see for synonymy list).

Material. 1 left valve from GSC locality 91833; 1 left valve (GSC 112444) and 1 right valve (GSC 112436) from GSC locality C-116290; 1 right valve (GSC 112437) from GSC locality C-175695. In shell preservation and as internal moulds.

Stratigraphic range. Late Pliensbachian to Toarcian.

Description. Large valves of *Plagiostoma giganteum* are thick-shelled, have a large umbonal angle of about 135°, and reach a maximum length of 16 cm (e.g. Pl. 7, Fig. 14; Pl. 8, Fig. 5). Low radial ribs are present at the antero-dorsal part of the shell (e.g. Pl. 8, Fig. 5); otherwise the outer surface is smooth. The anterior umbonal ridge is sharp and has a well developed lunule in front of it. The cardinal area is wide and bears a broad ligamental pit (e.g. Pl. 7, Fig. 14). Smaller specimens exhibit a narrower umbonal angle of about 90° and carry very low radial riblets wherever original shell material is preserved.

Remarks. The umbonal angle of very large specimens from western Canada is larger than in typical *P. giganteum* of comparable size from the Lower Lias of Europe (e.g. see figures in J. SOWERBY 1814: pl. 77; ZIETEN 1833: pl. 51, fig. 1; CHAPUIS & DEWALQUE 1853: pl. 28, fig. 2; BAYLE 1878: pl. 123, fig. 1). However, *P. giganteum* from the Lower Jurassic of Punjab (COX 1935: 4, pl. 1, fig. 6) has a similarly large umbonal angle as the Canadian specimens. Apparently, this morphological feature is fairly variable.

Plagiostoma semicircularis (GOLDFUSS 1835)

Pl. 7, Figs. 16-17

1835 *Lima semicircularis* sp. nov. - GOLDFUSS: 83, pl. 101, fig. 6.
1943 *Lima (Plagiostoma) semicircularis* GOLDFUSS - COX: 160, pl. 10, figs. 13-14 (see for synonymy list).
1994 *Plagiostoma* sp. A - ABERHAN: 26, pl. 10, figs. 1-6.

Material. 1 left valve (GSC 112439) from GSC locality 85416; 2 left valves from GSC locality 88604; 1 left valve (GSC 112438) from GSC locality 93191; 1 left valve from GSC locality C-86684; 1 left valve and 1 right valve from GSC locality C-118954. Preserved as internal and external moulds.

Stratigraphic range. Sinemurian to Pliensbachian.

Description. *Plagiostoma semicircularis* is characterized by a weakly inflated shell, an obliquely ovate outline, and an obtuse umbonal angle of about 120°. The shell exterior on the only complete specimen available is covered with 72 closely spaced, rounded ribs of equal strength. The interspaces are punctate in early growth stages and bear fine commarginal threads in later stages where the interspaces become wider. The posterior auricle is covered with several fine riblets.

Remarks. A prominent feature of the Canadian specimens and *P. semicircularis* from the Middle Jurassic of Europe is a large umbonal angle, which allows promt separation from most other nominal species of Jurassic *Plagiostoma*. Similar in outline is *P. punctatum* J. SOWERBY (e.g. J. SOWERBY 1815: 25, pl. 113, figs. 1-2; CHAPUIS & DEWALQUE 1853: 201, pl. 30, fig. 4) from the Liassic of Europe. This species, however, has more numerous and less pronounced riblets than *P. semicircularis*.

The Canadian specimens cannot be distinguished from *Plagiostoma* sp. A in ABERHAN (1994: 26, pl. 10, figs. 1-6) from the Lower Jurassic of northern Chile. This species best is also included in *P. semicircularis*.

Plagiostoma sp. A

Pl. 7, Figs. 11-13

Material. 1 left valve from GSC locality 62362; 2 left valves and 1 right valve from GSC locality 84160; 1 steinkern (GSC 112433) from GSC locality 94241; 1 right valve (GSC 112434) from GSC locality C-143319; 1 right valve (GSC 112435) from GSC locality C-143321; 1 left valve from GSC locality C-143324. Predominantly preserved as internal moulds.

Stratigraphic range. Late Hettangian to Early Sinemurian.

Description. The valves of *Plagiostoma* sp. A are moderately inflated and sub-triangular in outline with a concave antero-dorsal margin. Rare specimens that partly have relict shell material attached exhibit very faint radial riblets at the anterior and posterior margins.

Remarks. *Pagiostoma* sp. A has certain affinities to juveniles of *P. giganteum* (see above). However, all specimens are of considerably smaller size than adults of *P. giganteum* and have a smaller umbonal angle. Also, knowledge of the style of ribbing is too incomplete to allow a more precise identification.

Genus *Limea* BRONN 1815

Type species. *Ostrea strigilata* BROCCHI 1814.

Subgenus *Pseudolimea* ARKELL in DOUGLAS & ARKELL 1932

Type species. *Plagiostoma duplicata* J. DE C. SOWERBY 1827.

Remarks. On morphological and phylogenetic grounds, DHONDT (1989) suggested that *Pseudolimea* should be considered a subgenus of *Limea*. This view is followed here.

Limea (Pseudolimea) duplicata (J. DE C. SOWERBY 1827)

Pl. 8, Figs. 6-10

1827 *Plagiostoma duplicata* sp. nov. - J. DE C. SOWERBY: 114, pl. 559, fig. 3.
1944 *Pseudolimea duplicata* (J. DE C. SOWERBY) - COX: 84 (see for extensive synonymy list).
1989 *Pseudolimea duplicata* (J. DE C. SOWERBY, 1827) - FÜRSICH & WERNER: 150, pl. 16, figs. 5-6, text-fig. 23 (see for synonymy list).
1994 *Limea (Pseudolimea) duplicata* (J. DE C. SOWERBY, 1827) - MONARI: 164, pl. 2, figs. 4-6 (see for synonymy list).

Material. 2 right valves from GSC locality 84193; 1 right valve (GSC 112445) from GSC locality 85335; 1 right valve (GSC 112447) from GSC locality 88598; 1 right valve from GSC locality 93277; 1 right valve from GSC locality 93334; 1 left valve, 2 articulated specimens, and 2 fragmentary valves from GSC locality C-81972; 1 right valve from GSC locality C-90901; 1 fragmentary valve from GSC locality C-90902; 1 right valve (GSC 112446) and 1 fragmentary valve from GSC locality C-90903; 1 right valve from GSC locality C-90906; 1 left valve (GSC 112449) from GSC locality C-103114; 2 left valves (including GSC 112448) from GSC locality C-175695. Predominantly preserved as external moulds.

Stratigraphic range. Late Sinemurian to Toarcian.

Description. The shell exterior of *Limea (Pseudolimea) duplicata* is covered with 18 to 22, V-shaped main radial ribs. Additional finer ribs are present on the anterior and posterior end of the shell. The V-shaped to concave interspaces between the main ribs are bearing a single, well developed secondary riblet. In addition, the flanks of primary ribs and interspaces may be covered with up to 4 (counted from the crest of a rib to the next secondary riblet) fine radial threads.

Remarks. As recorded by COX (1944) and FÜRSICH & WERNER (1989), *L. (P.) duplicata* is a very variable species, in particular with regard to the type of ornamentation. The Canadian specimens agree well with the typical *L. duplicata* from Europe (e.g. CHAPUIS & DEWALQUE 1853: 198, pl. 30, fig. 3; PUGACZEWSKA 1986: 58, pl. 18, fig. 9, pl. 22, fig. 1, pl. 27, figs. 5-6; FÜRSICH & WERNER 1989: 150, pl. 16, figs. 5-6), South America (e.g. ABERHAN 1994: 27, pl. 11, figs. 1-2), Africa (e.g. COX 1965: 64, pl. 8, fig. 8), and Asia (e.g. COX 1952: 60, pl. 5, figs. 11-12; WEN 1979: 301, pl. 90, figs. 1, 4, 9, 10, 13, 16; JAITLY et al. 1995: 183, pl. 13, figs. 3-5) and can readily be assigned to this species.

EXPLANATION OF PLATE 8

Figs. 1, 2, 4. *Limea (Pseudolimea) hettangiensis* (TERQUEM 1855). 1. Figured specimen GSC 112442 from GSC locality 14720; ?Sinemurian of Brazeau Lake, Alberta. Latex cast of left valve; x 1. 2. Figured specimen GSC 112441 from GSC locality 20013; Lower Sinemurian of Edson area, Alberta. Internal mould of left valve; x 1. 4. Figured specimen GSC 112443 from GSC locality 14720; ?Sinemurian of Brazeau Lake, Alberta. Exterior view of left valve; x 1.

Fig. 3. *Ctenostreon?* sp. A. Figured specimen GSC 112440 from GSC locality 31417; Early Jurassic of Nelson area, British Columbia. Latex cast of right valve; x 1.2.

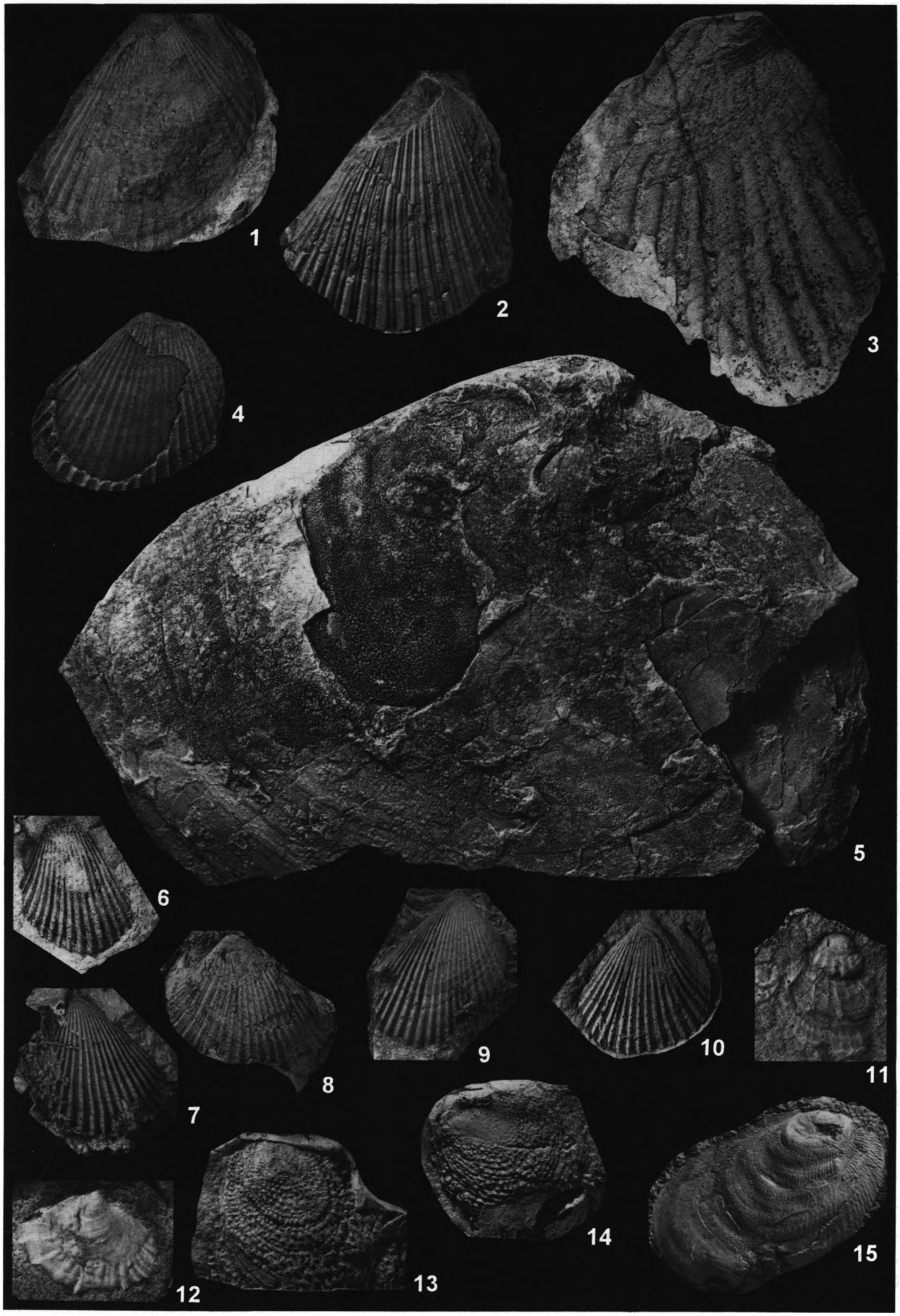
Fig. 5. *Plagiostoma giganteum* J. SOWERBY 1814. Figured specimen GSC 112444 from GSC locality C-116290; Toarcian of Telegraph Creek area, British Columbia. Exterior view of left valve; x 1.

Figs. 6-10. *Limea (Pseudolimea) duplicata* (J. DE C. SOWERBY 1827). 6. Figured specimen GSC 112445 from GSC locality 85335; Upper Sinemurian of Smithers area, British Columbia. Latex cast of right valve; x 1.2. 7. Figured specimen GSC 112447 from GSC locality 88598; Upper Sinemurian of Smithers area, British Columbia. Latex cast of right valve; x 1.2. 8. Figured specimen GSC 112446 from GSC locality C-90903; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of right valve; x 1.2. 9. Figured specimen GSC 112448 from GSC locality C-175695; Toarcian of Spatsizi area, British Columbia. Exterior view of left valve; x 1.2. 10. Figured specimen GSC 112449 from GSC locality C-103114; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of left valve; x 1.2.

Figs. 11-12. *Plicatula (Plicatula)* sp. A. 11. Figured specimen GSC 112450 from GSC locality 82579; ?Pliensbachian of Halfway River area, British Columbia. Latex cast of ?right valve; x 2. 12. Figured specimen GSC 112451 from GSC locality 51337; Toarcian of Halfway River area, British Columbia. Latex cast of right valve; x 2.

Figs. 13-14. *Plicatula (Harpax) rapa* BAYLE & COQUAND 1851. 13. Figured specimen GSC 112452 from GSC locality C-90928; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of ?right valve; x 1.2. 14. Figured specimen GSC 112453 from GSC locality C-103312; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of right valve; x 1.2.

Fig. 15. *Otapiria tailleuri* IMLAY 1967. Figured specimen GSC 112454 from GSC locality 82578; Sinemurian of Halfway River area, British Columbia. Exterior view of right valve; x 2.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Limea (Pseudolimea) hettangiensis (TERQUEM 1855)

Pl. 8, Figs. 1, 2, 4

1855 *Lima hettangiensis* sp. nov. - TERQUEM: 320, pl. 23, fig. 1.
1944 *Pseudolimea hettangiensis* (TERQUEM) - COX: 77, pl. 2, figs. 1, 3, 4 (see for synonymy list).

Material. 2 left valves (GSC 112442, 112443), 2 right valves, and 1 fragmentary valve from GSC locality 14720; 1 left valve (GSC 112441) and 2 fragmentary valves from GSC locality 20013; 2 right valves from GSC locality 21402; 1 left valve and 3 right valves from GSC locality C-143316. In shell preservation and as internal and external moulds.

Stratigraphic range. Late Hettangian to Sinemurian.

Description. *Limea (Pseudolimea) hettangiensis* reaches 48 mm in height, is well inflated, only slightly inequilateral, and exhibits 17 to 20 angular main radial ribs. The interspaces between ribs are flat to moderately concave. In some specimens they bear a strong secondary riblet (e.g. Pl. 8, Fig. 2); in others a prominent secondary riblet is missing (e.g. Pl. 8, Fig. 4). The rib flanks and interspaces carry numerous faint radial striae, which are more conspicuous in the interspaces, but cannot be observed on internal moulds. The anterior and posterior parts of the shell are covered with additional radial riblets.

Remarks. The Canadian material closely resembles *Limea (Pseudolimea) hettangiensis* from the Eary Jurassic of Europe (e.g. TERQUEM 1855: 320, pl. 23, fig. 1; COX 1944: 77, pl. 2, figs. 1, 3, 4) and Chile (ABERHAN 1994: 27, pl. 11, fig. 6). Although many specimens are internal moulds, all can be assigned to *L. hettangiensis* with high confidence. *L. hettangiensis* can be distinguished from *L. duplicata* by a larger size, a more equilateral shell, and a more symmetrical ventral margin. In addition, COX (1944) reports a lower number of main ribs in *L. hettangiensis*, which are also stronger, and a more prominent secondary rib in the interspaces between the main ribs. These last characters are only realized in part of the Canadian material and therefore appear to be variable features of poor diagnostic value.

Limea? (Pseudolimea?) parva (MILOVA 1976)

Pl. 6, Figs. 3-5, 9

1976 *Lima (Lima) parva* sp. nov. - MILOVA: 72, pl. 12, figs. 3-4.
v 1991 *Lima (Lima) parva* MILOVA - POULTON: 31, pl. 6, figs. 1-7.

Material. 6 left valves (including GSC 112416 to 112418), 3 right valves (including GSC 112419), and 3 fragmentary valves from GSC locality C-80834; 1 left valve and several fragmentary valves from GSC locality C-80843; 1 left valve from GSC locality C-81703. Predominantly preserved as internal moulds.

Stratigraphic range. Pliensbachian to Early Toarcian.

Description. The slightly inequilateral shell of *Limea? (Pseudolimea?) parva* is rather small, with one individual reaching 17 mm in height, but all the other specimens having a height of less than 10 mm. The number of ribs on internal moulds is ranging from 10 to 16. They are very obtuse and depressed and the interspaces are flat to slightly convex.

Remarks. The studied material only allows the examination of the shell interior or of internal moulds. Likewise, the figured specimens of *Lima (Lima) parva* from the ?Hettangian and Sinemurian of north-western Canada (POULTON 1991: 31, pl. 6, figs. 1-7) are internal moulds. However, latex casts from unfigured external moulds on a slab, which is partly reproduced in POULTON (1991: pl. 6, fig. 1) show that the radial ribs are relatively acute in cross-section. POULTON's specimens, although of older age, cannot be distinguished from the material described herein and apparently belong to the same species. As size, shape, and style of ornamentation of the analysed specimens correspond better to *Limea (Pseudolimea)* rather than *Lima (Lima)*, they are tentatively assigned to the former.

Lima transversa POLUBOTKO (e.g. POLUBOTKO in EFIMOVA et al. 1968: 84, pl. 8, figs. 5-6) from the Hettangian to Pliensbachian of the Russian Far East and *L.? (P.?) parva* most likely are synonyms.

Order Ostreoida FÉRUSSAC 1822

Remarks. In the collections of the Geological Survey of Canada, specimens of the Ostreoida are very rare and extremely poorly preserved and therefore are not considered further in this study. The only exception are the Plicatulidae, which traditionally have been placed in the Pterioida (e.g. COX & HERTLEIN in COX et al. 1969) but later were assigned to the Ostreoida (WALLER 1978).

Family Plicatulidae WATSON 1930

Genus *Plicatula* LAMARCK 1801

Type species. *Spondylus plicatus* LINNÉ 1758; by subsequent designation (SCHMIDT 1818).

Plicatula (Plicatula) sp. A

Pl. 8, Figs. 11-12

Material. 1 right valve (GSC 112451) and 2 single valves from GSC locality 51337; 1 ?right valve (GSC 112450) and 2 single valves from GSC locality 82579. Predominantly preserved as external moulds.

Stratigraphic range. ?Pliensbachian to Toarcian.

Remarks. In the literature there is a large number of nominal species assigned to *Plicatula*, most of them probably synonyms. This was, for example, expressed by FÜRSICH & WERNER (1989: 146), who accommodated forms with numerous spines and radial plicae in *Plicatula (P.) armata* GOLDFUSS. There is a number of species described from the Lower Jurassic of Europe that are closely related to *Plicatula (Plicatula)* sp. A in terms of general outline and style of ribbing. They include several species described by EUDES-DESLONGCHAMPS (1858) from the Lower Jurassic of Calvados, northern France, such as *P. auricula*, *P. baylii* TERQUEM, *P. lineolata*, *P. raristriata*, *P. vallata*, as well as *P. meridionalis* (BÖHM) (1901: 227, pl. 9, fig. 1) from the Hettangian of Portugal. Apparently, variations in shape between these forms are largely controlled by the size and form of the attachment area and are not well suited to distinguish between various species. As only two specimens are available for study at present and a revision of the group is beyond the scope of this paper, I prefer to classify the Canadian specimens informally as *Plicatula (Plicatula)* sp. A.

Subgenus *Harpax* PARKINSON 1811

Type species. *Harpax parkinsoni* BRONN 1824.

Remarks. *Harpax* has been placed as a junior synonym of *Plicatula (Picatula)* by several authors (e.g. COX & HERTLEIN in COX et al. 1969). However, characteristic hinge features and presence of a peculiar scaly ornamentation warrant the separation of *Harpax* from *Plicatula* (POULTON 1991, DAMBORENEA 1993a). Here, *Harpax* is regarded as a subgenus of *Plicatula*.

Plicatula (Harpax) rapa BAYLE & COQUAND 1851

Pl. 8, Figs. 13-14

1851 *Plicatula rapa* sp. nov. - BAYLE & COQUAND: 16, pl. 5, figs. 8-10.

v 1991 *Harpax* sp. cf. *H. spinosus* (SOWERBY) - POULTON: 29, pl. 7, figs. 2-7, 27, 28, pl. 9, figs. 7, 12.

v 1991 *Harpax laevigatus* D'ORBIGNY - POULTON: 29, pl. 9, fig. 8 only.

v 1994 *Plicatula (Harpax) rapa* BAYLE & COQUAND 1851 - ABERHAN: 29, pl. 11, figs. 15-18 (see for synonymy list).

Material. 1 single valve from GSC locality 95015; 1 ?right valve (GSC 112452) from GSC locality C-90928; 1 right valve (GSC 112453) from GSC locality C-103312. Preserved as external moulds.

Stratigraphic range. Sinemurian to Early Pliensbachian.

Remarks. The specimens from western Canada cannot be distinguished from Early Jurassic *Plicatula (Harpax) rapa* of Argentina (e.g. DAMBORENEA in DAMBORENEA et al. 1992: pl. 116, figs. 13-14, 1993a: fig. 3h) and Chile (e.g. BAYLE & COQUAND 1851: 16, pl. 5, figs. 8-10; ABERHAN 1994: 29, pl. 11, figs. 15-18) and therefore have been assigned to this species. *Harpax* (cf.) *spinosus* from the Lower Jurassic of the boreal realm (e.g. POLUBOTKO in EFIMOVA et al. 1968: 87, pl. 28, figs. 4-5; POULTON 1991: 29, pl. 7, figs. 2-7, 27, 28, pl. 9, figs. 7, 8, 12) most likely also belong here (see also ABERHAN 1994).

Order Pectinoida RAFINESQUE 1815

Family Monotidae FISCHER 1887

Genus *Otapiria* MARWICK 1935

Type species. *Pseudomonotis marshalli* TRECHMANN 1923.

Remarks. Throughout the Early Jurassic, *Otapiria* was a common faunal element in relatively fine-grained, offshore habitats of the circum-Pacific. Apart from some Upper Pliensbachian specimens of northern Yukon, which were doubtfully assigned to *Otapiria* by POULTON (1991: 27, pl. 9, figs. 6, 13-14), the specimens illustrated in this report are the first confirmed records of the genus in Canada.

Otapiria tailleuri IMLAY 1967

Pl. 8, Fig. 15; Pl. 9, Figs. 1-6

1967b *Otapiria tailleuri* sp. nov. - IMLAY: B3, pl. 1, figs. 1-23, pl. 2, fig. 32.

1992 *Otapiria tailleuri* IMLAY - SEY & POLUBOTKO in DAMBORENEA et al.: pl. 120, fig. 13.

v 1998 *Otapiria tailleuri* IMLAY - ABERHAN: fig. 31.

Material. 1 left valve from GSC locality 42530; 7 left valves (including GSC 112455) and 3 right valves from GSC locality 52228; 14 left valves (including GSC 112343, 112456, 112457, 112459) and 8 right valves (including GSC 112454, 112458) from GSC locality 82578; 28 left valves and 7 right valves from GSC locality C-187092. Predominantly in shell preservation and as internal moulds.

Stratigraphic range. Sinemurian. *Otapiria tailleuri* from northern Alaska originally was regarded as being Toarcian or Bajocian in age or both (IMLAY 1967b). However, given the fact, that the material was obtained from organic-rich shales directly overlying fossiliferous Upper Triassic (IMLAY 1967b: B6) and that they were found near beds yielding Sinemurian ammonites (DAMBORENEA 1987b: 157), a Sinemurian age of these specimens became highly plausible. In a later study, IMLAY (1981: 5, 16-17) stated that *O. tailleuri* is associated in the subsurface only with ammonites of Early Sinemurian age and concluded that its range is probably only Sinemurian and that it may not be younger than Early Sinemurian. *O. tailleuri* also occurs in the Canadian Arctic (ABERHAN et al. 1998), where it is associated with Early Sinemurian ammonites. An Early Sinemurian age is further corroborated by the stratigraphic position of *O. tailleuri* and the very closely related *O. omolonica* from North-East Russia, which in both cases is Early Sinemurian (e.g. POLUBOTKO & REPIN 1988). The Early Jurassic specimens examined in the present study are overlying *Monotis*-bearing Triassic and are known to be not younger than Early Pliensbachian (POULTON et al. 1990: 170). In conclusion, *O. tailleuri* from cratonic western Canada appears to indicate a Sinemurian, most likely an Early Sinemurian age.

Description. In early growth stages (e.g. Pl. 9, Figs. 2, 4, 6) the specimens tend to be sub-orbicular in outline, with an only feebly convex left valve and an almost flat right valve. The umbones are situated sub-centrally to slightly anterior of the median. In later growth stages (e.g. Pl. 8, Fig. 15; Pl. 9, Figs. 1, 3) the shells become strongly inequilateral, obliquely ovate in outline, and moderately to strongly extended posteriorly. The ornament is somewhat stronger on left valves than on right ones and consists of numerous sharp, slightly wavy, irregular radial riblets and irregularly spaced commarginal folds. The number of riblets increases by intercalation. They are densely packed and the interspaces between them are ranging from approximately the same width as the riblets to considerably narrower (see also IMLAY 1967b for a detailed description).

Remarks. Small individuals strongly resemble *Otapiria originalis* KIPARISOVA (e.g. POLUBOTKO in EFIMOVA et al. 1968: 33, pl. 3, figs. 1-3) from the Hettangian to Lower Sinemurian of North-East Russia. Adult specimens, however, agree very well in size, general form, type of ribbing, and intraspecific variability with those described and figured by IMLAY (1967b: B3, pl. 1, figs. 1-23, pl. 2, fig. 32) from the Lower Jurassic of northern Alaska.

According to their morphological variability, DAMBORENEA (1987b) arranged species of *Otapiria* into four supraspecific groups. The species belonging to her first group, which includes *Otapiria tailleuri*,

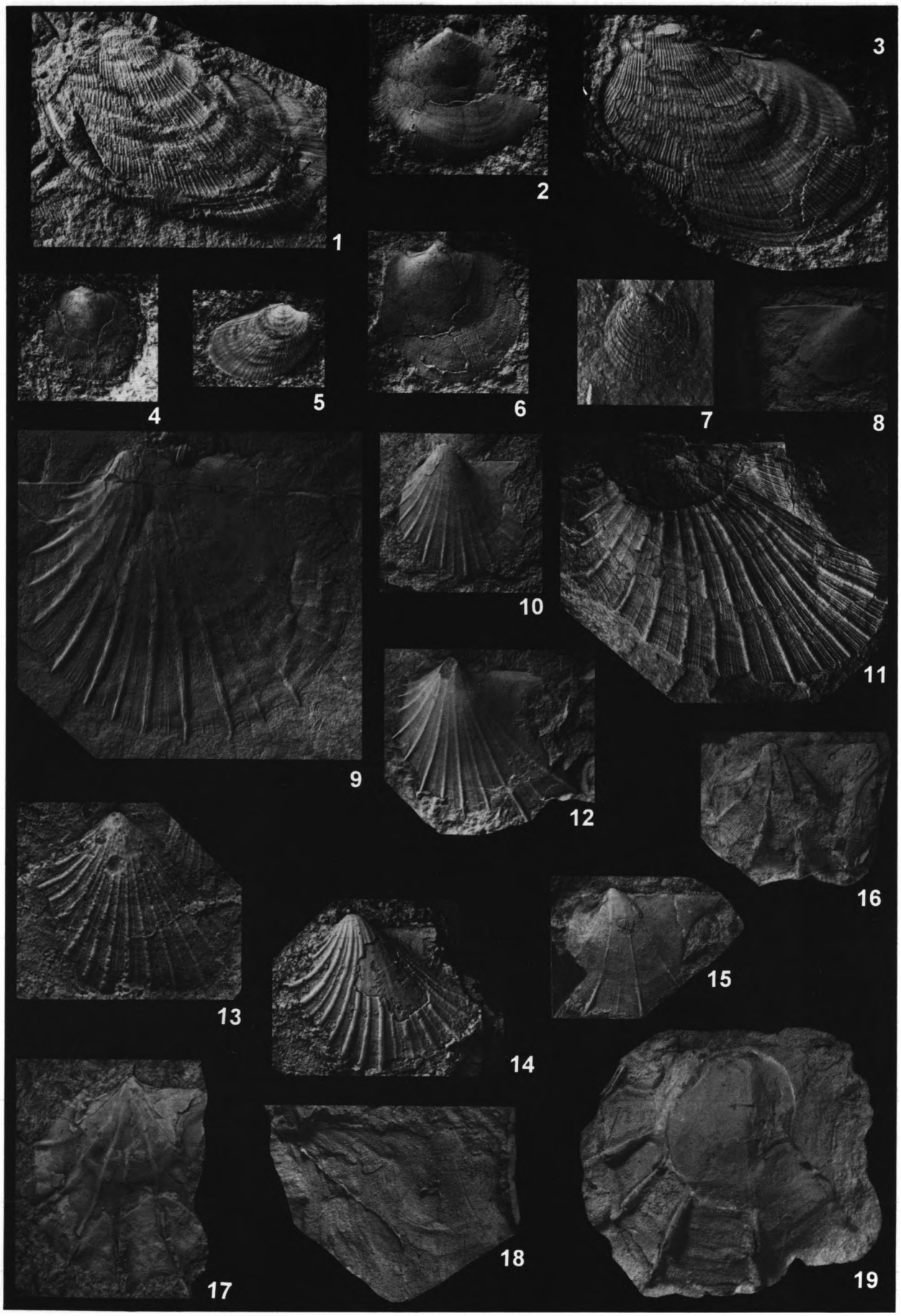
EXPLANATION OF PLATE 9

Figs. 1-6. *Otapiria tailleuri* IMLAY 1967. 1. Figured specimen GSC 112455 from GSC locality 52228; Sinemurian of Halfway River area, British Columbia. Exterior view of left valve; x 2. 2. Figured specimen GSC 112456 from GSC locality 82578; Sinemurian of Halfway River area, British Columbia. Exterior view of left valve; x 2. 3. Figured specimen GSC 112343 from GSC locality 82578; Sinemurian of Halfway River area, British Columbia. Exterior view of left valve; x 2. 4. Figured specimen GSC 112457 from GSC locality 82578; Sinemurian of Halfway River area, British Columbia. Exterior view of left valve; x 2. 5. Figured specimen GSC 112458 from GSC locality 82578; Sinemurian of Halfway River area, British Columbia. Exterior view of right valve; x 2. 6. Figured specimen GSC 112459 from GSC locality 82578; Sinemurian of Halfway River area, British Columbia. Latex cast of left valve; x 2.

Fig. 7. *Lupherella boechiformis* (HYATT 1894). Figured specimen GSC 112460 from GSC locality 40473; Upper Pliensbachian of Tulsequah area, British Columbia. Latex cast of left valve; x 2.

Figs. 8-14. *Oxytoma (Oxytoma) inequivalvis* (J. SOWERBY 1819). 8. Figured specimen GSC 112461 from GSC locality 91833; Upper Pliensbachian of Maude Island, British Columbia. Exterior view of right valve; x 2. 9. Figured specimen GSC 112462 from GSC locality 93563; Lower Pliensbachian of Moresby Islands, British Columbia. Exterior view of left valve; x 1.2. 10. Figured specimen GSC 112463 from GSC locality 40242; Lower Sinemurian of Mount Robson area, Alberta. Exterior view of left valve; x 2. 11. Figured specimen GSC 112464 from GSC locality 91818; Lower Pliensbachian of Maude Island, British Columbia. Exterior view of left valve; x 1. 12. Figured specimen GSC 112465 from GSC locality 84160; Lower Sinemurian of Pine Pass area, British Columbia. Exterior view of left valve; x 2. 13. Figured specimen GSC 112466 from GSC locality 78595; Upper Sinemurian of Fernie area, Alberta. Latex cast of left valve; x 2. 14. Figured specimen GSC 112467 from GSC locality 89003; ?Sinemurian of Ashcroft area, British Columbia. Exterior view of left valve; x 2.

Figs. 15-19. *Oxytoma (Palmoxytoma) cygnipes* (YOUNG & BIRD 1822). 15. Figured specimen GSC 112468 from GSC locality 14720; ?Sinemurian of Brazeau Lake area, Alberta. Exterior view of left valve; x 1. 16. Figured specimen GSC 112469 from GSC locality 14720; ?Sinemurian of Brazeau Lake area, Alberta. Latex cast of left valve; x 1. 17. Figured specimen GSC 112470 from GSC locality C-90615; Pliensbachian-Toarcian boundary of Maude Island, British Columbia. Internal mould of left valve with relict shell material attached; x 1. 18. Figured specimen GSC 112471 from GSC locality 14720; ?Sinemurian of Brazeau Lake area, Alberta. Latex cast of right valve; x 1. 19. Figured specimen GSC 112472 from GSC locality 14720; ?Sinemurian of Brazeau Lake area, Alberta. Latex cast of left valve; x 1.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are characterized by "elongated shells, the left valve more inflated than the right one and radial ornament prevailing over the commarginal and equally developed on both valves" (DAMBORENEA 1987b: 155). Other circum-Pacific Early Jurassic species that fall within this group can be distinguished from *O. tailleuri* as follows:

Otapiria marshalli (TRECHMANN 1923: 270, pl. 15, figs. 6-9; see also DAMBORENEA 1987b and references therein) from the Hettangian and Sinemurian of New Zealand and New Caledonia has a less oblique shape, a coarser radial ribbing, and a more extended postero-ventral region.

Otapiria neuquensis DAMBORENEA (1987b: 156, pl. 6, figs. 1-5; ABERHAN 1994: 34, pl. 16, figs. 7-9) has a less elongated, more sub-orbicular adult shell with a broader umbo and less numerous riblets.

Strongest affinities exist to *Otapiria omolonica* POLUBOTKO (in EFIMOVA et al. 1968: 37, pl. 4, figs. 8-10; SEY & POLUBOTKO in DAMBORENEA et al. 1992: pl. 120, figs. 10-12) from the Lower Sinemurian of North-East Russia. The latter appears to have a less evenly rounded ventral and antero-ventral margin, but little is known about its intraspecific morphological variability and it might well be conspecific with *O. tailleuri*.

Otapiria limaeformis ZAKHAROV (1962: 25, pl. 1, figs. 1-16) and *Otapiria affecta* POLUBOTKO (in EFIMOVA et al. 1968: 36, pl. 5, figs. 1-6) from the Upper Sinemurian of North-East Russia can easily be distinguished from *O. tailleuri* by the right valve being smooth or bearing only faint radial riblets.

The figured specimens assigned to *Otapiria?* cf. *limaeformis* ZAKHAROV from the Upper Pliensbachian of northern Yukon (POULTON 1991: 27, pl. 9, figs. 6, 13-14) are very poorly preserved and, as mentioned by POULTON (1991: 27), their generic status is doubtful and must be left open. They seem to have radially ribbed left valves and smooth right valves and in this respect differ from *O. tailleuri*.

Genus *Lupherella* IMLAY 1967

Type species. *Lupherella boechiformis* (HYATT 1894).

Remarks. A taxon closely related to *Otapiria* is *Lupherella* IMLAY from the Upper Pliensbachian of California and Oregon. *Lupherella* can be separated from *Otapiria* by a smaller and less oblique shell, a relatively long dorsal margin and posterior wing, finer and more numerous commarginal folds, and presence of a small anterior wing on left valves (IMLAY 1967b). The specimen figured in this monograph is the first record of *Lupherella* from western Canada.

Lupherella boechiformis (HYATT 1894)

Pl. 9, Fig. 7

1894 *Daonella böchiformis* sp. nov. - HYATT: 415.
1894 *Daonella cardinoides* sp. nov. - HYATT: 416.
1933a *Daonella böchiformis* HYATT - CRICKMAY: 53, pl. 14, figs. 8-13.
1933a *Daonella cardinoides* HYATT - CRICKMAY: 53, pl. 14, figs. 18-23.
1967b *Lupherella boechiformis* (HYATT) - IMLAY: B8, pl. 2, figs. 1-27.

Material. 2 left valves (including GSC 112460) from GSC locality 40473.

Stratigraphic range. Late Pliensbachian.

Remarks. The material from the Upper Pliensbachian of western Canada agrees perfectly well with coeval specimens figured by IMLAY (1967b) from eastern Oregon and California. The species was described in great detail by IMLAY (1967b) and no further comments are needed here.

Family Oxytomidae ICHIKAWA 1958

Remarks. The oxytomid (sub-)genera *Oxytoma* MEEK, *Palmoxytoma* COX, *Arctotis* BODYLEVSKY, and *Meleagrinella* WHITFIELD form an important group of epifaunal bivalves in the Lower Jurassic of the circum-Pacific. The latter two genera share a number of external morphological features and easily can be confused. According to CRAME (1985), *Meleagrinella* can be distinguished from *Arctotis* by its denser radial ribbing, pointed postero-dorsal wing, much smaller right anterior auricle, and a thinner left valve ligamental area, which exhibits a distinct tooth-like protuberance anterior to the resilifer. According to JELETZKY & POULTON (1987), *Arctotis* is further characterized by the common development of subradial folds or sulci on the posterior part of the shell and corresponding embayments of the ventral shell margin.

At first sight, some species of *Arctotis* and *Meleagrinella* appear to be quite similar in shell form and kind of ribbing to the monotid bivalve genera *Otapiria* MARWICK and *Lupherella* IMLAY. The latter two can be separated from these oxytomids by having a less convex left valve, an obliquely-elongated rather than rounded-oval outline, a posterior wing which is not pointed, and a more wavy radial ribbing. The very

small anterior auricle of the right valve of *Otapiria* and *Lupherella* is bounded by a deep groove and commonly lacks a well developed byssal notch (e.g. IMLAY 1967b); in adult specimens of *Otapiria* the right anterior auricle is almost overlapped by the dorsal part of the body (e.g. NEWELL & COX in COX et al. 1969). In contrast, *Meleagrinella* and *Arctotis* tend to develop a right anterior auricle, which is relatively larger, exhibits a deep byssal notch, and is clearly visible in adult specimens (see also BEGG & CAMPBELL 1985 for a discussion of various pteriomorphs).

Genus *Oxytoma* MEEK 1864

Subgenus *Oxytoma* MEEK 1864

Type species. *Avicula münsteri* BRONN 1830.

Oxytoma (Oxytoma) inequivalvis (J. SOWERBY 1819)

Pl. 9, Figs. 8-14

1819 *Avicula inequivalvis* sp. nov. - J. SOWERBY: 78, pl. 244, figs. 2-3.
1969 *Oxytoma inequivalve* (SOWERBY) - FREBOLD: 86, pl. 1, fig. 10.
v cf. 1977 *Oxytoma (Oxytoma)* sp. - FREBOLD & POULTON: 94, pl. 2, figs. 1-3.
1978 *Oxytoma (Oxytoma) inequivalve* (J. SOWERBY, 1819) - DUFF: 54, pl. 4, figs. 7, 9, 11, 13, 15-19, 21-23, text-fig. 17a-b (see for synonymy list).
1987b *Oxytoma (Oxytoma) inequivalvis* (J. SOWERBY) - DAMBORENEA: 160, pl. 6, figs. 9-12, text-fig. 15 (see for synonymy list).
v 1991 *Oxytoma (Oxytoma)* sp. - POULTON: pl. 6, figs. 17, 20.
v 1991 *Oxytoma (Oxytoma)* sp. cf. *O. (O.) sinemuriensis* (D'ORBIGNY) - POULTON: 26, pl. 6, figs. 18-19.
v 1991 *Oxytoma* - POULTON: pl. 9, fig. 12.
v 1991 *Oxytoma (Oxytoma)* sp. cf. *O. (O.) inequivalvis* (J. SOWERBY); - POULTON: 26, pl. 11, figs. 1-3.
1992 *Oxytoma* sp. - THOMSON & SMITH: pl. 2, fig. 2.

Material. *Oxytoma (Oxytoma) inequivalvis* was found at the following GSC localities: 14720; 22709; 25592; 31443; 40241; 40242 (including GSC 112463); 62370; 65057; 78595 (including GSC 112466); 79797; 84160 (including GSC 112465); 89003 (including GSC 112467); 89623; 90986; 91138; 91818 (GSC 112464); 91827; 91833 (including GSC 112461); 93563 (including GSC 12462); C-80229; C-80231; C-80235; C-80769; C-80838; C-80843; C-81703; C-87123; C-90811; C-90933; C-127465; C-143310; C-157702; C-158085. In shell preservation and as internal and external moulds.

Stratigraphic range. Late Hettangian to Aalenian.

Remarks. The material studied here lies well within the morphological range of *O. inequivalvis* as described, for example, by DUFF (1978) and DAMBORENEA (1987b). The considerable intraspecific variability of *O. inequivalvis* has been documented in detail by DUFF (1978) and his view is followed here.

POULTON (1991: 26) distinguished between several species of *Oxytoma* in the Lower and Middle Jurassic of western Canada on the basis of different length/height ratios. The recognized Early Jurassic species are *Oxytoma* cf. *sinemuriensis* (POULTON 1991: 26, pl. 6, figs. 18-19) and *Oxytoma* cf. *inequivalvis* (POULTON 1991: 26, pl. 11, figs. 1-3). Given the high degree of morphological variation in *O. inequivalvis*, these specimens are all included in the synonymy of *O. inequivalvis* herein.

Due to poor preservation, the Hettangian specimens of northern Yukon, which have been identified as *Oxytoma* sp. (FREBOLD & POULTON 1977: 94, pl. 2, figs. 1-3) can only doubtfully be included in the list of synonymy of *O. inequivalvis*.

Subgenus *Palmoxytoma* COX 1961

Type species. *Pecten cygnipes* YOUNG & BIRD 1822.

Oxytoma (Palmoxytoma) cygnipes (YOUNG & BIRD 1822)

Pl. 9, Figs. 15-19

1822 *Pecten cygnipes* sp. nov. - YOUNG & BIRD: pl. 9, fig. 6.
v 1957b *Oxytoma cygnipes* PHILLIPS - FREBOLD: 67, pl. 16, figs. 1-5.
v 1964 *Oxytoma cygnipes* PHILLIPS - FREBOLD: pl. 5, figs. 3-4 (refigured from FREBOLD 1957b: pl. 16, figs. 4, 1b).
v 1966 *Oxytoma cygnipes* PHILLIPS - FREBOLD: pl. 1, figs. 5-6 (refigured from FREBOLD 1957b: pl. 16, figs. 1a, 5).
v 1991 *Oxytoma (Palmoxytoma) cygnipes* (YOUNG & BIRD) - POULTON: 26, pl. 6, figs. 14-16, pl. 11, figs. 14-16 (see for a short synonymy list).

Material. *Oxytoma (Palmoxytoma) cygnipes* was found at the following GSC localities: 14269; 14270 (including GSC 112468, 112469, 112471, 112472); 14276; 14713; 14720; 21697; 23015; 27193; 65057; 77062; 79797; 84160; C-90615 (GSC 112470); C-127463; C-127465. In shell preservation and as internal and external moulds.

Stratigraphic range. Early Sinemurian to Pliensbachian-Toarcian boundary.

Description. The characteristic features of *Oxytoma (Palmoxytoma) cygnipes* are a left valve with 5 to 6 radial ribs that bear spines; in internal moulds the latter have a tuberculate appearance. The ribs are separated by wide interspaces which are covered by numerous fine radial striae. The right valve is almost flat and bears a few narrow radial grooves and fine striae in the interspaces between the grooves; the striae are best developed on the posterior wing.

Remarks. The Canadian specimens agree well in all specific characters with representatives from Europe (e.g. PHILLIPS 1829: 162, pl. 14, fig. 3; QUENSTEDT 1884: 787, pl. 61, fig. 17) and eastern Asia (e.g. HAYAMI 1959: 48, pl. 5, fig 14; POLUBOTKO in EFIMOVA et al. 1968: 46, pl. 22, figs. 11-12). Occurrences in Sinemurian sediments of the autochthonous western Canadian craton are well documented in the literature (see list of synonymy above) and further specimens are figured on Pl. 9, Figs. 15, 16, 18, and 19. In addition, the presence of *O. (P.) cygnipes* is documented for the first time from the Pliensbachian-Toarcian boundary of the Queen Charlotte Islands (Pl. 9, Fig. 17), an area that is part of the allochthonous terrane Wrangellia.

Genus *Arctotis* BODYLEVSKY 1960

Subgenus *Arctotis* BODYLEVSKY 1960

Type species. *Hinnites lenaensis* LAHUSEN 1886.

Remarks. Early Jurassic representatives of *Arctotis* appear to be absent from the allochthonous terranes of western Canada. In the present study *Arctotis* is recorded for the first time from the autochthonous craton in the Early Jurassic.

Arctotis (Arctotis) sp. A

Pl. 10, Figs. 1-2

v 1998 *Arctotis (Arctotis)* sp. A - ABERHAN: fig. 4K.

Material. 1 internal mould of a left valve (GSC 112357) and 2 right valves (GSC 112357, 112473) from GSC locality 21387.

Stratigraphic range. Pliensbachian.

Description. The left valve of *Arctotis (A.)* sp. A is sub-ovate in outline, longer than high and moderately

EXPLANATION OF PLATE 10

Figs. 1-2. *Arctotis (Arctotis)* sp. A. 1. Figured specimen GSC 112357 from GSC locality 21387; Pliensbachian of Brazeau Lake area, Alberta. Internal mould of left valve and interior view of right valve; x 1.2. 2. Figured specimen GSC 112473 from GSC locality 21387; Pliensbachian of Brazeau Lake area, Alberta. Latex cast from interior of right valve; x 1.2.

Fig. 3. *Placunopsis radiata* (PHILLIPS 1829). Figured specimen GSC 112337 from GSC locality C-86684; Upper Pliensbachian of Tulsequah area, British Columbia. Latex cast of left valve; x 1.

Figs. 4-10. *Meleagrinella* cf. *oxytomaeformis* POLUBOTKO 1968. 4. Figured specimen GSC 112474 from GSC locality C-159423; Sinemurian of Graham Island, British Columbia. Exterior view of left valve; x 1.5. 5. Figured specimen GSC 112475 from GSC locality C-159431; Sinemurian of Graham Island, British Columbia. Exterior view of left valve; x 1.5. 6. Figured specimen GSC 112476 from GSC locality C-159423; Sinemurian of Graham Island, British Columbia. Latex cast of right valve; x 1.5. 7. Figured specimen GSC 112477 from GSC locality 93728; Lower Pliensbachian of Graham Island, British Columbia. Latex cast of right valve; x 1.5. 8. Figured specimen GSC 112478 from GSC locality 93728; Lower Pliensbachian of Graham Island, British Columbia. Latex cast of right valve; x 1.5. 9. Figured specimen GSC 112479 from GSC locality C-175242; Lower Pliensbachian of Graham Island, British Columbia. Exterior view of left valve; x 1.5. 10. Figured specimen GSC 112350 from GSC locality 93728; Lower Pliensbachian of Graham Island, British Columbia. Latex cast of left valve; x 1.5.

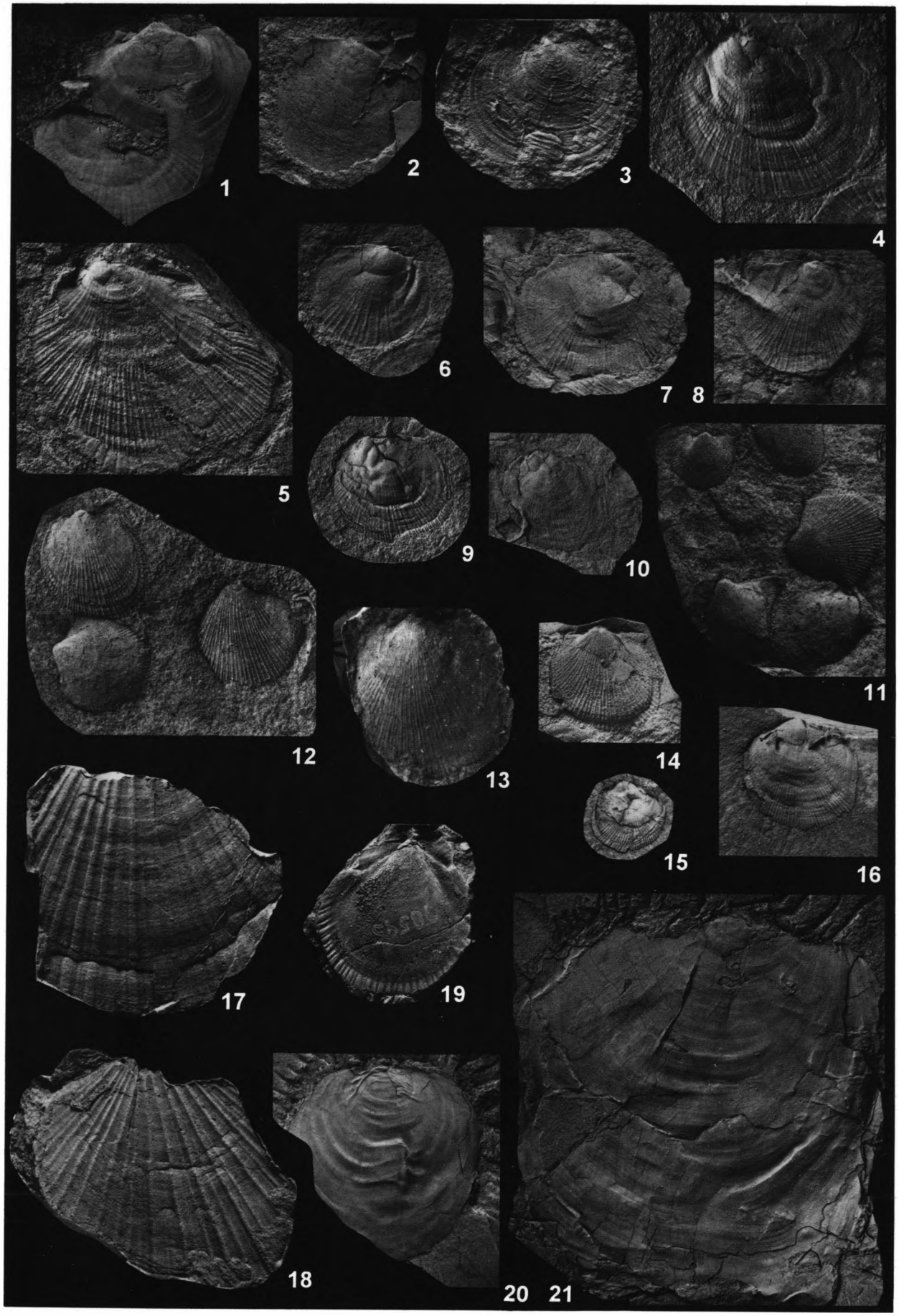
Figs. 11-14. *Meleagrinella ferniensis* (MCLEARN 1924). 11. Figured specimen GSC 112480 from GSC locality C-81311; Sinemurian of Laberge area, southern Yukon. Slab with several densely packed valves; x 2. 12. Figured specimen GSC 112351 from GSC locality C-81311; Sinemurian of Laberge area, southern Yukon. Slab with three left valves; x 2. 13. Figured specimen GSC 112481 from GSC locality C-81322; Sinemurian of Laberge area, southern Yukon. Latex cast of left valve; x 2. 14. Figured specimen GSC 112482 from GSC locality C-81311; Sinemurian of Laberge area, southern Yukon. Latex cast of left valve; x 2.

Figs. 15-16. *Placunopsis* cf. *fibrosa* LAUBE 1867. 15. Figured specimen TMP 83.168.19; Toarcian of Fernie area, Alberta. Exterior view of left valve; x 2. 16. Figured specimen TMP 83.168.21; Toarcian of Fernie area, Alberta. Exterior view of left valve; x 2.

Figs. 17-18. *Propeamussium (Striatoamussium) patriciae* POULTON 1991. 17. Figured specimen GSC 112485 from GSC locality C-156891; Late Toarcian to Aalenian of Graham Island, British Columbia. Latex cast of single valve; x 1. 18. Figured specimen GSC 112486 from GSC locality C-81704; Late Toarcian to Early Aalenian of Graham Island, British Columbia. Latex cast of single valve; x 1.

Fig. 19. *Kolymonectes staeschei* (POLUBOTKO 1968) Figured specimen GSC 112355 from GSC locality 78595; Upper Sinemurian of Fernie area, Alberta. Internal mould of right valve; x 1.2.

Figs. 20-21. ?terquemiid gen. et sp. nov.? 20. Figured specimen GSC 112487 from GSC locality C-156345; Hettangian of Graham Island, British Columbia. Internal mould of ?left valve; x 1. 21. Figured specimen GSC 112488 from GSC locality C-175206; Hettangian-Sinemurian boundary of Graham Island, British Columbia. Internal mould of single valve with relict shell material attached; x 1.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convex. The exterior is radially ribbed and bears irregularly spaced commarginal folds. The anterior and posterior wings are indistinctly delimited from the rest of the shell and obtuse. The right valve is thin, sub-orbicular in outline, and almost flat. The anterior auricle is long, tilted inwards, and has a straight dorsal margin. A deep byssal notch separates the anterior auricle from the main body of the shell. The exterior is covered with radial ribs, which apparently are less strong as compared to left valves. A median articulation ridge (see JELETZKY & POULTON 1987) is lacking.

Remarks. The assignment to *Arctotis (A.)* is mainly based on the presence of an obtuse left postero-dorsal wing, a long, flat-topped byssus ear, and relatively broad and widely spaced radial ribs on the left valve. As the only available left valve is an internal mould and only the interior of the right valve is known, a more precise description of the ornamentation must be postponed until better preserved material becomes available.

Genus *Meleagrinella* WHITFIELD 1885

Type species. *Avicula curta* HALL 1852; by subsequent designation (COX 1941).

Remarks. Identification of Jurassic specimens of *Meleagrinella* is strongly hampered by the huge amount of nominal species (partly also kept under the generic names *Avicula*, *Echinotus*, *Monotis*, and *Pseudomonotis*). Many are based on a few, often poorly preserved individuals, are presented by insufficient figures and descriptions, and/or have been erected on the basis of stratigraphical and regional considerations. The matter is further complicated by an obviously high degree of intraspecific variation, even within a single population. This point has been stressed by DUFF (1978), who demonstrated the high variability of *M. braamburiensis* (PHILLIPS), which is reflected mainly in the degree of inflation and the style of ornament. Based on these observations, the Canadian specimens can be accommodated within two variable species, i.e. *M. ferniensis* (MCLEARN) and *M.* cf. *oxytomaeformis* POLUBOTKO.

Meleagrinella ferniensis (MCLEARN 1924)

Pl. 10, Figs. 11-14

v 1924 *Pseudomonotis ferniensis* sp. nov. - MCLEARN: 42, pl. 3, figs. 1-4.

1968 *Pseudomonotis ferniensis* MCLEARN - PATERSON: 56, pl. 17, fig. 4.

v 1998 *Meleagrinella ferniensis* (MCLEARN) - ABERHAN: fig. 4E.

Material. 2 single valves from GSC locality C-81310; 18 left valves (including GSC 112351, 112480, 112482) from GSC locality C-81311; 1 left valve (GSC 112481) from GSC locality C-81322; 2 left valves from GSC locality C-81323. Predominantly in shell preservation and as external moulds.

Stratigraphic range. Sinemurian.

Description. The species is characterized by a small, sub-quadrangular shell. The left valve is relatively strongly convex. The most dorsal parts of the anterior and posterior margins are concave. The radial riblets are straight, their number increasing during ontogeny by intercalation of additional riblets, which rapidly gain about the same strength as the primary ones. The width of the interspaces is narrower than that of the riblets. No right valves were available for study.

Remarks. The Canadian specimens closely agree with *M. ferniensis* as figured by MCLEARN (1924). Left valves of *M. ferniensis* appear to differ from *M.* cf. *oxytomaeformis* by a smaller size, a less well rounded outline, more densely spaced riblets, and subordinate importance of commarginal elements in the former. Furthermore a studied paratype of a right valve of *M. ferniensis* appears to be smooth, whilst right valves of *M.* cf. *oxytomaeformis* (see below) are radially ribbed (see below).

POULTON (1991: 26, pl. 11, figs. 4-5, 11) described and figured *Meleagrinella?* aff. *ansparsicosta* POLUBOTKO from the Upper Sinemurian or Pliensbachian of north-western Canada. I examined the figured specimens, which are characterized by equilateral shells with a relatively small umbonal angle, and clearly delimited anterior and posterior auricles. They are not oxytomids, but rather belong to a pectinid genus identical or closely related to *Kolymonectes* or *Chlamys*. Since all studied specimens with auricles lack a deep byssal notch (presence of a byssal notch is typical of right valves of *Chlamys*) and *Kolymonectes* is reported from the Sinemurian of this region, the mentioned specimens most likely belong to the latter.

Meleagrinella sp. in POULTON (1991: 25, pl. 6, figs. 8-10, pl. 9, figs. 15-16, pl. 11, figs. 12-13) is more oblique than *M. ferniensis* and *M.* cf. *oxytomaeformis* and has a relatively straight anterior margin and a more pointed posterior wing.

Some other figured specimens of *Meleagrinella(?)* from the Lower Jurassic of north-western Canada (e.g. FREBOLD & POULTON 1977: 94, pl. 2, fig. 4; POULTON 1991: pl. 6, fig. 11, pl. 9, fig. 9) are too poorly pre-

served to allow meaningful comparisons with other species.

Meleagrinella cf. *oxytomaeformis* POLUBOTKO 1968

Pl. 10, Figs. 4-10

cf. 1968 *Meleagrinella oxytomaeformis* sp. nov. - POLUBOTKO in EFIMOVA et al.: 39, pl. 22, figs. 1-5.

cf. 1992 *Meleagrinella oxytomaeformis* POLUB. - SEY & POLUBOTKO in DAMBORENEA et al.: pl. 121, figs. 15-16 (refigured from POLUBOTKO in EFIMOVA et al. 1968: pl. 22, figs. 4, 1).

v 1998 *Meleagrinella* cf. *oxytomaeformis* POLUBOTKO - ABERHAN: fig. 4D.

Material. Several left and right valves (including GSC 112477, 112478) from GSC locality 93728; 1 left valve from GSC locality C-81707; 1 left valve (GSC 112474) and 2 right valves (including GSC 112476) from GSC locality C-159423; 1 left valve (GSC 112475) from GSC locality C-159431; 2 left valves (including GSC 112479) from GSC locality C-175242. Predominantly in shell preservation and as external moulds.

Stratigraphic range. Late Sinemurian to Early Pliensbachian.

Description. Shells of *Meleagrinella* cf. *oxytomaeformis* occur in fine-grained silty shales of the Queen Charlotte Islands, where they are of low convexity to flat, due to compaction. The left valve is medium-sized and sub-orbicular in outline. The most dorsal part of the posterior margin is concave. The posterior wing is poorly differentiated from the rest of the shell. Anterior to the umbo, an auricle of moderate size is developed. Adult specimens bear up to 80, slightly wavy, radial riblets; the number of riblets is increasing during ontogeny by intercalation of second order riblets. The spacing of the riblets may vary on different parts of the surface of the same specimen, but is of approximately the same width as the riblets. The latter are becoming weaker towards the anterior margin and on the posterior wing and often disappear completely. Commarginal growth lines are well developed and give rise to a fine reticulate pattern when crossing the radial riblets. In addition, broad commarginal folds are developed at irregularly spaced intervals.

The right valves are similar to left valves, also sub-orbicular in outline, and their most dorsal part of the posterior margin is feebly concave. The posterior wing is broad and flat; the anterior auricle is small and delimited from the body of the shell by a deep, sub-auricular byssal notch and finally, towards the umbo, by a deep groove. The anterior auricle is tilted inwards, forming an angle of about 20-30° with the plane of commissure. The exterior bears radial riblets of two orders of strength and a few commarginal folds. The riblets are fainter, more widely spaced and only about half in number as on the left valve. Similarly, they are fading towards the anterior and posterior margins and finally disappear.

Remarks. Apart from *M. oxytomaeformis*, several other species of *Meleagrinella* have been described and figured from the Lower Jurassic of North-East Russia. In the closely allied Hettangian to ?basal Sinemurian *M. subolifex* POLUBOTKO (in EFIMOVA et al. 1968: 38, pl. 2, figs. 6-8; SEY & POLUBOTKO in DAMBORENEA et al. 1992: pl. 120, figs. 7-9) the number of ribs on the left valve is about 75. According to the original description it differs from *M. oxytomaeformis* by having a sub-trapezoidal rather than rounded outline, radial ribs of subequal strength, and poorly defined radial ribs on the right valve. However, these differences may be due to differences in preservation and/or intraspecific variability and possibly both species are synonyms.

Other figured specimens from North-East Russia may belong to different groups of species. For example, the Late Pliensbachian *M. ansparsicosta* POLUBOTKO (in EFIMOVA et al. 1968: 41, pl. 21, figs. 3-7) and *M. ptchelincevae* POLUBOTKO (in EFIMOVA et al. 1968: 40, pl. 22, figs. 6-10) exhibit a more strongly pointed posterior wing and appear to have a more prosocline body of the shell.

Another Early Jurassic *Meleagrinella* based on poorly preserved material is *M. japonica* HAYAMI (1959: 47, pl. 5, figs. 20-22) from western Japan. It can be separated from the Canadian specimens by a more strongly pointed posterior wing and an apparently smooth right valve.

Meleagrinella braamburiensis (PHILLIPS) (e.g. DUFF 1978: 58, pl. 4, figs. 20, 24, 26-28, 31, 32, pl. 5, figs. 1, 2, 6, 11, text-figs. 18, 19) from the Callovian of Europe and Russia can be distinguished by the lack of a left anterior auricle. *M. echinata* (SMITH) differs from *M.* cf. *oxytomaeformis* by its more widely spaced radial ribs on the left valve, which are densely squamose.

Arctotis? frenguellii (DAMBORENEA 1987b: 158, pl. 6, figs. 7-8; 1993a: 117) from the Toarcian-Aalenian of Argentina resembles *M.* cf. *oxytomaeformis* in overall form, style of ribbing, and the presence of a small anterior auricle on the right valve, which is delimited by a deep byssal notch. However, *A.? frenguellii* lacks the short, concave parts of the postero-dorsal shell margin on both valves. Whereas shell outline and lack of subradial folds indicate affinities to the monotid *Otapiria*, presence of a right valve anterior auricle in *A.? frenguellii* together with a deep byssal notch is reminiscent of the oxytomids *Arctotis* and *Meleagrinella*.

?Family **Terquemiidae** COX 1964

Genus *Placunopsis* MORRIS & LYCETT 1853

Type species. *Placunopsis fibrosa* LAUBE 1867.

Placunopsis cf. *fibrosa* LAUBE 1867

Pl. 10, Figs. 15-16

cf. 1853 *Placunopsis jurensis* ROEMER sp. - MORRIS & LYCETT: 6, pl. 1, figs. 8, 8a, 8b [non *Placuna jurensis* ROEMER 1836: 66, pl. 16, fig. 4].
cf. 1867 *Placunopsis fibrosa* sp. nov. - LAUBE: 16, pl. 1, fig. 7.
cf. 1952 *Placunopsis fibrosa* LAUBE - COX: 45, pl. 4, figs. 14 (see for synonymy list).

Material. 2 left valves (TMP 83.168.19, TMP 83.168.21).

Stratigraphic range. Toarcian.

Remarks. Specimens of *Placunopsis* cf. *fibrosa* are relatively small and differ from *P. radiata* (see below) by a lower number of radial ribs, which are coarser than in *P. radiata*. These differences have been used by several authors (e.g. ARKELL 1929: 49; COX 1952: 46) to distinguish between both species, but a revision of the genus, taking into consideration the high variability of cemented bivalves, possibly may show that they are synonyms.

Placunopsis radiata (PHILLIPS 1829)

Pl. 10, Fig. 3

1829 *Orbicula? radiata* sp. nov. - PHILLIPS: 130, pl. 4, fig. 12.
1930a *Anomia columbiana* sp. nov. - CRICKMAY: 53, pl. 14, figs. 4-6.
1982 *Placunopsis radiata* (PHILLIPS 1829) - FÜRSICH: 56, figs. 24 K, M (see for extensive synonymy list).
1990 *Placunopsis radiata* (PHILLIPS 1829) - HÖLDER: 34, fig. 9a-d, i, k, fig. 11 (see for extensive synonymy list).
v 1998 *Placunopsis radiata* (PHILLIPS) - ABERHAN: fig. 3C.

Material. 1 left valve from GSC locality 95015; 1 left valve (GSC 112337) from GSC locality C-86684. Both preserved as external moulds.

Stratigraphic range. Sinemurian to Pliensbachian.

Remarks. *P. radiata* is a very long-ranging species and according to FÜRSICH (1982: 57), all larger *Placunopsis* may belong to this species. The western Canadian specimens cannot be distinguished from those described from the Jurassic of Greenland and other areas (see FÜRSICH 1982 and references therein) and recently from the Sinemurian and Pliensbachian of northern Chile (ABERHAN 1994: 36, pl. 17, figs. 6-8).

?terquemiid gen. et sp. nov.?

Pl. 10, Figs. 20-21

Material. 1 single valve from GSC locality C-156318; 1 ?left valve (GSC 112487) from GSC locality C-156345; 1 singe valve (GSC 112488) from GSC locality C-175206. All internal moulds.

Stratigraphic range. Hettangian.

Description. The specimens assigned to ?terquemiid gen. et sp. nov.? are large, sub-ovate (higher than long), sub-equilateral, and somewhat irregular in outline. Due to compaction and in-situ breakage of shells, the original convexity cannot be determined. The outer surface carries commarginal growth lines and irregularly spaced folds, which are also visible on internal moulds; an external radial ornament is lacking. The inner surface of the shell exhibits narrow, wavy, radial grooves, which form very fine striae on internal moulds.

Remarks. ?terquemiid gen. et sp. nov.? can be separated from *Placunopsis* and other terquemiid bivalves by the lack of an external radial sculpture and the presence of radial grooves on the shell interior. As I am not aware of any existing bivalve genus, which shows the observed features, and the available material is not adequate for erecting a new taxon, a more precise identification is not possible at present.

Family Propeamussiidae TUCKER ABBOTT 1954

Genus *Propeamussium* DE GREGORIO 1884

Type species. *Pecten (Propeamussium) ceciliae* DE GREGORIO 1884.

Remarks. As pointed out by DAMBORENEA (1998) there is some confusion regarding the generic relationships of internally ribbed propeamussiid bivalves. For example, in the Treatise (HERTLEIN in COX et al. 1969) *Variamussium* SACCO was placed in the synonymy of *Parvamussium* SACCO, disregarding clear differences in the style of ornamentation on both valves. Furthermore, the time ranges of *Propeamussium* s.s. and *Parvamussium* are mixed. DAMBORENEA (1998) concluded that most Jurassic species belong to *Parvamussium* rather than *Propeamussium* s.s. I regard *Parvamussium* and *Propeamussium* s.s. as subgenera of *Propeamussium* and a new subgenus, *Striatoamussium*, is herein erected.

Subgenus *Striatoamussium* subgen. nov.

Type species. *Propeamussium (Striatoamussium) patriciae* POULTON 1991.

Derivation of name. From striatus (lat.) = striated, and amusium (gr.) = raw.

Diagnosis. Propeamussiid bivalve with exterior of both valves ornamented with radial riblets; byssal notch moderately deep; interior of both valves with radial costae.

Remarks. Apart from internal radial costae, the presence of a radial ornament on the exterior of both valves is regarded as the main diagnostic feature of the new subgenus. The latter feature serves to distinguish *Striatoamussium* from the closely related *Parvamussium*, in which only the left valve is commonly covered with radial striae or riblets, and from *Propeamussium* s.s., in which an external ornament is absent on both valves. In addition, the new subgenus apparently attains a considerably larger adult size and a thicker shell than typical representatives of Jurassic *P. (Parvamussium)*.

Propeamussium (Striatoamussium) patriciae
POULTON 1991

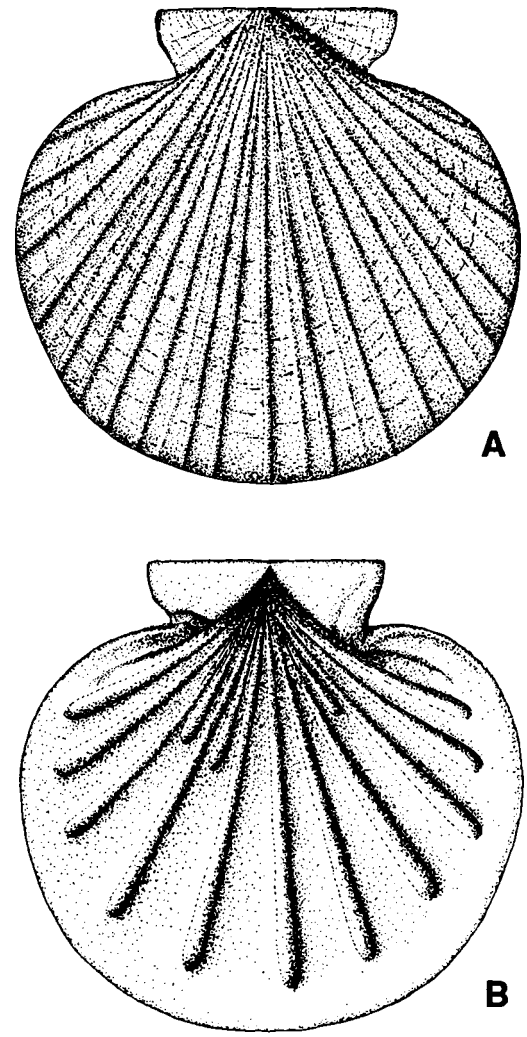
Pl. 10, Figs. 17-18; Pl. 11, Figs. 1, 3, 5, 7; Text-fig. 6

v 1991 *Propeamussium (Propeamussium) patriciae* sp. nov. - POULTON: 28, pl. 18, figs. 1-25.
v 1998 *Propeamussium patriciae* POULTON - ABERHAN: fig. 3B.

Material. 5 single valves from GSC locality 48565; 1 right valve from GSC locality 52329; 1 articulated specimen and 2 single valves (including GSC 112486) from GSC locality C-81704; 1 articulated specimen and 4 single valves from GSC locality C-81735; 2 right valves and 1 articulated specimen (GSC 112489) from GSC locality C-87113; 1 single valve from GSC locality C-87219; 1 articulated specimen and 1 single valve from GSC locality C-103127; 2 single valves (including GSC 112485) from GSC locality C-156891; 1 single valve from GSC locality C-157740; 3 single valves from GSC locality C-157748; 3 single valves from GSC locality C-157749; 2 single valves (including GSC 112491) from GSC locality C-157750; 1 right valve (GSC 112336) from GSC locality C-158047; 1 left valve (GSC 112490) from GSC locality C-158052; 1 right valve from GSC locality C-158083; 1 articulated specimen from GSC locality C-158084; 2 single valves from GSC locality C-158089. In shell preservation and as internal and external moulds.

Stratigraphic range. Late Toarcian to Early Aalenian.

Description. Shell medium-sized to large, equilateral, sub-orbicular in outline, length slightly exceeding height. Both valves of equally low convexity, not gaping along lateral margins. Auricles of both valves well demarcated from disc, subequal in shape, the anterior one being slightly larger than the posterior. Dorsal margins of auricles straight, meeting at an angle of 180°. Right valve anterior auricle with moderately deep byssal notch; posterior margin of posterior auricle weakly concave, meeting the disc at an acute angle. Both auricles of left valve meeting disc at an acute angle. Right auricles carry a few, faint radial riblets; left auricles smooth except for growth lines.



Text-fig. 6. *Propeamussium (Striatoamussium) patriciae* POULTON 1991. A. Reconstruction of exterior view of right valve. B. Reconstruction of interior view of right valve. Approximately x 1.

Radial sculpture of shell exterior (Text-fig. 6A) very variable, consisting of narrow to broadly rounded ribs and riblets; number of ribs increasing to a variable degree by intercalation of new ribs during ontogeny, which may or may not gain the same strength as the original ones. Riblets separated by very irregularly spaced intervals, the latter ranging from being as wide as the riblets to up to five times the width of the riblets on the same specimen. Left valve exterior ornamentation differs from that of right valve only by presence of radial depression on posterior part of disc, which is best developed in early growth stages.

Interior of valves with a maximum of 14 (10-14) internal costae in early stages of ontogeny (e.g. Text-fig. 6B); internal costae of slightly varying strength. 10-11 of the internal costae reaching from three quarters to nine-tenth of the distance to the ventral margin in adults; others fading while approaching shell margin. Resilifer deep, triangular in shape.

Remarks. *P. (Striatoamussium) patriciae* can easily be distinguished from all Jurassic species of *Propeamussium*, such as *P. (Parvamussium) pumilum* (e.g. JOHNSON 1984: 22, pl. 1, figs. 1-4, 7-9), *P. (Parvamussium) laeviradiatum* (e.g. JOHNSON 1984: 28, pl. 1, figs. 5, 6, 10, 12), *P. (Parvamussium) nonarium* (e.g. JOHNSON 1984: 32, pl. 1, figs. 13-14, ?15-16), and *P. (Parvamussium) olenekense* (e.g. SEY & POLUBOTKO in DAMBORENEA et al. 1992: pl. 122, figs. 1-2; also referred to as *Variamussium waageni* POLUBOTKO in EFIMOVA et al. 1968: 77, pl. 41, figs. 3-6) by both valves bearing a radial sculpture.

The specimens figured as *Variamussium* sp. by POLUBOTKO (in EFIMOVA et al. 1968: 78, pl. 66, fig. 1a-b) from the Upper Aalenian of North-East Russia closely resemble *P. (S.) patriciae*. As the external sculpture of the Russian form is only figured from a single valve, however, its generic (and specific) status must remain open.

Genus *Kolymonectes* MILOVA & POLUBOTKO 1976

Type species. *Aequipecten (?) anjuensis* MILOVA 1969.

Remarks. Recently, DAMBORENEA (1998) proposed that two stocks of Propeamussiidae were present in Mesozoic times. The first stock is characterized by genera with internal ribs such as *Parvamussium*. In a second stock taxa are grouped, which lack internal ribs, but on the basis of shell microstructure and the absence of a ctenolium can be referred to the Propeamussiidae. DAMBORENEA (1998) included *Kolymonectes* in the second stock and her view is followed here.

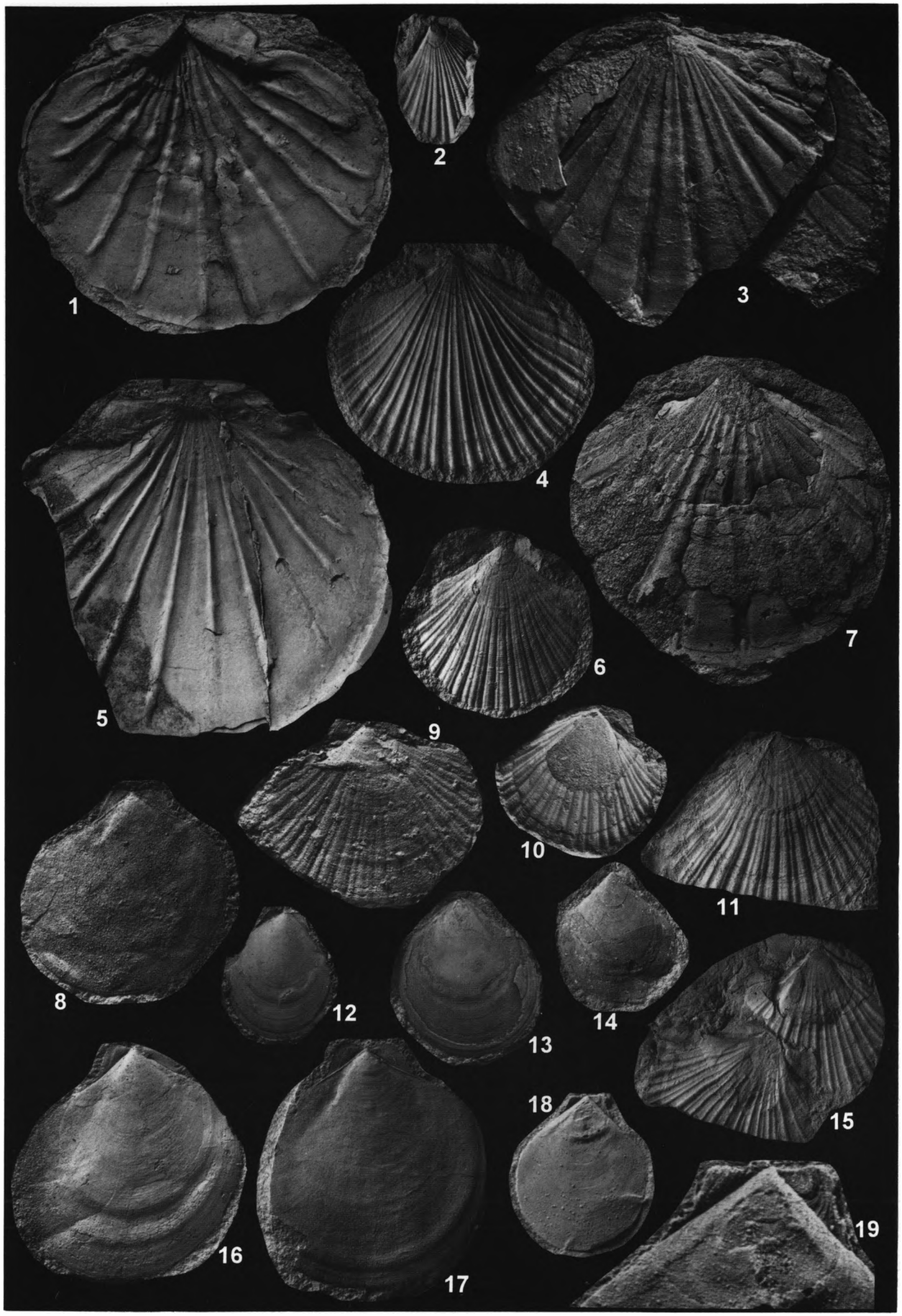
EXPLANATION OF PLATE 11

Figs. 1, 3, 5, 7. *Propeamussium (Striatoamussium) patriciae* POULTON 1991. 1. Figured specimen GSC 112336 from GSC locality C-158047; Upper Toarcian to Aalenian of Graham Island, British Columbia. Latex cast of interior of right valve; x 1. 3. Figured specimen GSC 112489 from GSC locality C-87113; Toarcian of Graham Island, British Columbia. Articulated specimen, internal mould of valve with relict shell material attached and external mould of corresponding valve (right part of specimen); x 1. 5. Figured specimen GSC 112490 from GSC locality C-158052; Upper Toarcian to Aalenian of Graham Island, British Columbia. Latex cast of interior of left valve; x 1. 7. Figured specimen GSC 112491 from GSC locality C-157750; ?Aalenian of Graham Island, British Columbia. Internal mould of single valve with relict shell material attached; x 1.

Figs. 2, 4, 6, 9-11, 15. *Kolymonectes carlottensis* (WHITEAVES 1884). 2. Figured specimen GSC 112502 from GSC locality C-80765; Upper Pliensbachian of Maude Island, British Columbia. Latex cast of right valve; x 1.2. 4. Figured specimen GSC 112345 from GSC locality C-80236; Pliensbachian of Maude Island, British Columbia. Latex cast of left valve; x 1.2. 6. Figured specimen GSC 112498 from GSC locality C-80843; Pliensbachian of Maude Island, British Columbia. Latex cast of right valve; x 1.2. 9. Figured specimen GSC 112499 from GSC locality 93324; Upper Pliensbachian of McConnell Creek area, British Columbia. Latex cast of right valve; x 1.2. 10. Figured specimen GSC 112500 from GSC locality C-80768; Upper Pliensbachian of Maude Island, British Columbia. Exterior view of single valve; x 1.2. 11. Figured specimen GSC 112501 from GSC locality C-80770; Pliensbachian of Maude Island, British Columbia. Latex cast of right valve; x 1.2. 15. Figured specimen GSC 112503 from GSC locality C-80239; Pliensbachian of Maude Island, British Columbia. Latex cast of right valve (lower part of specimen) and ?left valve (upper part of specimen); x 1.2.

Figs. 8, 12-14, 16, 17. *Entolium (Entolium) corneolum* (YOUNG & BIRD 1828). 8. Figured specimen GSC 112493 from GSC locality C-90906; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of right valve; x 1.2. 12. Figured specimen GSC 112494 from GSC locality C-87113; Toarcian of Graham Island, British Columbia. Exterior view of single valve; x 1.2. 13. Figured specimen GSC 112492 from GSC locality C-87212; Upper Toarcian of Graham Island, British Columbia. Internal mould of single valve; x 1.2. 14. Figured specimen GSC 112495 from GSC locality C-81322; Sinemurian of Laberge area, southern Yukon. Latex cast of right valve; x 1.2. 16. Figured specimen GSC 112496 from GSC locality C-90909; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of right valve; x 1.2. 17. Figured specimen GSC 112497 from GSC locality C-103104; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of right valve; x 1.2.

Figs. 18-19. *Entolium (Entolium) lunare* (ROEMER 1839). 18. Figured specimen GSC 112504 from GSC locality 90976; Lower Toarcian of Hazelton area, British Columbia. Latex cast of right valve; x 2. 19. Figured specimen GSC 112504 from GSC locality 90976; Lower Toarcian of Hazelton area, British Columbia. Detail of Fig. 18, showing presence of very pronounced byssal notch in early ontogenetic stages and its subsequent abandonment during later growth stages; x 7.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Kolymonectes is reported from Upper Triassic through Middle Jurassic strata of several regions of the circum-Pacific. In the Russian North-East, Lower Jurassic representatives of the genus appear to be of biostratigraphic importance (e.g. POLUBOTKO & REPIN 1988). Furthermore, *Kolymonectes* has been recorded from north-western Canada (POULTON 1991), western Argentina (e.g. DAMBORENEA 1993b), and also a specimen from New Zealand has been doubtfully included (DAMBORENEA & MANCEÑIDO 1992).

Kolymonectes carlottensis (WHITEAVES 1884)

Pl. 11, Figs. 2, 4, 6, 9-11, 15

1884 *Pecten carlottensis* sp. nov. - WHITEAVES: 251.
1900 *Pecten carlottensis* sp. nov. - WHITEAVES: pl. 33, fig. 7.
v 1998 *Kolymonectes carlottensis* (WHITEAVES) - ABERHAN: fig. 3K.

Material. *Kolymonectes carlottensis* was found at the following GSC localities: 48564; 91827; 91828; 93324 (GSC 112499); C-56954; C-80215; C-80218; C-80224; C-80229; C-80230; C-80231; C-80232; C-80236 (GSC 112345); C-80237; C-80238; C-80239 (including GSC 112503); C-80765 (GSC 112502); C-80767; C-80768 (including GSC 112500); C-80770 (GSC 112501); C-80843 (GSC 112498); C-81709; C-81730; C-86367; C-87246; C-90614. Predominantly preserved as external moulds.

Stratigraphic range. Early to Late Pliensbachian.

Description. *Kolymonectes carlottensis* has a suborbicular disc with moderately concave antero-dorsal and postero-dorsal margins. The subequal auricles are well demarcated from the disc, the anterior one being slightly larger than the posterior. On the right valve, the posterior auricle is meeting the disc at an acute angle; the anterior one is meeting the disc at an approximately right angle; the byssal notch is shallow. On the left valve the posterior auricle is meeting the disc at an acute angle. The anterior auricle is meeting the disc at an acute or nearly right angle and a byssal sinus, when present, is very shallow. The ornament of the posterior auricle of the right valve is unknown; all other auricles bear one to several faint radial riblets and very fine commarginal growth lines.

The exterior surface of the disc is ornamented differently in left and right valves. The left valve bears slightly curved, rounded ribs, which increase in number by intercalation of second and sometimes also third order riblets. The interspaces have about the same width as the ribs. Secondary ribs may reach the height of the originals only in adults; third order riblets always remain very narrow and low. In right valves, the ribs tend to be considerably broader than the interspaces between them and weaker than on the left valve. The ribs increase in number mainly by splitting, though intercalation may occur subordinately. Secondary ribs reach about the same height as the primaries. The shell surface is covered with densely and regularly spaced commarginal lines. In well preserved right valves, these lines are raised to form fine lamellae.

Remarks. Several species of *Kolymonectes* have been described from the Lower Jurassic of the Russian North-East. Preliminary comparisons of these forms with *K. carlottensis* have been carried out, but a revision of the group is beyond the scope of this study. A very closely related form is the Late Sinemurian *K. staeschei* POLUBOTKO (in EFIMOVA et al. 1968: 80, pl. 7, figs. 1-9; MILOVA 1988: 76, pl. 5, figs. 9-27; SEY & POLUBOTKO in DAMBORENEA et al. 1992: pl. 120, figs. 26-27). Whilst their left valves cannot be separated, right valves of *K. staeschei* differ from *K. carlottensis* in being ornamented with narrow, faint radial riblets, which are best developed along the ventral margin.

Similarly, the radial ornament of the right valve is very indistinct and sometimes the valves are smooth in the Sinemurian *K. anjuensis* (MILOVA 1969: 182, pl. 1, figs. 1-9; 1976: 68, pl. 11, figs. 1-9), the Lower Sinemurian *K. kedonensis* POLUBOTKO (in POLUBOTKO & MILOVA 1986: 121, pl. 15, figs. 1-8; SEY & POLUBOTKO in DAMBORENEA et al. 1992: pl. 120, figs. 22-23; SHURYGIN & LUTIKOV 1991: pl. 13, figs. 5-7), and in the Upper Pliensbachian *K. terekhovi* POLUBOTKO (in EFIMOVA et al. 1968: 81, pl. 23, figs. 2-3, pl. 27, figs. 2-3; Milova 1988: 79, pl. 6, figs. 13-15).

The most similar species is *K. mongkensis* POLUBOTKO (in POLUBOTKO & MILOVA 1986: 122, pl. 15, figs. 14-19; MILOVA 1988: 77, pl. 6, figs. 1-12; SHURYGIN & LUTIKOV 1991: pl. 16, figs. 4-6; SEY & POLUBOTKO in DAMBORENEA et al. 1992: pl. 120, figs. 24-25) from the lower Upper Pliensbachian, which is also covered by relatively strong ribs on the right valve. It cannot be ruled out that *K. mongkensis* is a junior synonym of *K. carlottensis*.

Kolymonectes coloradoensis (WEAVER 1931: 274, pl. 28, fig. 164; LEANZA 1942: 176, pl. 7, figs. 3, 5, pl. 10, fig. 3; DAMBORENEA in DAMBORENEA et al. 1992: pl. 115, figs. 11-12) is an abundant pectinid from the Pliensbachian of Argentina. Like most of the Russian forms, it exhibits a different sculpture on left and right valves. That of the left valve consists of narrow ribs, whose number increases by intercalation. In contrast to *K. carlottensis*, the right valve only bears very fine radial striae.

Kolymonectes staeschei (POLUBOTKO 1968)

Pl. 10, Fig. 19

1968 *Aequipecten* (?) *staeschei* sp. nov. - POLUBOTKO in EFIMOVA et al.: 80, pl. 7, figs. 1-9.
v 1991 *Kolymonectes staeschei* (POLUBOTKO) - POULTON: 27, pl. 6, figs. 21-28.
v 1998 *Kolymonectes staeschei* (POLUBOTKO) - ABERHAN: fig. 4I.

Material. 1 right valve (GSC 112355) and 4 single valves from GSC locality 78595. All preserved as internal moulds.

Stratigraphic range. Late Sinemurian.

Remarks. The left valves of *Kolymonectes staeschei* and *K. carlottensis* cannot be distinguished from each other. Right valves of *K. staeschei* differ from *K. carlottensis* by the presence of narrow, faint radial riblets, which are best developed along the ventral margin in *K. staeschei*. In Canada, *K. staeschei* was also reported from the ?Hettangian and Sinemurian of northern Yukon by POULTON (1991: 27, pl. 6, figs. 21-28) and it occurs in the Sinemurian of the Canadian Arctic (ABERHAN et al. 1998). Thus, the present findings are the southernmost records of the species (and the genus) on the North American craton.

Family Entoliidae VON TEPPNER 1922

Genus *Entolium* MEEK 1865

Subgenus *Entolium* MEEK 1865

Type species. *Pecten demissus* PHILLIPS 1829; as illustrated by QUENSTEDT (1858: 353, pl. 48, fig. 7).

Entolium (Entolium) corneolum
(YOUNG & BIRD 1828)

Pl. 11, Figs. 8, 12-14, 16, 17

1828 *Pecten corneolus* sp. nov. - YOUNG & BIRD: 234, pl. 9, fig. 5.
v cf. 1930b *Entolium semlini* sp. nov. - CRICKMAY: 56, pl. 4, fig. e.
v cf. 1933b *Entolium equabile* HYATT Ms. - CRICKMAY: 904, pl. 24, figs. 4-6.
v cf. 1933b *Entolium meeki* HYATT 1892 - CRICKMAY: 905, pl. 24, figs. 2-3.
cf. 1960 *Entolium meeki* "HYATT"-CRICKMAY, 1933 - SANBORN: 24, pl. 2, fig. 13.
cf. 1960 *Entolium equabile* "HYATT"-CRICKMAY, 1933 - SANBORN: 24, pl. 2, fig. 14.
1984 *Entolium (Entolium) corneolum* (YOUNG & BIRD 1828) - JOHNSON: 45, pl. 1, figs. 24-26, ?20, ?22, ?27 (see for an extensive synonymy list).
v 1991 *Entolium* sp. - POULTON: 27, pl. 6, figs. 29-30, pl. 17, figs. 12-18.

Material. *Entolium (Entolium) corneolum* was found at the following GSC localities: 20013; 24692; 40241; 40242; 40425; 40430; 40438; 40472; 42091; 62403; 82845; 83995; 83998; 84001; 84002; 84189; 85326; 85333; 85335; 88495; 88500; 88604; 89010; 93184; 93221; 93350; 93587; 95092; C-17988; C-81310; C-81322 (including GSC 112495); C-81323; C-81519; C-81947; C-81972; C-81975; C-86364; C-86684; C-86807; C-87113 (including GSC 112494); C-87212 (GSC 112492); C-90835; C-90901 to C-90905; C-90906 (GSC 112493); C-90907; C-90909 (including GSC 112496); C-90912; C-90924 to C-90927; C-90930; C-90932; C-90933; C-103070; C-103074; C-103077; C-103078; C-103088; C-103093; C-103104 (GSC 112497); C-103198; C-103307; C-103318; C-103326; C-103327; C-103446; C-116863; C-12747; C-143309; C-175695. Predominantly preserved as internal and external moulds.

Stratigraphic range. Hettangian to Aalenian.

Description. The best preserved specimens of *Entolium (E.) corneolum* are from the Lower Pliensbachian in the surroundings of Joan Lake, Spatsizi map area, British Columbia (e.g. Pl. 11, Figs. 8, 16, 17). They reach an adult size of up to 65 mm in height. The disc is sub-ovate and of low convexity. The right valve is characterized by auricles which extend dorsally well beyond the hinge line. The right valve consistently lacks a byssal notch even during the juvenile stages. This can be inferred from the early growth lines of the right anterior auricle in a few very well preserved specimens. The early growth lines are meeting the disc at approximately the same acute angle as during later growth stages. The auricles of the left valve meet each other at an angle of 180° or slightly less. Both valves are covered with fine commarginal lines of growth.

Less well preserved material is available from Sinemurian strata (e.g. Pl. 11, Fig. 14). In these specimens, the auricles are either broken off or, if present, the growth lines are not preserved. The same holds true of the studied specimens of Toarcian age (e.g. Pl. 11, Figs. 2, 12), which commonly are fragmented and have a smaller maximum size (the maximum height is 25 mm) than the Pliensbachian forms.

Remarks. In his comprehensive study of Jurassic pectinids from Europe, JOHNSON (1984) separates *E. corneolum* from other species of *Entolium* by the lack of a small byssal notch in juveniles and by both valves ornamented only with fine commarginal striae. The Pliensbachian specimens described above thus lie fully within the diagnosis of their European counterparts. In Sinemurian and Toarcian specimens, the diagnostic lack of a byssal notch in juveniles cannot be determined with certainty. However, as they otherwise cannot be distinguished from the Pliensbachian specimens discussed above, they are included in *E. corneolum* here.

Entolium meeki (HYATT) (CRICKMAY 1933b: 905, pl. 24, figs. 2-3; SANBORN 1960: 24, pl. 2, fig. 13)

from the Sinemurian of California is characterized by commarginal folds in the umbonal area. This feature has also been observed on one specimen from the Sinemurian of western Canada. The latter is regarded as a variant of *E. corneolum* in which growth rates have been periodically decreased during early stages in ontogeny. As it is not clear whether commarginal folds in the umbonal region of the Californian species are a consistent feature occurring in a large number of specimens, affinities to *E. corneolum* must remain open at present. Likewise, *E. equabile* (HYATT) (CRICKMAY 1933b: 904, pl. 24, figs. 4-6; SANBORN 1960: 24, pl. 2, fig. 14) from the upper Lower Jurassic and/or lower Middle Jurassic of California as well as the holotype of *E. semlini* CRICKMAY (1930b: 56, pl. 4, fig. e) have a striking similarity to *E. corneolum* in overall shape of the shell. As the presence/absence of a byssal notch cannot be inferred from the figured specimens, a detailed comparison with *E. corneolum* must await further examination.

It is noteworthy that in Europe *E. corneolum* first occurs in the Toarcian and extends into the uppermost Jurassic, possibly even into the Cretaceous (JOHNSON 1984). Along the East Pacific, however, *E. corneolum* is already represented from the Hettangian onwards (ABERHAN 1994, this study). The stratigraphic range of *E. lunare*, by contrast, is from the Hettangian into the Toarcian in Europe. In the East Pacific region it is only known from the Toarcian (see below). Whilst *E. lunare* is the typical Lower Jurassic representative of the genus in Europe, this role is held by *E. corneolum* in the East Pacific.

EXPLANATION OF PLATE 12

Figs. 1-5. *Agerchlamys wunschae* (MARWICK 1953). 1. Figured specimen GSC 112505 from GSC locality C-157630; Hettangian of Graham Island, British Columbia. Exterior view of right valve; x 2. 2. Figured specimen GSC 112506 from GSC locality 84160; Lower Sinemurian of Pine Pass area, British Columbia. Exterior view of right valve; x 1.2. 3. Figured specimen GSC 112341 from GSC locality 84160; Lower Sinemurian of Pine Pass area, British Columbia. Exterior view of left valve; x 1.2. 4. Figured specimen GSC 112507 from GSC locality 84160; Lower Sinemurian of Pine Pass area, British Columbia. Exterior view of right valve; x 1.2. 5. Figured specimen GSC 112508 from GSC locality 84160; Lower Sinemurian of Pine Pass area, British Columbia. Exterior view of left valve; x 1.2.

Figs. 6, 7, 9. *Agerchlamys* sp. A. 6. Figured specimen GSC 112509 from GSC locality C-80839; Upper Pliensbachian of Maude Island, British Columbia. Exterior view of single valve; x 2.5. 7. Figured specimen GSC 112510 from GSC locality C-87123; Toarcian of Graham Island, British Columbia. Exterior view of single valve; x 2.5. 9. Figured specimen GSC 112335 from GSC locality C-87113; Toarcian of Graham Island, British Columbia. Exterior view of right valve; x 2.5.

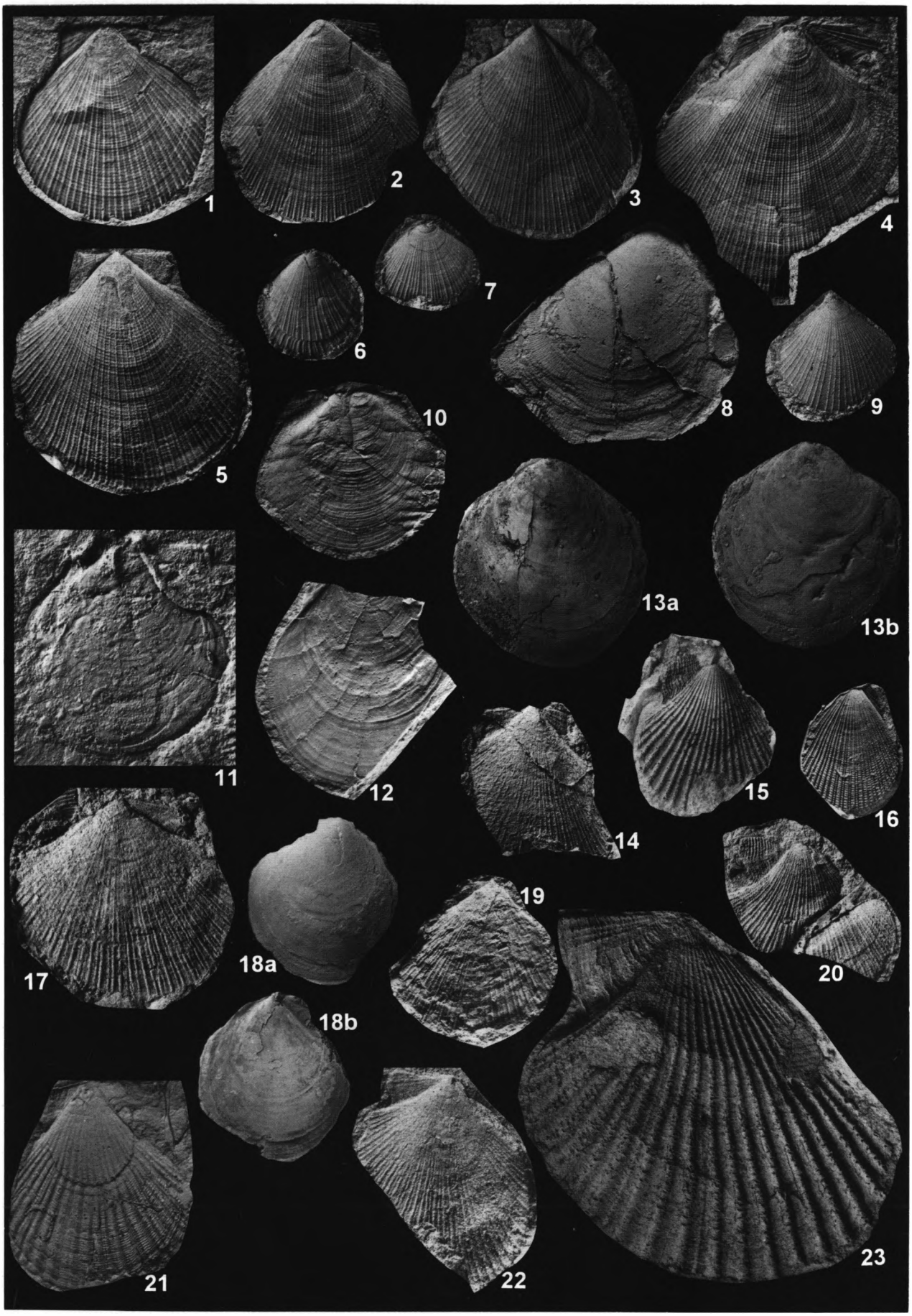
Fig. 8. *Camptonectes (Camptonectes) auritus* (VON SCHLOTHEIM 1813). Figured specimen GSC 112511 from GSC locality C-103136; Toarcian of Spatsizi area, British Columbia. Latex cast of single valve; x 1.2.

Figs. 10-12. *Camptonectes (Camptonectes) subulatus* (MÜNSTER 1836). 10. Figured specimen GSC 112347 from GSC locality 78843; Lower Toarcian of Fernie area, British Columbia. Latex cast of left valve; x 1.5. 11. Figured specimen GSC 112512 from GSC locality 78843; Lower Toarcian of Fernie area, British Columbia. Internal mould of right valve with relict shell material attached; x 1.5. 12. Figured specimen GSC 112513 from GSC locality 78843; Lower Toarcian of Fernie area, British Columbia. Exterior view of right valve; x 1.5.

Figs. 13, 18. *Camptonectes (Costicamptonectes)* sp. A. 13a, b. Figured specimen GSC 112342 from GSC locality C-158089; Lower Aalenian of Graham Island, British Columbia. a, internal mould of left valve with relict shell material attached; b, internal mould of right valve with relict shell material attached; x 1. 18a, b. Figured specimen GSC 112514 from GSC locality C-87221; Upper Toarcian of Graham Island, British Columbia. a, internal mould of left valve; b, internal mould of right valve; x 1.

Figs. 14, 17, 19, 22. *Chlamys (Chlamys) valoniensis* (DEFRANCE 1825). 14. Figured specimen GSC 112515 from GSC locality 19578; Lower Sinemurian of Quesnel Lake area; British Columbia. Latex cast of left valve; x 1.2. 17. Figured specimen GSC 112516 from GSC locality 19578; Lower Sinemurian of Quesnel Lake area; British Columbia. Latex cast of right valve; x 1.2. 19. Figured specimen GSC 112517 from GSC locality 19578; Lower Sinemurian of Quesnel Lake area; British Columbia. Latex cast of right valve; x 1.2. 22. Figured specimen GSC 112518 from GSC locality 19578; Lower Sinemurian of Quesnel Lake area; British Columbia. Latex cast of left valve; x 1.2.

Figs. 15, 16, 20, 21, 23. *Chlamys (Chlamys) textoria* (VON SCHLOTHEIM 1820). 15. Figured specimen GSC 112519 from GSC locality 84189; Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1.2. 16. Figured specimen GSC 112520 from GSC locality C-103082; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of left valve; x 1.2. 20. Figured specimen GSC 112521 from GSC locality C-81322; Sinemurian of Laberge area, southern Yukon. Latex cast of left valve; x 1.2. 21. Figured specimen GSC 112522 from GSC locality 88599; Upper Sinemurian of Smithers area, British Columbia. Latex cast of right valve; x 1.2. 23. Figured specimen GSC 112339 from GSC locality C-117279; Middle Toarcian of Nass River area, British Columbia. Latex cast of left valve; x 1.2.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Entolium (Entolium) lunare (ROEMER 1839)

Pl. 11, Figs. 18-19

1839 *Pecten lunaris* sp. nov. - ROEMER: 26.
1984 *Entolium (Entolium) lunare* (ROEMER 1839) - JOHNSON: 36, Pl. 1, figs. 17, 18, ?23 (see for an extensive synonymy list).

Material. 1 right valve (GSC 112504) and 4 single valves from GSC locality 90976. Preserved as internal and external moulds.

Stratigraphic range. Early Toarcian.

Remarks. As can be seen from the growth line pattern of the right valve anterior auricle (Pl. 11, Fig. 19), *E. lunare* exhibits a distinct byssal notch early in ontogeny, which is subsequently abandoned during later growth stages. This diagnostic feature (see JOHNSON 1984) allows the clear assignment to *E. lunare*.

Family Pectinidae WILKES 1810

Genus *Agerchlamys* DAMBORENEA 1993

Type species. *Chlamys (Camptochlamys) wunschae* MARWICK 1953.

Remarks. *Agerchlamys* has been erected recently by DAMBORENEA (1993a) to accommodate pectinids with a fine cancellate ornament consisting of "very numerous (more than 40) narrow, nearly straight radial costae, dense continuous commarginal lamellae and fine antimarginal striae over the whole shell surface" (DAMBORENEA 1993a: 120).

Agerchlamys wunschae (MARWICK 1953)

Pl. 12, Figs. 1-5

1953 *Chlamys (Camptochlamys) wunschae* sp. nov. - MARWICK: 98, pl. 10, figs. 23-24.
1992 *Camptochlamys wunschae* (MARWICK) - DAMBORENEA in DAMBORENEA et al.: pl. 116, figs. 9-10 (also in DAMBORENEA 1993a: figs. 4b, h).
1992 *"Camptochlamys" wunschae* (MARWICK) - DAMBORENEA & MANCEÑIDO: pl. 1, fig. 6a-b (also in DAMBORENEA 1993a: figs. 4a-b).
1993a *Agerchlamys wunschae* (MARWICK) - DAMBORENEA: figs. 4a-j.
v 1994 *Agerchlamys wunschae* (MARWICK 1953) - ABERHAN: 38, pl. 18, figs. 1-6.
v 1998 *Agerchlamys wunschae* (MARWICK) - ABERHAN: fig. 3G.

Material. 5 left valves (including GSC 112341, 112508), 10 right valves (including GSC 112506, 112507) and several fragmentary valves from GSC locality 84160; 1 right valve from GSC locality 93727; 1 right valve and 1 fragmentary valve from GSC locality 94898; 1 articulated specimen from GSC locality C-156304; 2 left valves from GSC locality C-156308; 1 right valve from GSC locality C-156314; 1 single valve from GSC locality C-156434; 1 right valve (GSC 112505) from GSC locality C-157630. Predominantly in shell preservation.

Stratigraphic range. Early Hettangian to Late Sinemurian.

Remarks. In general, the morphological features of the Hettangian to Sinemurian specimens from western Canada agree very well with *Agerchlamys wunschae* described from the Lower Jurassic of South America (e.g. DAMBORENEA 1993a, ABERHAN 1994). In the Canadian material, the number of radial riblets is about 30 in early growth stages but the number doubles by intercalation in adults. The *Camptonectes*-like, divaricate (= antimarginal) ornament only has been observed at the posterior margin of one right valve. A divaricate sculpture is neither visible in the illustrations of the type material (MARWICK 1953: 98, pl. 10, figs. 23-24; SPEDEN & KEYES 1981: pl. 13, figs. 2, 7; DAMBORENEA 1993a: figs. 4a, d) nor in those from Argentina (DAMBORENEA 1993a: figs. 4b, c, e-h) and it is not preserved in the studied Chilean material (ABERHAN 1994: 38, pl. 18, figs. 1-6). Apparently, the presence of divaricate striae appears to be limited to very well preserved specimens.

Agerchlamys sp. A

Pl. 12, Figs. 6, 7, 9

v 1998 *Agerchlamys* sp. A - ABERHAN: fig. 3A.

Material. 1 single valve from GSC locality C-80837; several single valves (including GSC 112509) from GSC locality C-80839; 1 right valve (GSC 112335) from GSC locality C-87113; 1 left valve, 2 right valves, and 2 single valves (including GSC 112510) from GSC locality C-87123. Predominantly in shell preservation.

Stratigraphic range. Late Pliensbachian to Toarcian.

Description. The shells of *Agerchlamys* sp. A are small, with height and length never exceeding 10 mm, and strongly convex. A deep byssal notch is present below the anterior auricle of the right valve. The radial ornament consists of about 35 straight to slightly wavy, radial riblets, which are subequal in strength. Only rarely their number increases by intercalation. Together with continuous commarginal lamellae, which are less pronounced than the riblets, they produce a fine cancellate ornament. The interspaces between riblets are variable, ranging from twice to about four times the width of the riblets. The disc ornament continues onto the auricles.

Remarks. The lack of divaricate striae and the pres-

ence of commarginal lamellae on the outer surface of the shell prevent assignment of the specimens to *Camptonectes* s.s. The commarginal lamellae being more delicate than the radial riblets prevents inclusion into *Camptonectes (Camptochlamys)*.

Agerchlamys sp. A differs from *A. wunschae* primarily by its small size and by being more strongly convex. All specimens of *Agerchlamys* sp. A are from the Queen Charlotte Islands. The various localities also yielded *Entolium corneolum*, *Oxytoma inequivalvis* and other species, which all attain a smaller maxium size than elsewhere in the Lower Jurassic of western Canada. Therefore, it cannot be completely ruled out that the small specimens grouped in *Agerchlamys* sp. A are juveniles or dwarfed forms of *A. wunschae*.

Genus *Camptonectes* AGASSIZ in MEEK 1864

Subgenus *Camptonectes* AGASSIZ in MEEK 1864

Type species. *Pecten lens* J. SOWERBY 1818; by subsequent designation (STOLICZKA 1871).

Camptonectes (Camptonectes) auritus (VON SCHLOTHEIM 1813)

Pl. 12, Fig. 8

1813 *Chamites auritus* sp. nov. - VON SCHLOTHEIM: 103.
1984 *Camptonectes (Camptonectes) auritus* (SCHLOTHEIM 1813) - JOHNSON: 113, pl. 3, figs. 25-40 (see for extensive synonymy list).

Material. 1 external mould of a single valve (GSC 112511) from GSC locality C-103136.

Stratigraphic range. Toarcian.

Remarks. Although the auricles are not preserved in the only available Lower Jurassic specimen, the suborbicular outline and the fine divaricate striae on all parts of the disc (except where abraded) are diagnostic enough to allow assignment to *Camptonectes (C.) auritus*. In western Canada, the species first appeared in the Toarcian and ranged into the Middle Jurassic, where it became more abundant. The same distribution pattern was found in South America (ABERHAN 1994).

Camptonectes (Camptonectes) subulatus (MÜNSTER 1836)

Pl. 12, Figs. 10-12

1836 *Pecten subulatus* sp. nov. - MÜNSTER in GOLDFUSS: 73, pl. 98, figs. 12a-c.
1984 *Camptonectes (Camptonectes) subulatus* (MÜNSTER 1836) - JOHNSON: 107, pl. 4, figs. 3-5, 7, 8, ?6, ?9 (see for extensive synonymy list).
v 1991 *Entolium*(?) sp. - POULTON: 27, pl. 6, figs. 31, 33-36.
v 1991 *Camptonectes (Camptonectes)* sp. - POULTON: 28, pl. 6, fig. 37.
v 1998 *Camptonectes (Camptonectes) subulatus* (MÜNSTER) - ABERHAN: fig. 4A.

Material. 1 right valve from GSC locality 6577; 1 single valve from GSC locality 6578; 1 left valve and 3 right valves from GSC locality 14720; 1 single valve from GSC locality 31437; 1 left valve (GSC 112347) and 2 right valves (GSC 112512, 112513) from GSC locality 78843; 2 left valves and 1 single valve from GSC locality 79797. In shell preservation and as internal and external moulds.

Stratigraphic range. Sinemurian to Toarcian.

Description. *Camptonectes (C.) subulatus* is characterized by a sub-orbicular disc and fine divaricate striae, which are restricted to the anterior and posterior margins of the disc. Otherwise, the valve exterior is smooth, except for commarginal growth lines. By the intersection of divaricate striae and growth lines, a punctate pattern originates.

Remarks. The Toarcian specimens (e.g. Pl. 12, Figs. 10-12) exhibit the diagnostic features of *C. (C.) subulatus*, i.e. a relatively orbicular disc and the restriction of the divaricate ornament to the anterior and posterior margins. The Sinmurian specimens are internal moulds and therefore the external ornament of the corresponding shell is unknown. They are included into *C. (C.) subulatus* because (1) they agree well with *C. (C.) subulatus* in general outline and shape and (2) coeval specimens with an ornament typical of *C. (C.) subulatus* occur in an adjacent sedimentary basin in northern Yukon (e.g. see specimens figured by POULTON 1991: pl. 6, figs. 33, 36). This is the first documentation of the species outside Europe.

Subgenus *Costicamptonectes* FÜRSICH 1982

Type species. *Camptonectes (Costicamptonectes) milnelandensis* FÜRSICH 1982.

Camptonectes (Costicamptonectes) sp. A

Pl. 12, Figs. 13, 18

v 1998 *Camptonectes (Costicamptonectes)* sp. A - ABERHAN: fig. 3H.

Material. 1 steinkern from GSC locality 93131; 1 steinkern (GSC 112514) from GSC locality C-87221; 1 articulated specimen (GSC 112342) from GSC locality C-158089.

Stratigraphic range. Toarcian to Aalenian.

Description. The shell of *Camptonectes (Costicamptonectes)* sp. A. is sub-oval in outline, with the height slightly exceeding the length. The right valve is feebly convex; the antero-dorsal margin is moderately concave. Its anterior auricle is relatively long and on internal moulds it carries a radial groove. Below the anterior auricle is a deep byssal notch with a ctenolium, which is also well developed in adults. The left valve is moderately convex. The outermost shell layer is not preserved and therefore it is not possible to determine the original shell ornamentation with certainty.

Remarks. Very similar specimens in terms of shape, outline, convexity, presence of a well developed ctenolium etc. occur in the ?Toarcian and Aalenian of the Canadian Arctic and internal moulds cannot be distinguished from *Camptonectes (Costicamptonectes)* sp. A. Composite moulds and relics of attached shell material of the Arctic specimens bear the typical *Camptonectes* ornament of divaricating ribs. In addition, two very well preserved external moulds exhibit several fine radial striae near the anterior margin. These features allow the assignment of the Arctic specimens to *Costicamptonectes* and the coeval specimens from western Canada described above, are thought to belong to the same species. Illustrations of the Arctic representatives of this probably new species will be presented elsewhere (HRUDKA, in preparation).

Genus *Canadonectites* gen. nov.

Type species. *Canadonectites paucicostatus* sp. nov.

Derivation of name. From Canada, where the type species was found, and nectere (lat.) = to connect.

Diagnosis. Pectiniform shell, with radial riblets restricted to the anterior margin of the right valve; shell exterior of remainder of right valve and of left valve smooth.

Remarks. In general shell characters *Canadonectites* is essentially similar to *Pleuronectites* VON SCHLOTHEIM and *Radulonectites* HAYAMI (see below). It mainly differs in its kind of ornament and in this respect is intermediate between the two. Whilst the exterior of both valves of *Pleuronectites* is smooth, in *Radulonectites* all of the shell surface of both valves is covered with narrow, tightly spaced, and slightly sinuous radial riblets. By contrast, the radial sculpture in *Canadonectites* is confined to the antero-dorsal margin of the right valve whilst the remainder of the right valve and the left valve are smooth.

A similar ornament with a few radial riblets near the anterior margin characterizes *Camptonectes (Costicamptonectes)*, which is known by its type species *Camptonectes (Costicamptonectes) milnelandensis* FÜRSICH (1982: 50, figs. 23 C, D, F, G) from the Upper Jurassic of East Greenland and a probably new species from the Lower Jurassic of Canada (see above). In contrast to *Canadonectites*, however, the right valve of *Costicamptonectes* also bears an ornament typical of *Camptonectes* sensu stricto, consisting of fine, divaricate, punctate striae. The ornament of left valves of *Costicamptonectes* is as yet unknown.

Canadonectites paucicostatus sp. nov.

Pl. 13, Figs. 1-3; Text-fig. 7

v 1998 aff. *Costicamptonectes* sp. A - ABERHAN: fig. 3L.

Derivation of name. From pauci (lat.) = few, and costatus (lat.) = ribbed.

Holotype. GSC 112346 from GSC locality C-159444, latex cast of right valve, figured on Pl. 13, Fig. 1. Additional material. 4 left valves (including GSC 112523) and 2 right valves (including GSC 112524) from GSC locality C-159444. Preserved as internal and external moulds.

Measurements (in mm).

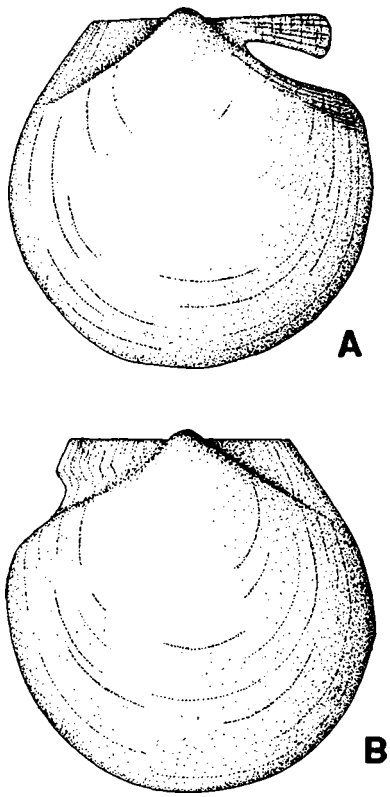
	L	H	AH	PH	UA
GSC 112346 (rv)	25	23	9.2	6.5	127°
GSC 112523 (lv)	25	23	~8	~7.5	~127°
GSC 112524 (rv)	26	~25	10.1	6.8	~120°
unfigured lv	25	~24	-	-	-
unfigured lv	25	~23	-	-	-

Stratigraphic range. Sinemurian-Pliensbachian boundary.

Diagnosis. Sub-orbicular, approximately equivalve, pectiniform shell with deep byssal notch and ctenolium in right valve. Anterior auricle of right valve bearing radial riblets; antero-dorsal part of exterior of right valve disc sculptured with fine radial riblets, otherwise smooth.

Description. Thin, medium-sized shell, disc sub-orbicular, approximately equilateral, dorsal margins of disc concave. Anterior and posterior auricles of left valve and posterior auricle of right valve smooth, meeting hinge line at an obtuse angle and disc at an acute angle; delimited from disc by wide and shallow grooves. Right anterior auricle elongated, its dorsal margin being longer than dorsal margin of right posterior auricle; anterior auricle of right valve bearing fine radial riblets. Byssal notch deep, ctenolium present. Antero-dorsal margin of right valve exterior sculptured with few (about 10), low, narrow, slightly

wavy radial riblets; riblets lower and more widely-spaced with increasing distance from the antero-dorsal margin until they finally disappear. Left valve exterior smooth except for commarginal growth lines.



Text-fig. 7. *Canadonectites paucicostatus* sp. nov. A. Reconstruction of exterior view of right valve. B. Reconstruction of exterior view of left valve. Approximately x 1.5.

Remarks. Preservation quality of the specimens renders the critical examination of several shell features impossible. Both valves appear to be of low convexity. However, as all available specimens exhibit in-situ breakage, apparently caused by compaction, and shell breakage predates steinkern formation, the original degree of convexity cannot be assessed. Similarly, it remains unclear to what extent the umbones of both valves are protruding beyond the dorsal margins. Finally, internal shell features are unknown.

Nevertheless, there are no Mesozoic pectinid bivalves reported in the literature, which would exhibit an ornament as described for *Canadonectites*. The conspicuous radial sculpture, being restricted to the antero-dorsal part of the right valve disc and anterior auricle is regarded to be sufficiently diagnostic to warrant the erection of both a new genus and species.

Genus *Chlamys* RÖDING 1798

Subgenus *Chlamys* RÖDING 1798

Type species. *Pecten islandicus* MÜLLER 1776; by subsequent designation (HERRMANNSEN 1776).

Chlamys (Chlamys) textoria (VON SCHLOTHEIM 1820)

Pl. 12, Figs. 15, 16, 20, 21, 23

1820 *Pectinites textorius* sp. nov. - VON SCHLOTHEIM: 229.
1984 *Chlamys (Chlamys) textoria* (SCHLOTHEIM 1820) - JOHNSON: 163, pl. 6, figs. 10-12, pl. 7, figs. 1-21, pl. 8, figs. 1-3, 5-20, ?4 (see for extensive synonymy list).
cf. 1992 *Camptonectes (Camptochlamys)* sp. - THOMSON & SMITH: pl. 2, fig. 1.
v 1998 *Chlamys (Chlamys) textoria* (VON SCHLOTHEIM) - ABERHAN: fig. 3E.

Material. *Chlamys (Chlamys) textoria* was found at the following GSC localities: 6577; 6578; 10246; 24838; 28922; 40425; 84001; 84047; 84078; 84189 (GSC 112519); 85305; 85329; 85334; 85340; 85416; 88498; 88599 (including GSC 112522); 88601; 88602; 88604; 93221; 93618; 95021; C-81308; C-81318; C-81322 (including GSC 112521); C-86684; C-90519; C-90520; C-90930; C-103078; C-103079; C-103082 (GSC 112520); C-103091; C-103140; C-117279 (including GSC 112339); C-117280; C-158035. Predominantly preserved as external moulds.

Stratigraphic range. Sinemurian to Toarcian.

Remarks. JOHNSON (1984), who revised the Jurassic pectinid bivalves from Europe, distinguished *Chlamys (Ch.) textoria* from all other Jurassic species of *Chlamys* by the presence of imbricate lamellae on the radial plicae. Besides the characteristic morphological attributes of the genus, this diagnostic feature has been observed on all specimens assigned to *Ch. textoria* in the present study.

Based on the number of plicae, JOHNSON (1984) distinguished three groups within *Ch. textoria*, which he regarded as ecophenotypic variations of a single, variable species. They were termed the 'coarse' (17-26 plicae), the 'intermediate' (27-36 plicae), and the 'fine' phenotype (more than 36 plicae) respectively. Subsequently, this spectrum of morphological variability was also recognized in South American specimens of *Ch. textoria* (ABERHAN 1994) and it is also represented in the material from western Canada.

Camptonectes (Camptochlamys) sp. from the Pliensbachian of British Columbia (THOMSON & SMITH 1992: pl. 2, fig. 1) is tentatively included in *Ch. textoria*. Its oblique shape and the curved nature of the radial ribs are untypical of *Ch. textoria*. However, specimens exhibiting these features also were found together with "regular" *Ch. textoria* in a single collection. Their asymmetrical shape most likely is not a primary feature but is interpreted as being due to post-depositional deformation. The specimen figured by THOMSON & SMITH (1992) neither exhibits continuous

commarginal lamellae as is diagnostic of *Camptochlamys* nor divaricate striae as typical of *Camptonectes* s.s.

Chlamys (Chlamys) valoniensis (DEFRANCE 1825)

Pl. 12, Figs. 14, 17, 19, 22

1825 *Pecten Valoniensis* sp. nov. - DEFRANCE: 507, pl. 22, fig. 6.
1984 *Chlamys (Chlamys) valoniensis* (DEFRANCE, 1825) - JOHNSON: 179, pl. 9, figs. 1-6 (see for extensive synonymy list).
v cf. 1991 *Eopecten*(?) sp. - POULTON: 28, pl. 6, figs. 12-13, pl. 11, figs. 8-9.
v 1994 *Chlamys (Chlamys) valoniensis* (DEFRANCE 1825) - ABERHAN: 40, pl. 19, figs. 7-9.

Material. 1 single valve from GSC locality 10240; 5 left valves (including GSC 112515, 112518), 7 right valves (including GSC 112516, 112517) and several fragmentary valves from GSC locality 19578; 1 single valve from GSC locality 21696. Predominantly preserved as external moulds.

Stratigraphic range. Sinemurian.

Remarks. According to JOHNSON (1984), *Chlamys (Ch.) valoniensis* can be distinguished from *Ch. (Ch.) textoria* by the lack of commarginal lamellae on the plicae. The Canadian specimens closely resemble *Ch. valoniensis* from the Hettangian of northern Chile (e.g. ABERHAN 1994: pl. 19, fig. 7) and the Upper Triassic and Hettangian of Europe (e.g. JOHNSON 1984: pl. 9, figs. 2-5).

Genus *Eopecten* DOUVILLÉ 1897

Type species. *Hinnites tuberculatus* GOLDFUSS 1836 (errore pro *Spondylus tuberculosus* GOLDFUSS 1836).

Eopecten hartzi (ROSENKRANTZ 1957)

Pl. 13, Figs. 4-7, 9-11

1934 *Velata hartzi* sp. nov. - ROSENKRANTZ: pl. 8, fig. 1, no description.
1957 *Velata hartzi* sp. nov. - ROSENKRANTZ: 79, figs. 1-7.
1987b *Eopecten hartzi* (ROSENKRANTZ 1957) ? - DAMBORENEA: 199, pl. 6, figs. 16-19, text-fig. 31.
v 1998 *Eopecten hartzi* (ROSENKRANTZ) - ABERHAN: fig. 4J.

Material. 1 left valve (GSC 112526) from GSC locality 21402; 2 left valves from GSC locality 21696; 1 left valve from GSC locality 24692; 3 left valves (including GSC 112530) from GSC locality 42091; 1 left valve (GSC 112525) from GSC locality 56416; 1 left valve from GSC locality 95092; 1 left valve (GSC 112529) from GSC locality C-127470; 1 right valve from GSC locality C-127477; 1 left valve (GSC 112528) from GSC locality C-143074; 1 left valve from GSC locality C-143307; 1 left valve from GSC locality C-143310; 1 left valve (GSC 112356) and 4 right valves (including GSC 112527) from GSC locality C-143319. Predominantly preserved as internal and external moulds.

Stratigraphic range. Late Hettangian to Sinemurian.

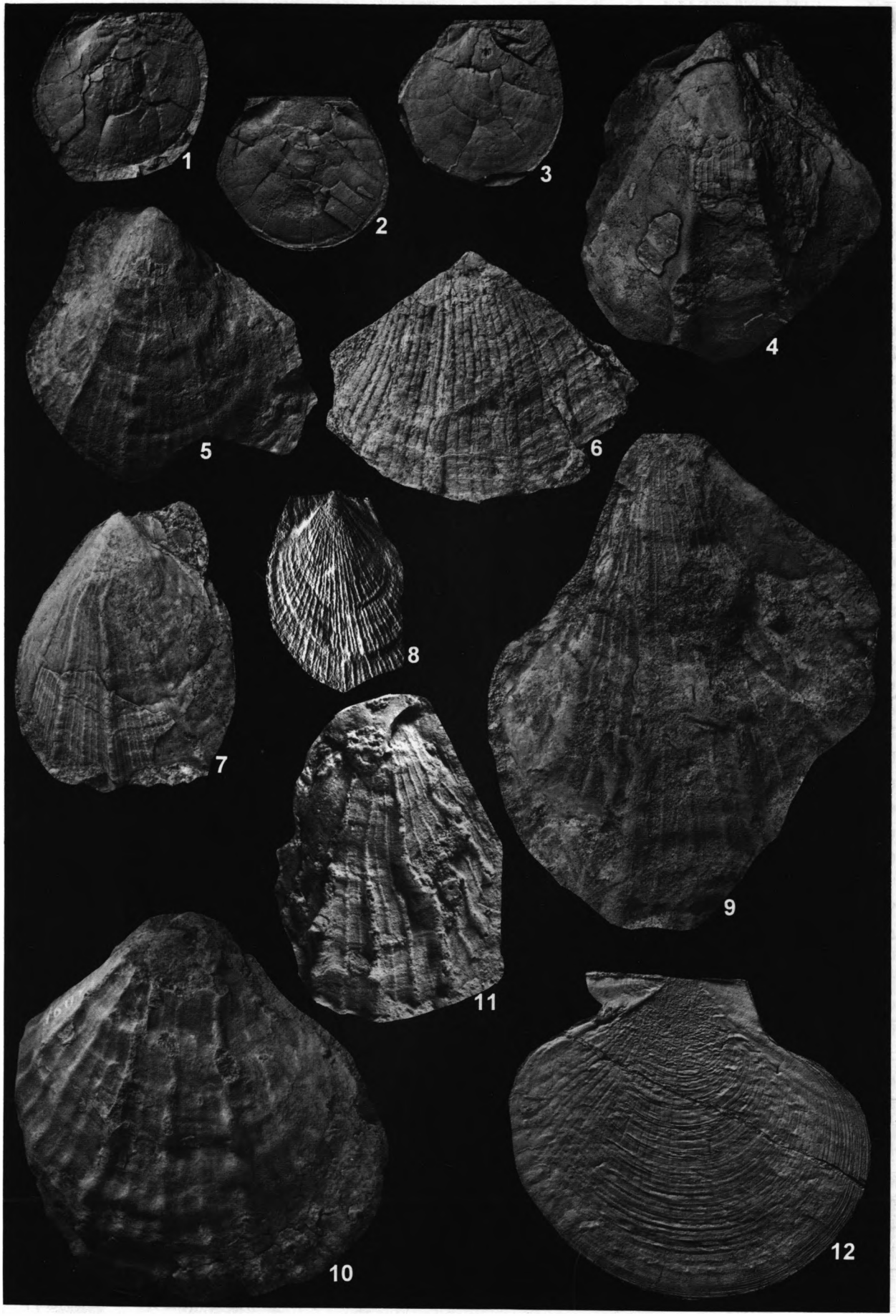
Description. The most conspicuous feature of Canadian *Eopecten hartzi* is the characteristic external ornament on its left valve. It consists of a low number (mostly 3, but occasionally up to 5) of enlarged costae,

EXPLANATION OF PLATE 13

Figs. 1-3. *Canadonectites paucicostatus* sp. nov. 1. Holotype GSC 112346 from GSC locality C-159444; Sinemurian-Pliensbachian boundary of Graham Island, British Columbia. Latex cast of right valve; x 1.2. 2. Paratype GSC 112523 from GSC locality C-159444; Sinemurian-Pliensbachian boundary of Graham Island, British Columbia. Internal mould of left valve with relict shell material attached; x 1.2. 3. Paratype GSC 112524 from GSC locality C-159444; Sinemurian-Pliensbachian boundary of Graham Island, British Columbia. Internal mould of right valve; x 1.2.

Figs. 4-7, 9-11. *Eopecten hartzi* (ROSENKRANTZ 1957). 4. Figured specimen GSC 112525 from GSC locality 56416; Lower Sinemurian of Taseko Lakes area, British Columbia. Internal mould of left valve with relict shell material attched; x 1. 5. Figured specimen GSC 112526 from GSC locality 21402; Sinemurian of Edson area, Alberta. Internal mould of left valve; x 1. 6. Figured specimen GSC 112527 from GSC locality C-143319; Upper Hettangian of Taseko Lakes area, British Columbia. Interior view of right valve; x 1. 7. Figured specimen GSC 112356 from GSC locality C-143319; Upper Hettangian of Taseko Lakes area, British Columbia. Internal mould of left valve with relict shell material attched; x 1. 9. Figured specimen GSC 112529 from GSC locality C-127470; ?Sinemurian of Kananaskis Lakes area, Alberta. Latex cast of left valve; x 1. 10. Figured specimen GSC 112530 from GSC locality 42091; Sinemurian of Mount Robson area, British Columbia. Internal mould of left valve; x 1. 11. Figured specimen GSC 112528 from GSC locality C-143074; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 2.

Figs. 8, 12. *Ochotochlamys aequistriata* sp. nov. 8. Paratype GSC 112531 from GSC locality 52226; Lower Jurassic of Trutch area, British Columbia. Latex cast of left valve; x 1.2. 12. Paratype GSC 112532 from GSC locality C-159417; Upper Sinemurian of Graham Island, British Columbia. External mould of right valve with relict shell material attached; x 1.2.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and a variable (but much higher) number of riblets of higher orders. This differentiation of the ornament into costae and riblets exists throughout all ontogenetic stages. As a rule, the enlarged costae have nodose crests; on one specimen, preserved as an external mould, the presence of hollow spines on the costae can be proven (Pl. 13, Fig. 8). As the external ornament is not preserved on the umbonal part, it is not clear, whether the enlarged costae are the only primary ribs or whether riblets of higher order are also present early in ontogeny.

The right valve is flat and exhibits a large anterior auricle with a deep byssal notch. It carries a large number of narrow, slightly unequal radial ribs. In addition, several (up to 7), more or less regularly spaced, wide radial grooves have been observed in all available right valves. The narrow ribs continue to be present in the grooves. The latter are evident on the shell exterior as well as on the interior, where they appear as broadly rounded ribs (e.g. Pl. 13, Fig. 6).

Remarks. *Eopecten hartzi* was first figured and described from the Lower Pliensbachian of East Greenland (ROSENKRANTZ 1957). The figured left valves clearly show the presence of three, more or less nodose primary ribs together with riblets of second, third, and fourth order, which never reach the height of the primary ones. Subsequently, specimens from the Pliensbachian to Lower Toarcian of Argentina doubtfully have been assigned to *E. hartzi* by DAMBORENEA (1987b). There, the primary ribs number 5 to 8 with three of them being much more prominent than the others. Again, the primary ribs are accompanied by second and third order riblets, which maintain their different strength up to the ventral margin.

I consider the above mentioned records to fall within the morphologic range of a single species. Although a marked degree of variability exists, the diagnostic features in common include the presence of a low number (mostly 3, range: 3 to 5) of enlarged costae and riblets of higher orders, which never gain the size of the primary ones.

JOHNSON (1984) considered all European Jurassic specimens of *Eopecten* to be resolvable into three species, i.e. *E. velatus* (GOLDFUSS 1833), *E. spondyloides* (ROEMER 1836), and *E. abjectus* (PHILLIPS 1829). Whilst their right valves are unsuitable for a separation at the species level, they can be distinguished by the ornament of their left valves. *E. hartzi* has strongest affinities to *E. velatus*, which is characterized by the differentiation of the ornament on the left valve into costae and striae in all but very large specimens. The sculpture comprises between 15 and 20 (range: 5 to 28) radial costae with several fine striae inbetween. Thus, the number of primary costae is usually distinctly higher than in *E. hartzi*, though they appear to overlap slightly. However, *E. velatus* lacks the enlarged costae typical of *E. hartzi*; rather all primaries are subequal in height.

Eopecten hartzi can be distinguished from *E. spondyloides* and *E. abjectus* by exhibiting a clear differentiation into costae and striae during all stages in ontogeny, whilst in the latter two the intercalated costae rapidly gain the same height as the original costae. Furthermore, *E. spondyloides* has no enlarged costae and in *E. abjectus* only two of the costae are enlarged.

Eopecten obliquus FÜRSICH & WERNER (1989: 141, pl. 13, figs. 6-9) from the Kimmeridgian of Portugal is a strongly inequilateral *Eopecten* with very asymmetric auricles and in this respect differs from all other Jurassic *Eopecten* mentioned above. It can be further distinguished from *E. hartzi* by possessing fine radial striae, which are turning into ribs towards the ventral margin. The crests of the costae of the left valve exhibit a similar intraspecific variability as has been observed in *E. hartzi*. They may be rounded or bear tubercles and short, hollow spines. Likewise, the crests of the left valve costae of *E. velatus* may be rounded (e.g. JOHNSON 1984) or bear tubercles (FÜRSICH & WERNER 1989, ABERHAN 1994) and testify to the morphological variability within species of *Eopecten*.

Genus *Ochotochlamys* MILOVA & POLUBOTKO 1976

Type species. *Chlamys (Ochotochlamys) gizhigensis* POLUBOTKO 1976.

Ochotochlamys aequistriata sp. nov.

Pl. 13, Figs. 8, 12; Pl. 14, Figs. 1-7; Text-figs. 8-9

v 1998 *Ochotochlamys* sp. A - ABERHAN: fig. 4G.

Derivation of name. From aequus (lat.) = equal, and striatus (lat.) = striated.

Holotype. GSC 112534 from GSC locality C-80802, latex cast of right valve, figured on Pl. 14, Fig. 2. Additional material. 2 left valves, 1 right valve, and 1 fragmentary valve from GSC locality 51225; 4 left valves, 6 right valves (including GSC 112535, 112537), and 3 fragmentary valves from GSC locality 51788; 1 articulated specimen from GSC locality 52223; 2 left valves and 2 right valves from GSC locality 52224; 2 left valves (including GSC 112531) and 4 right valves from GSC locality 52226; 1 left valve and 2 right valves from GSC locality 52229; 3 left valves from GSC locality 52231; 2 left valves (including GSC 112533) from GSC locality 82577; 3 left valves and 2 right valves (GSC 112353) from GSC locality 89670; 1 left valve from GSC locality 93721; 1 left

valve and 4 right valves from GSC locality 93728; 2 single valves from GSC locality C-80249; 1 right valve from GSC locality C-80802; 1 left valve (GSC 112538), 1 right valve (GSC 112538), and 1 single valve from GSC locality C-81707; 1 right valve and 3 single valves from GSC locality C-81733; 1 right valve from GSC locality C-117021; 1 left valve (GSC 112536) from GSC locality C-142906; 1 left valve and 1 right valve from GSC locality C-153971; 2 right valves from GSC locality C-156328; 1 left valve and 1 right valve from GSC locality C-156401; 1 left valve from GSC locality C-156411; 1 left valve and 1 right valve from GSC locality C-156415; 1 left valve from GSC locality C-159257; 1 left valve from GSC locality C-159258; 1 left valve and 2 fragmentary valves from GSC locality C-159412; 1 right valve and 1 single valve from GSC locality C-159414; 1 right valve (GSC 112532) from GSC locality C-159417; 1 right valve from GSC locality C-159429; 2 left valves and 1 right valve from GSC locality C-159435; 1 right valve from GSC locality C-159439; 1 left valve from GSC locality C-159441; 2 left valves from GSC locality C-175234. Predominantly preserved as external mould.

Measurements (in mm). The number of ribs (NR) was counted at two different heights. Number in brackets refers to distance from umbo at which ribs were counted.

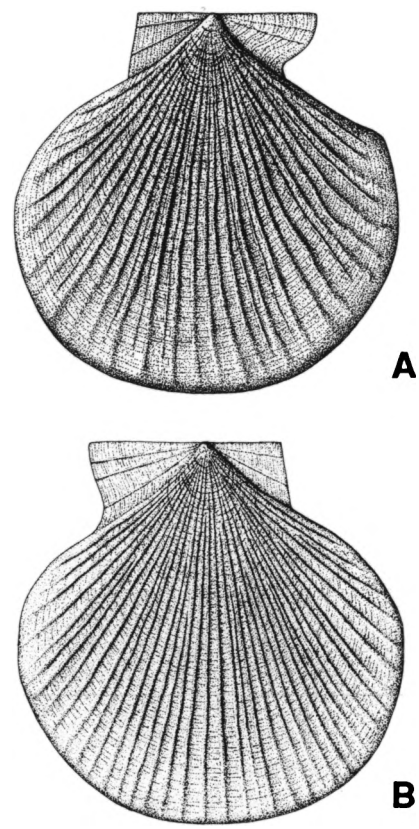
	L	H	AH	PH	UA	NR1	NR2
GSC 112353 (rv)	43	-	~13.3	8.6	112°	26 (10)	32 (20)
GSC 112531 (lv)	32	~28	7.6	5.9	104°	-	33 (20)
GSC 112532 (rv)	56	50	14.6	10.0	119°	-	-
GSC 112533 (lv)	30	36	~10	~8	98°	28 (15)	47 (36)
GSC 112534 (rv)	43	42	10.8	7.9	119°	28 (15)	39 (30)
GSC 112535 (rv)	34	29	9.3	6.5	103°	25 (10)	40 (32)
GSC 112536 (lv)	38	37	8.8	-	-	-	-
GSC 112537 (rv)	32	32	~8	6.0	108°	25 (10)	48 (33)
GSC 112538 (lv)	33	30	8.0	7.4	102°	-	-
GSC 112538 (rv)	29	30	7.7	5.3	107°	-	-
unfigured lv	27	27	9.1	-	121°	25 (15)	36 (27)
unfigured rv	~32	34	9.1	6.0	93°	-	42 (30)
unfigured rv	36	34	10.4	-	114°	-	-

Stratigraphic range. Hettangian to Early Pliensbachian. The studied material from the Fernie Formation of the Halfway River map area is from strata devoid of identifiable ammonites and the stratigraphic position of *O. aequistriata* must be inferred indirectly. *O. aequistriata*, which is referred to as "probably *Entolium*" in POULTON et al. (1990), occurs some 16 m above beds with *Otapiria tailleuri*. For the latter, a Sinemurian, most likely an Early Sinemurian age has been inferred (see above). On the other hand, *O. aequistriata* is not younger than Early Pliensbachian as it occurs below ammonites, which indicate this age. Specimens of *O. aequistriata* from the Queen Charlotte Islands are ranging from Hettangian to Early Pliensbachian in age. Therefore, the beds yielding *O. aequistriata* in the Halfway River map area most likely are Late Sinemurian and/or Early Pliensbachian in age.

Diagnosis. Medium-sized *Ochotochlamys* with deep byssal notch in right valve and well developed byssal sinus in left valve; all auricles ornamented with radial striae; exterior of both valves with identical ornament of radial riblets and commarginal lamellae and folds.

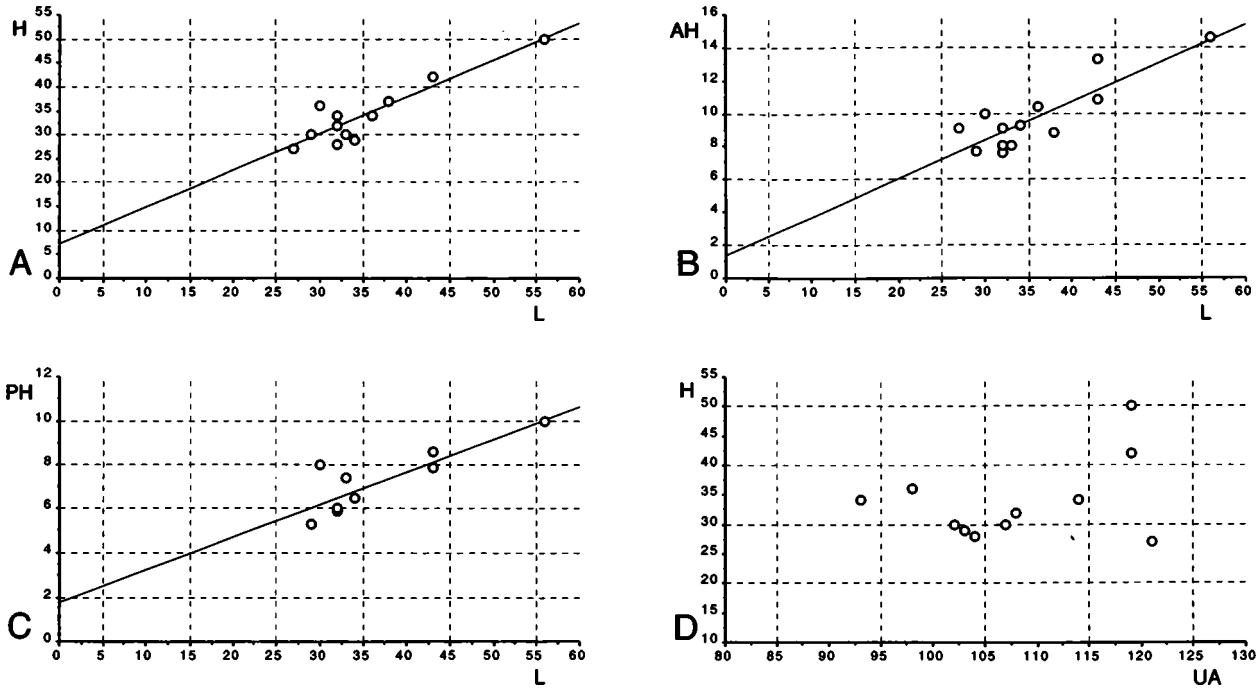
Description. Shell medium-sized, thin, approximately equilateral and equivalve, both valves of very low convexity; disc sub-orbicular to sub-ovate. Umbonal angle increasing slowly during ontogeny to produce slightly concave dorsal margins. Hinge-line straight; beak not protruding beyond hinge-line.

Auricles clearly separated from disc; anterior auricles distinctly larger than posterior ones. Posterior auricles of both valves meeting hinge at an obtuse angle and disc at an acute angle. Anterior auricles meeting hinge at an approximately right angle. Anterior auricle of right valve always with deep byssal notch during all ontogenetic stages. Anterior auricle of left valve with well developed byssal sinus. All auricles ornamented with commarginal growth lines and two to four fine radial striae; anterior auricles also with commarginal folds at irregular intervals.



Text-fig. 8. *Ochotochlamys aequistriata* sp. nov. A. Reconstruction of exterior view of right valve. B. Reconstruction of exterior view of left valve. Approximately x 1.

Exterior of both valves ornamented with commarginal growth lamellae, commarginal folds, and radial riblets. Commarginal folds irregularly spaced and variable in strength, tending to be more prominent than radial ornament in early ontogenetic stages. Radial riblets narrow, rounded, wavy, of somewhat variable, subequal strength, their number increasing by intercalation (see measurements). Interspaces between riblets variable even on the same specimen, approximately of same width as riblets or wider.



Text-fig. 9. *Ochotochlamys aequistriata* sp. nov. A. Height/length ratios. B. Anterior hinge length/length ratios. C. Posterior hinge length/length ratios. D. Height/umbonal angle ratios.

Remarks. So far, *Ochotochlamys* was thought to be endemic to the Upper Triassic and Lower Jurassic of north-eastern Asia (POLUBOTKO & REPIN 1984, SEY & KALACHEVA 1988) and this is the first record of *Ochotochlamys* outside this region.

Three species of *Ochotochlamys* have been described from the Lower Jurassic of the Russian Far East and North-East: *O. kiparisovae* MILOVA, *O.*

EXPLANATION OF PLATE 14

Figs. 1-7. *Ochotochlamys aequistriata* sp. nov. 1. Paratype GSC 112533 from GSC locality 82577; Upper Sinemurian or Lower Pliensbachian of Halfway River area, British Columbia. Latex cast of left valve; x 1.2. 2. Holotype GSC 112534 from GSC locality C-80802; Lower Pliensbachian of Graham Island, British Columbia. Latex cast of right valve; x 1.2. 3. Paratype GSC 112353 from GSC locality 89670; Sinemurian or Lower Pliensbachian of Hazelton area, British Columbia. Latex cast of two right valves; x 1.2. 4. Paratype GSC 112535 from GSC locality 51788; Lower Jurassic of Trutch area, British Columbia. Latex cast of right valve; x 1.2. 5. Paratype GSC 112536 from GSC locality C-142906; Upper Sinemurian of Queen Charlotte Islands, British Columbia. Composite mould of left valve; x 1.2. 6. Paratype GSC 112537 from GSC locality 51788; Lower Jurassic of Trutch area, British Columbia. Latex cast of right valve; x 1.2. 7. Paratype GSC 112538 from GSC locality C-81707; Pliensbachian of Graham Island, British Columbia. Internal mould of right valve (upper part of specimen) and external mould of left valve (lower part) with relict shell material attached; x 1.2.

Figs. 8-12, 16. *Ochotochlamys* cf. *bureiensis* SEY 1984. 8. Figured specimen GSC 112539 from GSC locality 19568; ?Pliensbachian of Wapiti area, Alberta. Slab with several valves; x 1.2. 9. Figured specimen GSC 112540 from GSC locality 88014; Pliensbachian of Edson area, Alberta. Internal mould of left valve with relict shell material attached; x 1.2. 10. Figured specimen GSC 112541 from GSC locality 23131; Late Pliensbachian of Calgary area, Alberta. Latex cast of ?left valve; x 1.2. 11. Figured specimen GSC 112542 from GSC locality 75324; ?Pliensbachian of Brazeau Lake area, Alberta. Internal mould of right valve; x 1.2. 12. Figured specimen GSC 112543 from GSC locality C-86379; Pliensbachian or Toarcian of Calgary area, Alberta. Latex cast of left valve; x 1.2. 16. Figured specimen GSC 112349 from GSC locality 79776; Pliensbachian or Toarcian of Calgary area, Alberta. Latex cast of right valve and small left valve (lower right part of specimen); x 1.2.

Fig. 13. *Weyla (Weyla) bodenbenderi* (BEHRENDSEN 1891). Figured specimen GSC 112348 from GSC locality C-90518; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of left valve; x 1.

Figs. 14-15. *Radulonectites sosneadoensis* (WEAVER 1931). 14. Figured specimen GSC 112544 from GSC locality C-90903; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of right valve; x 1.2. 15. Figured specimen GSC 112545 from GSC locality C-90903; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of left valve; x 1.2.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bureiensis SEY, and *O. grandis* POLUBOTKO. *O. aequistriata* sp. nov. can be distinguished from all other Lower Jurassic species of *Ochotochlamys* by exhibiting a radial ornament, which is of more or less equal strength in both left and right valves. It has strongest affinities to the Hettangian *O. kiparisovae* (e.g. MILOVA 1988: 96, pl. 15, figs. 17-20, pl. 16, figs. 1-9), which, like *O. aequistriata*, is characterized by a sub-orbicular to trigonally sub-oval outline, large anterior auricles, a deep byssal notch, and a relatively small apical angle (not larger than 105°). However, in contrast to *O. aequistriata,* the left valve exhibits narrow, rounded radial ribs of different orders of strength. In the right valve, radial elements are lacking or are hardly noticeable.

The Late Pliensbachian *O. grandis* (e.g. MILOVA 1988: 97, pl. 16, figs. 10-13, pl. 17, figs. 1-3) can be separated from *O. aequistriata* by its considerably larger maximum size, anterior and posterior auricles that are strongly unequal in size (the anterior auricle is 2 to 2.5 times larger than the posterior one), and a larger apical angle (115-130°). Most importantly, whilst the left valve is bearing relatively coarse radial ribs, the right valve is smooth or may bear very faint riblets.

The Late Pliensbachian *O. bureiensis* (e.g. SEY 1984: 93, pl. 17, figs. 1-3; SEY & POLUBOTKO in DAMBORENEA et al. 1992: pl. 121, fig. 8) differs from *O. aequistriata* by a disc that tends to be longer than high, relatively small auricles which are subequal in size, a relatively shallow byssal notch, and a larger apical angle (125-135°). Again, right and left valves bear a different kind of radial sculpture. That of the left valve exhibits a distinctive differentiation in radial ribs and striae, the latter giving rise to a reticulate pattern when crossing the commarginal growth lamellae; the right valve only carries faint riblets.

A different ornament in right valves is also present in Upper Triassic representatives of *Ochotochlamys* and serves to distinguish *O. aequistriata* from *O. gizhigensis* POLUBOTKO (in MILOVA 1976: 61, pl. 8, figs. 8-12), *O. vadopadnyensis* MILOVA (1976: 62, pl. 8, fig. 13, pl. 9, figs. 1-6), and *O. noricus* MILOVA (1976: 63, pl. 9, figs. 7-10).

Ochotochlamys cf. *bureiensis* SEY 1984

Pl. 14, Figs. 8-12, 16

cf. 1984 *Chlamys (Ochotochlamys?) bureiensis* sp. nov. - SEY: 93, pl. 17, figs. 1-3.

cf. 1992 *Ochotochlamys bureiensis* SEY - SEY & POLUBOTKO in DAMBORENEA et al.: pl. 121, fig. 8.

v 1998 *Ochotochlamys* cf. *bureiensis* SEY - ABERHAN: fig. 4C.

Material. *Ochotochlamys* cf. *bureiensis* has been found at the following GSC localities: 14437; 14716; 19568 (including GSC 112539); 19569; 19572; 21052; 21700; 22702; 22713; 22765; 22766; 22768; 22769; 23131 (including GSC 112541); 23242; 24701; 28809; 28814; 31369; 51338; 75323; 75324 (including GSC 112542); 77063; 79678; 79680; 79743; 79776 (including GSC 112349); 79778; 79802; 79915; 80831; 88013; 88014 (including GSC 112540); C-86379 (including GSC 112543); C-86397; and TMP 92.64.5. Predominantly preserved as internal and external moulds.

Stratigraphic range. Early Pliensbachian to Toarcian.

Description. *Ochotochlamys* cf. *bureiensis* has a sub-orbicular disc with auricles that are well demarcated from the disc. As typical of the genus, the anterior auricle of the right valve exhibits a distinct byssal notch and the anterior auricle of the left valve has a byssal sinus. All auricles carry weak radial riblets. The characteristic feature of *O.* cf. *bureiensis* is its kind of ribbing which is different on left and right valves. On left valves it consists of almost straight to slightly undulating radial ribs of two or three orders of strength, which are present on all of the shell exterior. In addition, regularly and tightly spaced commarginal lamellae and commarginal folds, which occur at much wider and more irregularly spaced intervals than the lamellae, are present. The secondary (and tertiary) riblets are intercalated between primary ribs later during ontogeny and, in general, they remain lower than the primary ones throughout ontogeny. Growth lamellae and striae together generate a reticulate pattern. The right valve is smooth or exhibits weak, subequal radial ribs.

Remarks. In these features the studied specimens cannot be distinguished from *O. bureiensis* from the Upper Pliensbachian of the Far East of Russia. The only differences are more strongly concave antero- and postero-dorsal margins, which result in larger umbonal angles in the specimens from the Far East as figured in SEY (1984: pl. 17, figs. 1-3).

Ochotochlamys cf. *bureiensis* can be separated from *Ochotochlamys aequistriata* by the presence of ribs of several orders of strength on left valves. Even more important is the different style of ribbing on left and right valves as opposed to a similar kind of ornament on left and right valves in *O. aequistriata.*

Genus *Radulonectites* HAYAMI 1957

Type species. *Radulonectites japonicus* HAYAMI 1957.

Radulonectites sosneadoensis (WEAVER 1931)

Pl. 14, Figs. 14-15; Pl. 15, Figs. 1, 4

1931 *Pecten sosneadoensis* sp. nov. - WEAVER: 272, pl. 28, fig. 169.
v 1991 *Camptonects (Camptochlamys)* sp. - POULTON: 28, pl. 11, figs. 17-22.
v 1994 *Radulonectites sosneadoensis* (WEAVER 1931) - ABERHAN: 41, pl. 20, figs. 5-6 (see for synonymy list).
v 1998 *Radulonectites sosneadoensis* (WEAVER) - ABERHAN: fig. 3D.

Material. 1 right valve from GSC locality 14333; 2 left valves and 1 fragmentary valve from GSC locality 40424; 1 left valve (GSC 112546) and 1 right valve from GSC locality 40425; 1 right valve from GSC locality 93221; 1 left valve from GSC locality C-81978; 1 right valve from GSC locality C-86677; 2 right valves (including GSC 112338) and 1 fragmentary valve from GSC locality C-86682; 2 left valves from GSC locality C-90902; 3 left valves, 2 right valves (GSC 112544, 112545), and 5 fragmentary valves from GSC locality C-90903; 1 right valve from GSC locality C-90925; 1 left valve and 1 fragmentary valve from GSC locality C-90931; 1 right valve from GSC locality C-103198. Predominantly preserved as external moulds.

Stratigraphic range. Early to Late Pliensbachian.

Description. The outline of *Radulonectites sosneadoensis* is semicircular in the lower half of the shell and sub-triangular in the upper half. The shell is covered with about 80 to 90 narrow, flat-topped, and slightly wavy radial riblets. Only very rarely new riblets are intercalated during growth. The grooves between the riblets are much narrower than the riblets. Both grooves and riblets are crossed by commarginal striae, which are more pronounced in the grooves and, where well preserved, give them a punctate appearance. The anterior auricle of the right valve is about twice as long as the posterior one and is delimited from the main body of the shell by a deep byssal notch. A ctenolium is present also in adult stages. All auricles exhibit strong commarginal growth lines. Radial riblets on the auricles of adult forms are either lacking or are only very weakly developed.

Remarks. *Radulonectites sosneadoensis* is known from Argentina (e.g. WEAVER 1931, DAMBORENEA 1993a), and Late Pliensbachian specimens from Chile have been discussed in some detail by ABERHAN (1994). The Canadian specimens correspond well to the South American forms.

Closely related species are *Radulonectites japonicus* HAYAMI (1957b: 90, pl. 16, figs. 1-8; 1975: pl. 3, figs. 9-10) from the Upper Pliensbachian of Japan and its junior synonym *R. hayamii* POLUBOTKO (in EFIMOVA et al. 1968: 82, pl. 24, figs. 1-5; MILOVA 1988: 88, pl. 12, figs. 7-9, pl. 13, figs. 1-6; SHURYGIN & LUTIKOV 1991: 71, pl. 14, figs. 8-10; HAYAMI in SATO & WESTERMANN 1991) from the Upper Pliensbachian of eastern Siberia. The observed range in the number of riblets is 70 to around 90 in *R. sosneadoensis* and 65 to 85 in *R. japonicus*. Consequently, the two species cannot be separated on this basis. The western Pacific form, however, can be distinguished from *R. sosneadoensis* by a sub-orbicular outline, and a right valve, which is distinctly inequilateral and exhibits a more strongly concave antero-dorsal shell margin. Furthermore, the umbonal part is devoid of a radial sculpture in *R. japonicus*, whilst in unabraded *R. sosneadoensis* it is covered by fine radial striae extending to the beak.

From the Upper Pliensbachian of eastern Siberia several further species of *Radulonectites* have been described. These are *R. antiquus* MILOVA (1988: 85, pl. 10, figs. 1-6), *R. mongkensis* MILOVA (1985: 53, pl. 12, figs. 1-9; 1988: 87, pl. 10, fig. 9, pl. 11, figs. 1-11, pl. 12, figs. 1-6; POLUBOTKO & MILOVA 1986: 124, pl. 16, figs. 3-5), and *R. levis* POLUBOTKO (in POLUBOTKO & MILOVA 1986: 125, pl. 16, figs. 6-7). They appear to differ from *R. sosneadoensis* in shell outline, relative size of the auricles, and style of ribbing. A revision of Lower Jurassic *Radulonectites*, however, is beyond the scope of this paper.

Camptonectes (Camptochlamys) sp. in POULTON (1991: 28, pl. 11, figs. 17-22) from the ?Sinemurian and Pliensbachian of northern Yukon apparently lacks the diagnostic commarginal lamellae of *Camptochlamys*. As the figured specimens from the northern Yukon agree well with *R. sosneadoensis* in general shape and style of ribbing they are included in the list of synonymy herein.

Radulonectites is regarded as a typical faunal element of the Lower Jurassic circum-Pacific (see DAMBORENEA 1993a) and the present findings for the first time document its occurrence in western North America.

Family Neitheidae SOBETZKY 1960

Genus *Weyla* BÖHM 1922

Subgenus *Weyla* BÖHM 1922

Type species. *Pecten alatus* VON BUCH 1838.

Weyla (Weyla) alata (VON BUCH 1838)

Pl. 15, Figs. 3, 5-8; Pl. 16, Figs. 3, 12

1838 *Pecten alatus* sp. nov. - VON BUCH: 55.
1839 *Pecten alatus* - VON BUCH: 3, figs. 1-3.
v 1933b *Parapecten praecursor* sp. nov. - CRICKMAY: 905, pl. 25, figs. 4-5.
v 1933b *Parapecten acutiplicatus* MEEK - CRICKMAY: 906, pl. 25, figs. 1-3.

1986 *Weyla alata* (VON BUCH) - SMITH & TIPPER: fig. 2.5.
1987b *Weyla (Weyla) alata alata* (VON BUCH 1838) - DAMBORENEA: 170, pl. 9, fig. 1, pl. 10, figs. 1-5, text-figs. 18, 19-1, 22a (see for extensive synonymy list).
1987b *Weyla (Weyla) alata angustecostata* (R. PHILIPPI 1899) - DAMBORENEA: 177, pl. 6, fig. 17b, pl. 7, figs. 1-2, pl. 8, figs. 1-3, pl. 9, figs. 2-3, text-figs. 2, 19-2, 21.
v 1994 *Weyla (Weyla) alata* (VON BUCH 1838) - ABERHAN: 43, pl. 22, figs. 1-3, pl. 23, figs. 1-2 (see for synonymy list).
v 1998 *Weyla (Weyla) alata* (VON BUCH) - ABERHAN: fig. 3F, J.

Material. *Weyla (Weyla) alata* has been found at the following GSC localities: 28500; 32786 (including GSC 112340); 40422; 40451; 40472; 40941; 79004; 82365; 83263; 84186; 84191; 84192; 85334; 85335; 85424 (including GSC 112344); 85438 (including GSC 112550, 112553); 86265; 87382; 88602; 88604 (including GSC 112548); 88735; 91052; 92079; 93174; 93175; 93184; 93225; 93272; 93313 (including GSC 112551); 93587 (including GSC 112549); C-88230; C-90545; C-90835; C-90901; C-90903; C-90914; C-90917; C-90919; C-90920; C-90922; C-90925; C-90930; C-103074; C-103099; C-103327; C-116869; C-186957; C-186958. Predominantly as external moulds; more rarely in shell preservation.

Stratigraphic range. Sinemurian to Late Pliensbachian.

Remarks. *Weyla alata* is, together with *W. bodenbenderi*, by far the most common bivalve species in the Lower Jurassic of western Canada. Specimens are mainly preserved as internal and external moulds and for this reason preservation is not as excellent as commonly encountered in specimens from South America. *W. alata* was described and discussed in great detail by DAMBORENEA (1987b) and ABERHAN (1994) and no further comments are needed here. Affinities with the closely related *W. bodenbenderi* are discussed below.

Weyla (Weyla) bodenbenderi (BEHRENDSEN 1891)

Pl. 14, Fig. 13; Pl. 15, Fig. 2; Pl. 16, Fig. 5; Pl. 19, Fig. 2

1891 *Pecten Bodenbenderi* sp. nov. - BEHRENDSEN: 391, pl. 22, fig. 3.
1969 *Weyla* sp. indet. - FREBOLD & TIPPER: 13, pl. 1, fig. 1.
1969 *Weyla* sp. indet. aff. *W. bodenbenderi* (BEHRENDSEN) - FREBOLD & TIPPER: 13, 16, pl. 1, figs. 2-4.
1992 *Weyla bodenbenderi* (BEHRENDSEN 1891) - THOMSON & SMITH: pl. 1, fig. 1.
v 1998 *Weyla (Weyla) bodenbenderi* (BEHRENDSEN) - ABERHAN: fig. 4B.

Material. *Weyla (Weyla) bodenbenderi* has been found at the following GSC localities: 324; 14333; 19382; 19392; 19399 (GSC 112547); 20118; 28923; 32786; 36981; 40423 to 40425; 40472; 43661; 44413; 82860; 82866; 82900; 84189; 85329; 85340; 89090; 90785; 93184; 93221; 93272; 93307; 93313; 93327; 93352; 93587; 93618; 93619; C-53514; C-81947; C-81948; C-81971; C-81972; C-86676; C-90518 (including GSC 112348); C-90659; C-90836; C-90901; C-90902; C-90907 (GSC 112562); C-90908; C-90909; C-90911 (including GSC 112585); C-90912; C-90921; C-90923; C-90925; C-90930 to C-90933; C-103070; C-103072; C-103078; C-103093; C-103096; C-103099; C-103204; C-103303; C-103310; C-103406; C-116863; C-116869; C-117274; C-186955; C-186957; C-186959; C-212407. In shell preservation and as internal and external moulds.

Stratigraphic range. Sinemurian to Early Toarcian.

Remarks. *Weyla (W.) bodenbenderi* can be distinguished from *W. alata* by its different style of ribbing. The ribs on the right valve are less prominent and broader than those of *W. alata*. They commonly show splitting of primary ribs and/or intercalation of secondary ribs, a feature that is absent in *W. alata*. The ribs on the left valve of *W. bodenbenderi* are flat-topped, of about the same width or wider than the interspaces, and frequently also exhibit secondary riblets. In contrast, the ribs on left valves of *W. alata* are narrow and triangular in cross-section with the interspaces being always wider than the ribs, and intercalation and splitting of ribs are absent. These differences are apparent on the outer surface of the shell as well as on external moulds. Both species can also be distinguished when preserved as internal moulds, although differences are more subtle (see DAMBORENEA 1987b: text-fig. 23).

EXPLANATION OF PLATE 15

Figs. 1, 4. *Radulonectites sosneadoensis* (WEAVER 1931). 1. Figured specimen GSC 112546 from GSC locality 40425; Upper Pliensbachian of Tulsequah area, British Columbia. Latex cast of left valve; x 1.2. 4. Figured specimen GSC 112338 from GSC locality C-86682; Upper Pliensbachian of Tulsequah area, British Columbia. Latex cast of right valve; x 1.2.

Fig. 2. *Weyla (Weyla) bodenbenderi* (BEHRENDSEN 1891). Figured specimen GSC 112547 from GSC locality 19399; Lower Jurassic of Nootka Sound area, British Columbia. Exterior view of right valve; x 1.

Figs. 3, 5-8. *Weyla (Weyla) alata* (VON BUCH 1838). 3. Figured specimen GSC 112548 from GSC locality 88604; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1. 5. Figured specimen GSC 112550 from GSC locality 85438; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1.2. 6. Figured specimen GSC 112549 from GSC locality 93587; Upper Pliensbachian of Cape Flattery area, British Columbia. Latex cast of right valve; x 1.5. 7. Figured specimen GSC 112344 from GSC locality 85424; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1. 8. Figured specimen GSC 112551 from GSC locality 93313; Lower Pliensbachian of McConnell Creek area, British Columbia. Exterior view of right valve; x 1.


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Weyla (Weyla) meeki DAMBORENEA 1987

Pl. 16, Figs. 2, 8, 11, 13; Text-figs. 11-13

v 1864 *Pecten acutiplicatus* sp. nov. - MEEK: 46, pl. 8, fig. 3 (non *Pecten acuteplicatus* ALTH 1850).
v 1929 *Neithea mexicana* sp. nov. - JAWORSKI: 2, unnumbered pl., figs. 1-3.
v 1933b *Parapecten praecursor* sp. nov. - CRICKMAY: 905, pl. 25, fig. 6.
1960 *Pecten* cf. *P. acutiplicatus* MEEK - SANBORN: pl. 2, fig. 21.
v non 1987b *Weyla (Lywea) meeki* nov. nom. - DAMBORENEA: 186, 189, text-fig. 26.
v 1998 *Weyla meeki* DAMBORENEA - ABERHAN: fig. 4L.

Material. *Weyla (Weyla) meeki* has been found at the following GSC localities: 19392; 40941 (including GSC 112358, 112556); 44419; 84047; 84188 (including GSC 112554, 112555); 85338; 85399; 88525; 88601; C-86367; C-88151. Predominantly as external moulds.

Stratigraphic range. Early Sinemurian to Late Pliensbachian.

Description. The shell of *Weyla (W.) meeki* is of medium to large size, about equal in length and height, and very inequivalve. The right valve is highly convex, and ornamented with 14 to 15 strong radial ribs. The ribs are triangular in cross-section with acute to somewhat rounded crests. Similarly, the interspaces between ribs are triangular in cross-section with acute to slightly rounded bottoms. The anterior auricle is relatively large, ornamented with several radial riblets, and has a moderately deep byssal notch. Size, shape, and style of ornamentation of the posterior auricle are unknown.

The left valve is flat to very feebly convex in a dorsal-ventral direction and flat to slightly concave in an anterior-posterior direction. The external ornamentation consists of 14 to 15 V-shaped radial ribs and acute, triangular interspaces, which become somewhat more rounded towards the anterior, posterior, and ventral margins. The auricles are separated from the shell by a deep sulcus. The more ventral part of the surface of the posterior auricle is moderately concave; towards the dorsal margin its surface becomes feebly convex and caries two radial riblets. The surface of the anterior auricle is flat and ornamented with a few (up to 3) radial riblets.

Remarks. *Weyla meeki*, better known to North American palaeontologists under its former name *Weyla acutiplicata* (MEEK 1864), is a poorly known species first described from the Lower Jurassic of California. It has been renamed by DAMBORENEA (1987b), because its original name was pre-occupied by *Pecten acuteplicatus* ALTH 1850. Unfortunately, DAMBORENEA (1987b) did not realize the plano-convex nature of *W. meeki* and, under this name, figured two specimens collected by SIMON W. MULLER from the Lower Jurassic at Gabb's Valley Range, Nevada, USA, which are housed in the British Museum of Natural History (L.70795 and L.70796). One of the two specimens, here refigured in Text-fig. 10A-E, is articulated and clearly biconvex, and is included in *Weyla (Lywea) unca* (see below). The second specimen is a single right valve (Text-fig. 10F-H), which certainly belongs to the same species as the first one.

EXPLANATION OF PLATE 16

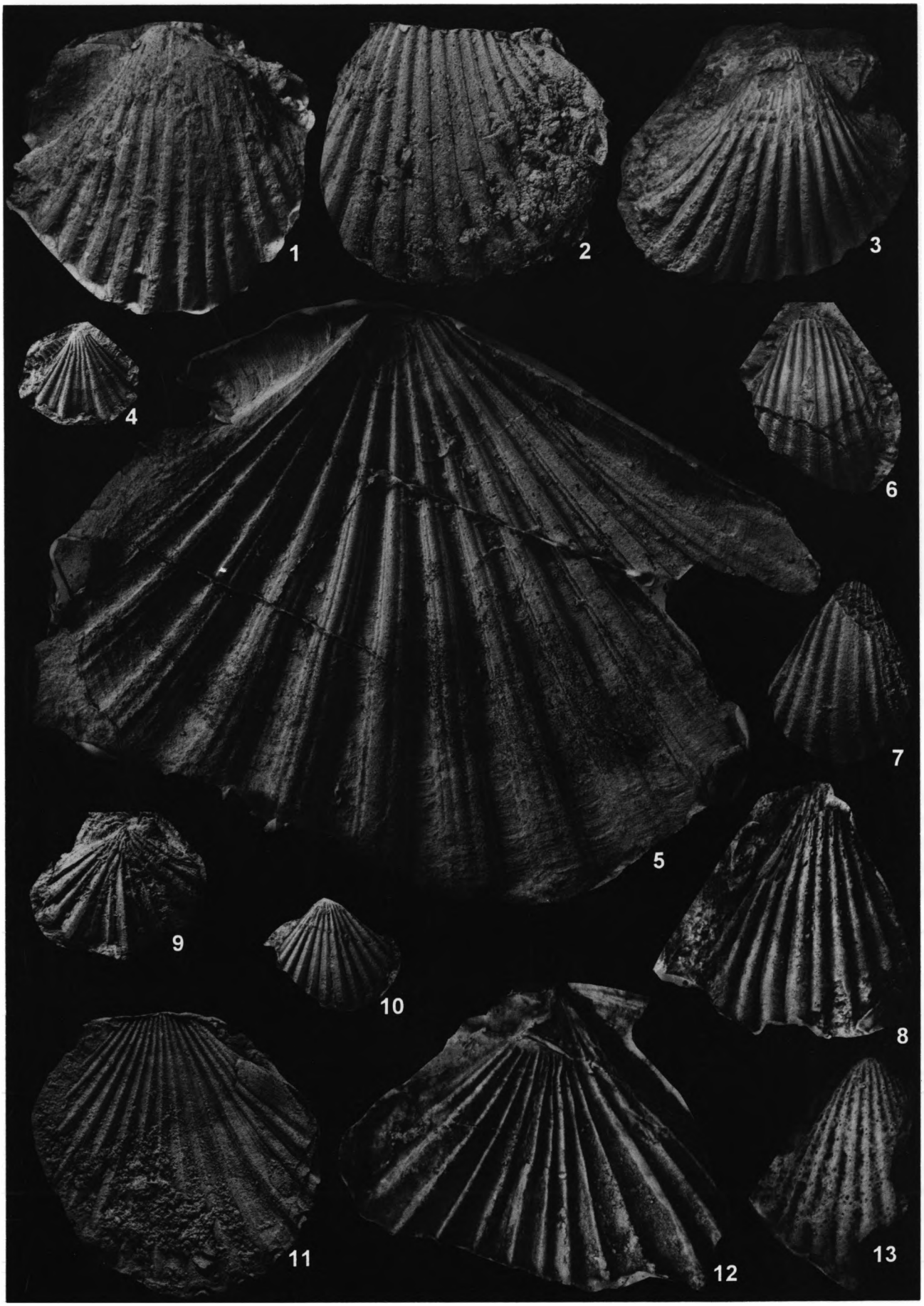
Fig. 1. *Weyla (Lywea) yukonensis* sp. nov. Paratype GSC 112552 from GSC locality 84187; Upper Sinemurian of Smithers area, British Columbia. Latex cast of right valve; x 1.

Figs. 2, 8, 11, 13. *Weyla (Weyla) meeki* DAMBORENEA 1987. 2. Figured specimen GSC 112554 from GSC locality 84118; Upper Sinemurian of Smithers area, British Columbia. Latex cast of right valve; x 1. 8. Figured specimen GSC 112358 from GSC locality 40941; Sinemurian of Moresby Island, British Columbia. Latex cast of right valve; x 1. 11. Figured specimen GSC 112555 from GSC locality 84118; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1. 13. Figured specimen GSC 112556 from GSC locality 40941; Sinemurian of Moresby Island, British Columbia. Latex cast of right valve; x 1.5.

Figs. 3, 12. *Weyla (Weyla) alata* (VON BUCH 1838). 3. Figured specimen GSC 112340 from GSC locality 32786; ?Pliensbachian of Telegraph Creek area, British Columbia. Exterior view of right valve; x 1. 12. Figured specimen GSC 112553 from GSC locality 85438; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1.

Figs. 4, 6, 7, 9, 10. *Weyla (Lywea) unca* (PHILIPPI 1899). 4. Figured specimen GSC 112557 from GSC locality 88602; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1.2. 6. Figured specimen GSC 112558 from GSC locality C-81971; Upper Sinemurian of Spatsizi area, British Columbia. Exterior view of right valve; x 1.2. 7. Figured specimen GSC 112559 from GSC locality C-81971; Upper Sinemurian of Spatsizi area, British Columbia. Exterior view of right valve; x 1.2. 9. Figured specimen GSC 112560 from GSC locality 90981; ?Sinemurian of Hazelton area, British Columbia. Latex cast of left valve; x 1.2. 10. Figured specimen GSC 112561 from GSC locality C-81971; Upper Sinemurian of Spatsizi area, British Columbia. Exterior view of left valve; x 1.2.

Fig. 5. *Weyla (Weyla) bodenbenderi* (BEHRENDSEN 1891). Figured specimen GSC 112562 from GSC locality C-90907; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of left valve; x 1.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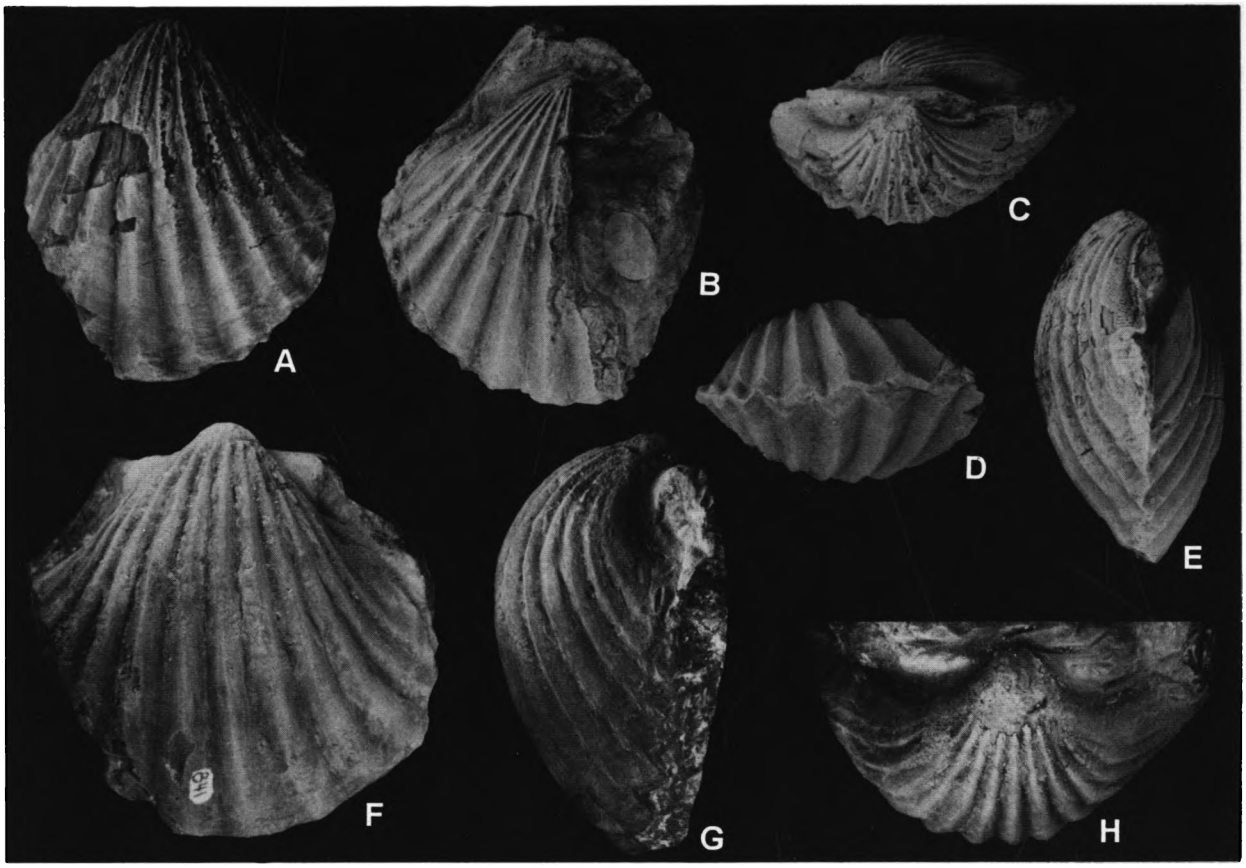

Text-fig. 10. *Weyla (Lywea) unca* (PHILIPPI 1899), collected by S. W. MULLER, Lower Jurassic of Gabb's Valley Range, Nevada, USA. A-E, articulated specimen, BMNH L.70795. A, exterior view of right valve; B, exterior view of left valve; C, dorsal view; D, ventral view; E, anterior view. F-H, right valve, BMNH L.70796. F, exterior view; G, anterior view; H, dorsal view. All x 1 (original material of *Weyla (Lywea) meeki* DAMBORENEA; figured in DAMBORENEA 1987b: text-fig. 26).

Although it was impossible to locate the original type material as described and figured by MEEK (1864), I was able to trace a latex cast of the holotype housed in the University of California Museum of Paleontology (UCMP 11411). Since its first publication by MEEK (1864: pl. 8, fig. 3), the specimen has been prepared (see Text-fig. 11), and therefore differs somewhat from MEEK's original figure. It is evident that the holotype is a left valve which is essentially flat. It exhibits a slight concave tendency in an anterior-posterior direction and a slight convex tendency in a dorsal-ventral direction and, in this respect,

EXPLANATION OF PLATE 17

Fig. 1. *Modiolus (Modiolus) mandannaensis* (LEES 1934). Figured specimen GSC 112563 from GSC locality C-81311; Sinemurian of Laberge area; southern Yukon. Exterior view of left valve; x 1.5.

Figs. 2-4, 7. *Modiolus (Modiolus)* cf. *scalprum* J. SOWERBY 1821. 2. Figured specimen GSC 112564 from GSC locality C-117279; Middle Toarcian of Nass River area, British Columbia. Latex cast of left valve; x 1. 3. Figured specimen GSC 112565 from GSC locality 62403; Hettangian of Taseko Lakes area, British Columbia. Internal mould of right valve; x 1. 4a, b. Figured specimen GSC 112566 from GSC locality 94205; Hettangian or Lower Sinemurian of Taseko Lakes area, British Columbia. a, internal mould of right valve; b, internal mould of left valve; x 1. 7a-d. Figured specimen GSC 112567 from GSC locality 94240; Lower Sinemurian of Taseko Lakes area, British Columbia. a, internal mould of right valve; b, antero-dorsal view of steinkern; c, internal mould of left valve; d, dorsal view of steinkern; x 1.

Figs. 5-6. *Weyla (Lywea) yukonensis* sp. nov. 5a-d. Holotype GSC 112354 from GSC locality 10248; Lower Sinemurian of Laberge area, southern Yukon. a, internal mould of left valve with relict shell material attached; b, exterior view of right valve; c, dorsal view of articulated specimen; d, anterior view of articulated specimen; x 1.2. 6. Paratype GSC 112568 from GSC locality 42091; Sinemurian of Mount Robson area, British Columbia. Internal mould of right valve; x 1.


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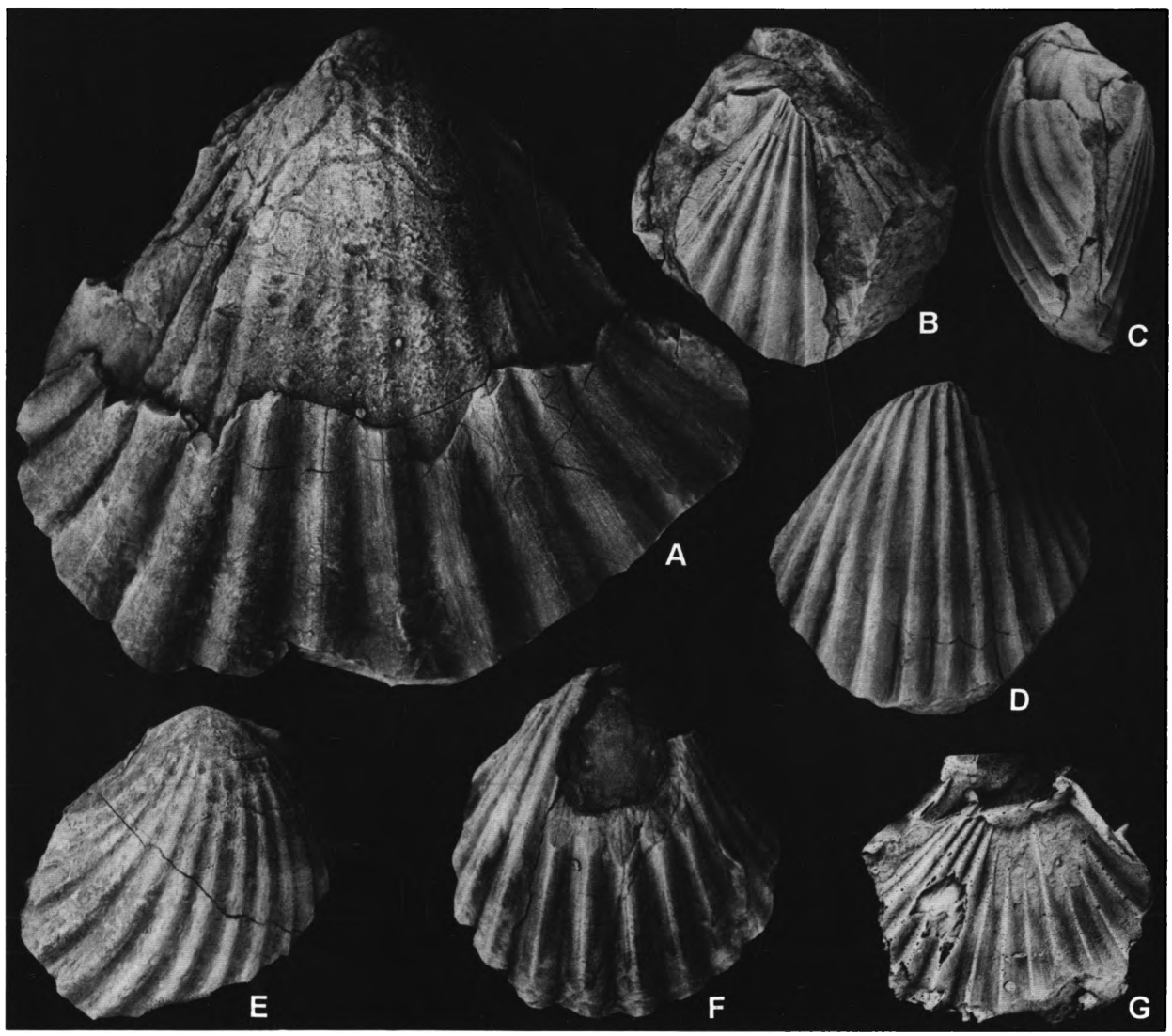
Text-fig. 11. *Weyla (Weyla) meeki* DAMBORENEA 1987, UCMP 11411. Lower Jurassic of Mount Jura, California, USA. Latex cast of left valve; x 1 (holotype of *Pecten acutiplicatus* MEEK; figured in MEEK 1864: pl. 8, fig. 3).

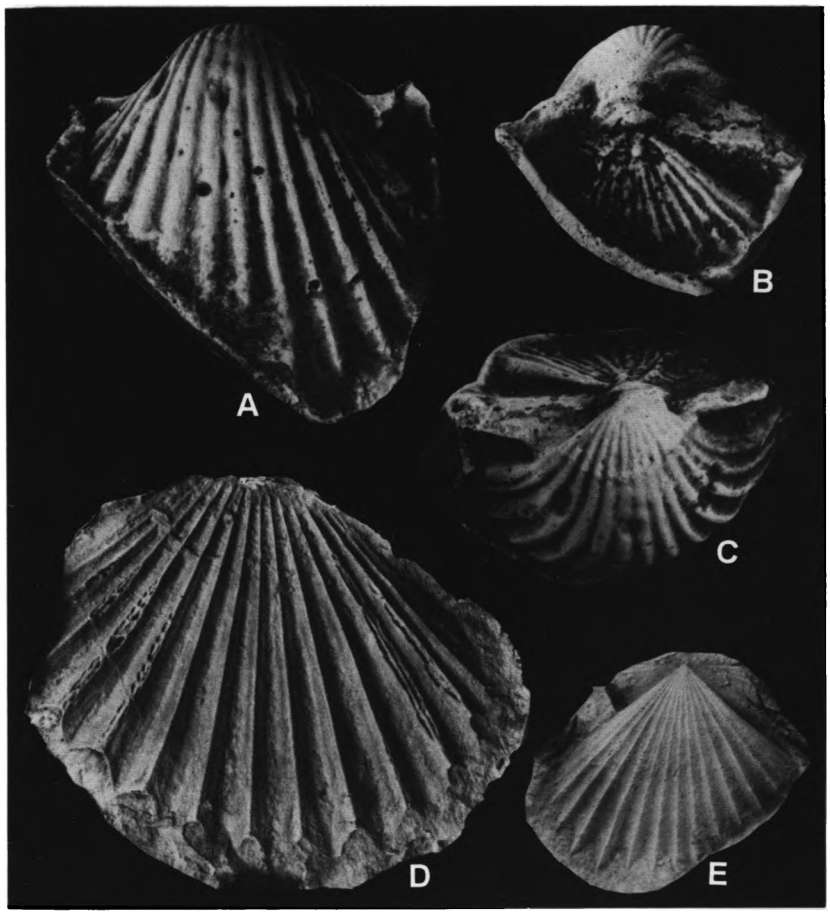
strongly resembles left valves of *W. alata*. It can be readily distinguished from *W. alata*, however, by its style of ornamentation. In the latter, the main ribs on left valves are commonly flanked by a pair of minor ridges, and the interspaces between main ribs are fairly wide and have slighty concave bottoms. In contrast, *W. meeki* lacks the flanking ridges, and the interspaces are acute and of the same width as the ribs.

Text-fig. 12. *Weyla (Weyla) meeki* DAMBORENEA 1987. A-F, Lower Jurassic of Gabb's Valley Range, Nevada, USA. A, GSC 112588, exterior view of right valve; B-D, articulated specimen, GSC 112589; B, exterior view of left valve; C, anterior view; D, exterior view of right valve; E, GSC 112590, exterior view of right valve of articulated specimen; F, GSC 112591, exterior view of right valve of articulated specimen. G, GSC 27738; Lower Jurassic of Mount Jura, California, USA; latex cast of left valve (paratype of *Parapecten praecursor* CRICKMAY; figured in CRICKMAY 1933b: pl. 25, fig. 6). All x 1.



Further fairly well preserved specimens of *Weyla meeki* from the Lower Jurassic of Gabb's Valley Range, Nevada are housed in the Geological Survey of Canada. The figures presented herein (Text-fig. 12A-F) constitute the first published record of articulated specimens of *W. meeki*, which clearly testify to the plano-convex condition of this species (e.g. Text-fig. 12B-D). Obviously, at Gabb's Valley Range, at least two species of *Weyla* are present, *W. meeki* (e.g. Text-figs. 12A-F) and *W. unca* (e.g. Text-fig. 10).

Weyla mexicana (JAWORSKI 1929) from the Lower Jurassic of Sonora, Mexico is here included in the synonymy of *W. meeki*. The type material (Text-fig. 13), which is housed in the Naturhistorisches Museum Basel, Switzerland, also belongs to the plano-convex group of species of *Weyla*. The right valve is highly convex and the left valve is flat to febbly convex in the dorsal-ventral direction and flat to feebly concave in the anterior-posterior direction. The ornamentation of disc and auricles is the same as described for *W. meeki*.



Text-fig. 13. *Weyla (Weyla) meeki* DAMBORENEA 1987. A-C, E, Lower Jurassic (?Pliensbachian) of Mina Sierra de Santa Rosa, Sonora, Mexico; A-C, plaster cast of articulated specimen, NHMB G17149; A, exterior view of right valve; B, exterior view of left valve; C, dorsal view; all x 1.5 (holotype of *Neithea mexicana* JAWORSKI; figured in JAWORSKI 1929: unnumbered plate, fig. 1a-b); E, NHMB G17150, latex cast of left valve; x 1 (paratype of *Neithea mexicana* JAWORSKI; figured in JAWORSKI 1929: unnumbered plate, fig. 2). D, NHMB G17151; Lower Jurassic (?Pliensbachian) of Cajón de las Amarillas, Sonora, Mexico; latex cast of left valve; x 1 (paratype of *Neithea mexicana* JAWORSKI; figured in JAWORSKI 1929: unnumbered plate, fig. 3).

According to DAMBORENEA (1987b), a diagnostic feature of *W. mexicana* is the presence of very strong, lamellose and regularly spaced growth lines on the left valve, which are most conspicuous in the interspaces. This feature, however, is not developed on the type material, although this is incorrectly shown on one of JAWORSKI's original drawings (JAWORSKI 1929: fig. 1c). In any case, accentuated growth lines in Jurassic *Weyla* are by no means limited to a single species, and, for instance, are occasionally present in *W. unca* and *W. meeki*. As this feature is always restricted to parts of populations of a species, it is of little diagnostic value.

Subgenus *Lywea* DAMBORENEA 1987

Type species. *Pecten uncus* PHILIPPI 1899.

Original diagnosis. "Pectiniform biconvex shell, inequivalve. Left valve less inflated than the right one. The right valve umbo is very prominent and extends well above the hinge-line. The shell is very thick. The auricles are subequal in size and not separated by a sulcus from the disc of the shell. Without byssal notch. The external ornamentation consists of simple radial ribs, V-shaped in cross-section, some of which may be more prominent than the others." (DAMBORENEA

1987b: 185).

Amended diagnosis. *Weyla* with biconvex shell; left valve less inflated than right one; both valves ornamented with simple radial ribs.

Remarks. Taking the original diagnosis of *Weyla (Lywea)* as a basis for a subgeneric identification of *Weyla meeki* and *Weyla yukonensis* is problematic, because only those species can be accommodated with *Lywea* that exhibit an external ornamentation of V-shaped radial ribs. Thus, due to the triangular cross-section of its ribs, *W. meeki* has strong affinities to *Lywea*. However, belonging to the plano-convex group of species of *Weyla*, it is better placed in *Weyla* s.s.

Weyla yukonensis is clearly biconvex, and therefore can not be included in *Weyla* s.s. At the same time, given the original diagnosis, lack of V-shaped ribs on right valves prevents assignment to *Lywea*. I regard the cross-section of ribs and other features, such as the presence or absence of a byssal notch and differences in shell thickness, as features that may vary between species of the same subgenus. Consequently, an amended diagnosis is suggested above, which, first of all, emphasizes differences in shell convexity between *Weyla* s.s. and *W. (Lywea)*, and permits more subgeneric variability in the style of ornamentation. This allows assignment of all known Canadian species of *Weyla* to two subgenera, *W. (Weyla)* and *W. (Lywea)*.

Weyla (Lywea) unca (PHILIPPI 1899)

Pl. 16, Figs. 4, 6, 7, 9, 10; Pl. 18, Figs. 7, 10, 13; Pl. 19, Figs. 4, 6; Text-fig. 10

1899 *Pecten uncus* sp. nov. - PHILIPPI: 30, pl. 17, fig. 3.
1987b *Weyla (Lywea) unca* (R. PHILIPPI 1899) - DAMBORENEA: 187, pl. 12, fig. 4, pl. 13, figs. 1-11, text-fig. 25 (see for extensive synonymy list).
v 1987b *Weyla (Lywea) meeki* nov. nom. - DAMBORENEA: 186, 189, text-fig. 26.
v 1994 *Weyla (Lywea) unca* (PHILIPPI 1899) - ABERHAN: 46, pl. 23, fig. 5, pl. 24, fig. 2, pl. 25, fig. 2 (see for synonymy list).
v 1994 *Weyla (Lywea)* aff. *unca* (PHILIPPI 1899) - ABERHAN: 46, pl. 24, fig. 1.
v 1998 *Weyla (Lywea) unca* (PHILIPPI) - ABERHAN: fig. 4F.

Material. *Weyla (Lywea) unca* has been found at the following GSC localities: 20118; 31417 (including GSC 112587); 43661; 64821; 69414; 69415; 79693; 84189; 84190 (including GSC 112586); 85333; 85449; 86264 (including GSC 112352); 88602 (including GSC 112557); 89090; 90981 (including GSC 112560); 93184; C-53514 (GSC 112580); C-81971 (GSC 112558, 112559, 112561); C-81972; C-81974; C-90901 (GSC 112579); C-90921; C-90924; C-90930. Predominantly as external moulds and in shell preservation.

Stratigraphic range. Sinemurian to Pliensbachian.

Description. *Weyla (Lywea) unca* belongs to the biconvex group of species of *Weyla*. The right valve, which is higher than long, is more strongly convex than the left valve, which is longer than high. Both valves carry 11 to 14 radial ribs. Both ribs and inter-

EXPLANATION OF PLATE 18

Figs. 1, 3, 8, 9. *Modiolus (Modiolus) mandannaensis* (LEES 1934). 1. Figured specimen GSC 112569 from GSC locality C-81311; Sinemurian of Laberge area, southern Yukon. Exterior view of right valve; x 1.5. 3. Figured specimen GSC 112570 from GSC locality 10243; ?Sinemurian of Laberge area, southern Yukon. Internal mould of right valve; x 1.5. 8. Figured specimen GSC 112571 from GSC locality C-81311; Sinemurian of Laberge area, southern Yukon. Exterior view of right valve; x 1.5. 9. Figured specimen GSC 112572 from GSC locality 10243; ?Sinemurian of Laberge area, southern Yukon. Internal mould of left valve; x 1.5.

Figs. 2, 4, 5. *Weyla (Lywea) yukonensis* sp. nov. 2. Paratype GSC 112573 from GSC locality 84187; Upper Sinemurian of Smithers area, British Columbia. Internal mould of right valve with relict shell material attached; x 1. 4. Paratype GSC 112574 from GSC locality 10247; Lower Jurassic of Laberge area, southern Yukon. External mould of left valve; x 1. 5a, b. Paratype GSC 112575 from GSC locality 19419; Lower Jurassic of Nootka Sound area, British Columbia. a, exterior view of right valve; b, exterior view of left valve; x 1.

Figs. 6, 11, 12. *Modiolus (Modiolus)* cf. *scalprum* J. SOWERBY 1821. 6. Figured specimen GSC 112576 from GSC locality 62403; Hettangian of Taseko Lakes area, British Columbia. Internal mould of left valve; x 1. 11. Figured specimen GSC 112577 from GSC locality 94240; Lower Sinemurian of Taseko Lakes area, British Columbia. Internal mould of right valve; x 1. 12. Figured specimen GSC 112578 from GSC locality C-90901; Lower Pliensbachian of Spatsizi area, British Columbia. Internal mould of right valve with relict shell material attached; x 1.

Figs. 7, 10, 13. *Weyla (Lywea) unca* (PHILIPPI 1899). 7. Figured specimen GSC 112352 from GSC locality 86264; Upper Hettangian or Lower Sinemurian of Iskut River area, British Columbia. Latex cast of left valve; x 1.2. 10. Figured specimen GSC 112579 from GSC locality C-90901; Lower Pliensbachian of Spatsizi area, British Columbia. Latex cast of right valve; x 1.2. 13. Figured specimen GSC 112580 from GSC locality C-53514; Upper Pliensbachian of Ashcroft area, British Columbia. Exterior view of right valve; x 1.2.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spaces between ribs are V-shaped in cross-section. Towards the anterior, ventral, and posterior margins the ribs become lower on both valves. Commonly, several ribs are more prominent than others on left valves.

Remarks. *Weyla (Lywea) unca* has been described more fully by DAMBORENEA (1987b) and ABERHAN (1994), and therefore only its most important features are repeated in the description given above. *W. unca* has strong affinities to *Weyla meeki*, which is analyzed in more detail above. Although *W. unca* tends to have less numerous ribs than *W. meeki*, their range in rib numbers overlaps slightly. Nevertheless, left valves of both species can be distinguished fairly easily. Whilst the left valve of *W. unca* is clearly convex, that of *W. meeki* is more or less flat. In both species, the left valve ribs are acutely triangular in cross-section. In *W. unca*, however, the interspaces between ribs remain V-shaped throughout all ontogenetic stages, whereas in *W. meeki* the interspaces become slightly rounded especially towards the ventral margin. The accentuation of various ribs in left valves was regarded as a typical feature of *W. unca* (DAMBORENEA 1987b). Though this a common feature, it is neither developed in all left valves nor is it restricted to *W. unca*. For example, this pattern is also evident in several left valves of *Weyla alata* from the Lower Jurassic of northern Chile.

Differences between right valves of *W. unca* and *W. meeki* are much more subtle, and in less well preserved specimens a distinction may be impossible. In *W. unca* the cross-sections of ribs and interspaces are V-shaped on all parts of the shell surface, and consequently the growth lines and the ventral margin have a zig-zag appearance. In contrast, ribs and interspaces in *W. meeki* are triangular in cross-section with a tendency towards slightly rounded crests of ribs and bottoms of interspaces. This gives rise to a somewhat more sinuous development of both growth lines and ventral margin. In addition, the ribs of *W. unca* become distinctly flatter towards the ventral margin, whereas in *W. meeki* their ontogenetic increase in height corresponds to their concomitant increase in width.

Weyla (Lywea) yukonensis sp. nov.

Pl. 16, Fig. 1; Pl. 17, Figs. 5-6; Pl. 18, Figs. 2, 4, 5; Pl. 19, Figs. 1, 3, 5, 7; Text-figs. 14-15

v 1998 *Weyla* sp. A - Aberhan: fig. 4H.

Derivation of name. After southern Yukon, where the holotype was found. In an unpublished sketch on the "phylogeny of the Lower Jurassic pecten *Weyla*", SIMON W. MULLER referred to this species as *W. yukonensis* and his suggestion is followed here.

Holotype. GSC 112354 from GSC locality 10248, articulated specimen, figured on Pl. 17, Figs. 5a-d.

Additional material. 1 left valve and 2 articulated specimens from GSC locality 10244; 1 left valve (GSC 112574) from GSC locality 10247; 1 right valve and 1 articulated specimen (GSC 112582) from GSC locality 10248; 1 articulated specimen (GSC 112575) from GSC locality 19419; 2 right valves (including GSC 112581) and 2 articulated specimens (including GSC 112584) from GSC locality 28500; several valves (including GSC 112568) from GSC locality 42091; 7 left valves and 8 right valves (including GSC 112552, 112573) from GSC locality 84187; 1 left valve (GSC 112583) from GSC-locality 84193; 4 left valves and 1 right valve from GSC locality C-81308; 2 left valves and 2 right valves from GSC locality C-81316; several left and right valves from GSC locality C-186954. In shell preservation and as internal and external moulds.

Measurements (in mm).

	L	H	I	UA
GSC 112354 (2v)	93	~83	~45	116°
GSC 112568 (rv)	59	51	~20	113°
GSC 112573 (rv)	~117	~117	~49	-
GSC 112575 (2v)	71	70	38	122°

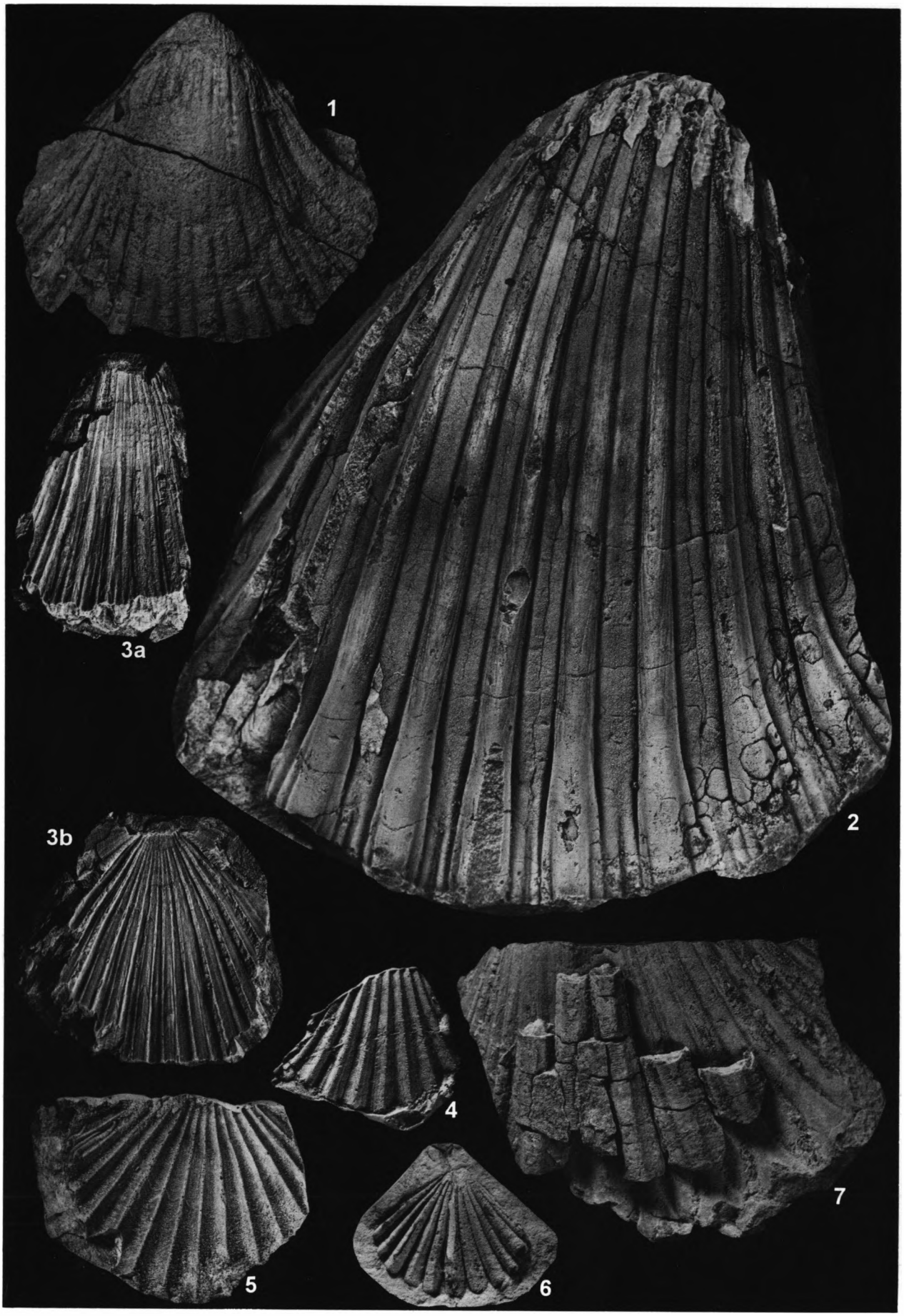
Stratigraphic range. Hettangian to Sinemurian.

EXPLANATION OF PLATE 19

Figs. 1, 3, 5, 7. *Weyla (Lywea) yukonensis* sp. nov. 1. Paratype GSC 112581 from GSC locality 28500; Lower Jurassic of Glenlyon area, Yukon. Internal mould of right valve; x 1. 3a, b. Paratype GSC 112582 from GSC locality 10248; Lower Sinemurian of Laberge area, southern Yukon. a, interior view of right valve; b, interior view of left valve; x 1. 5. Paratype GSC 112583 from GSC locality 84193; Upper Sinemurian of Smithers area, British Columbia. Latex cast of left valve; x 1. 7. Paratype GSC 112584 from GSC locality 28500; Lower Jurassic of Glenlyon area, Yukon. Internal mould and shell of right valve of articulated specimen; x 1.

Fig. 2. *Weyla (Weyla) bodenbenderi* (BEHRENDSEN 1891). Figured specimen GSC 112585 from GSC locality C-90911; Lower Pliensbachian of Spatsizi area, British Columbia. Internal mould of right valve; x 1.

Figs. 4, 6. *Weyla (Lywea) unca* (PHILIPPI 1899). 4. Figured specimen GSC 112586 from GSC locality 84190; ?Sinemurian of Smithers area, British Columbia. Latex cast of right valve; x 1. 6. Figured specimen GSC 112587 from GSC locality 31417; Lower Jurassic of Nelson area, British Columbia. Latex cast of left valve; x 1.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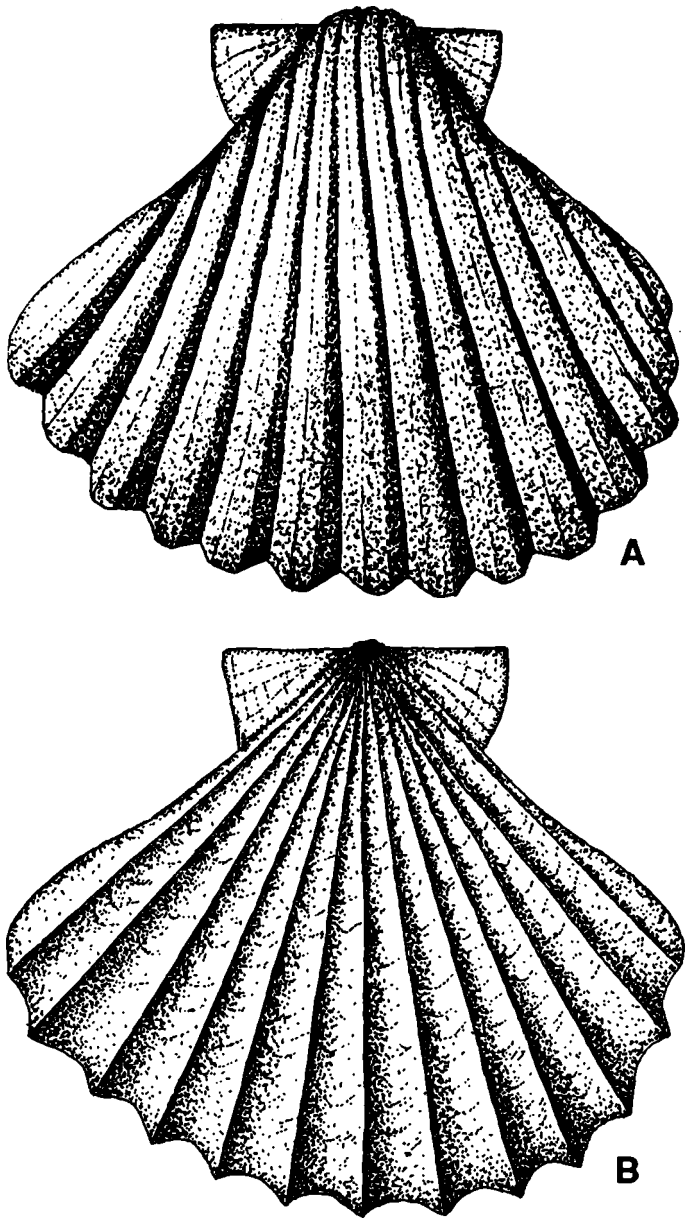


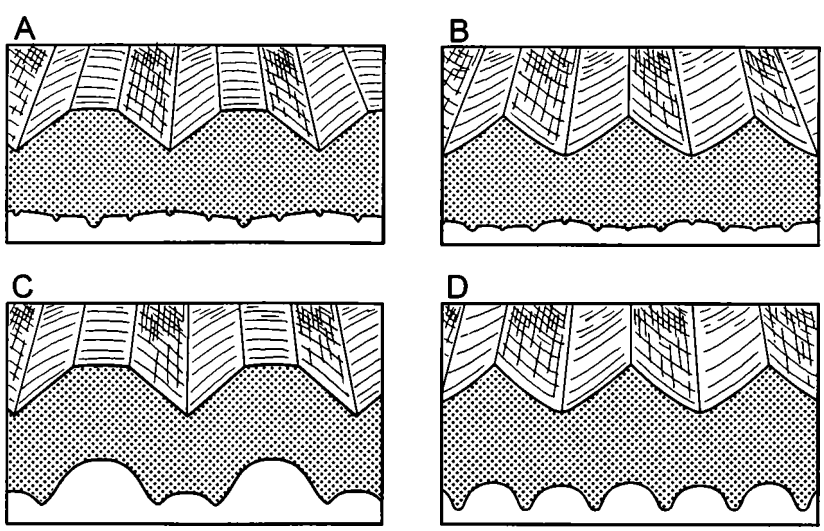
Text-fig. 14. *Weyla (Lywea) yukonensis* sp. nov. A. Reconstruction of exterior view of right valve. B. Reconstruction of exterior view of left valve. Approximately x 1.

Diagnosis. Medium- to large-sized, pectiniform, biconvex shell with the right valve more strongly convex than the left valve. External ornamentation of right valve consisting of broad, prominent radial ribs with flat to slightly rounded crests and moderately steeply dipping flanks; ribs separated by triangular interspaces. External ornamentation of left valve consists of narrow, radial ribs, acutely triangular in cross-section, and separated by interspaces, which are wider than the ribs and have slightly concave bottoms.

Description. Shell of medium to large size, pectiniform, biconvex, thick-shelled; inequivalve, with right valve strongly convex and larger than left valve, which is only moderately convex; length greater than height in both valves. Right valve umbo very prominent, mesogyrous, and projecting distinctly beyond hinge-line; left umbo extends only slightly beyond hinge-line. Auricles large, but incompletely preserved; not delimited from disc of shell by a deep sulcus. Surface of both right auricles convex. Free margin of posterior right auricle meets dorsal margin at an approximately right angle and disc at an acute angle. Surface of left valve posterior auricle feebly convex; its free margin is straight, meeting disc at an acute angle.

Shell surface ornamented with 13 to 15 straight radial ribs, which bifurcate and are different on each valve. Ribs of right valve strong, broad, and in cross-section with flat to slightly rounded crests; flanks of ribs

Internal and external ornamentation of *Weyla (Lywea) yukonensis*



Text-fig. 15. Internal and external ornamentation of *Weyla (Lywea) yukonensis* sp. nov. A. Cross-section of right valve at approximately mid-length from umbo to ventral margin. B. Cross-section of left valve at approximately mid-length from umbo to ventral margin. C. Cross-section of right valve close to ventral margin. D. Cross-section of left valve close to ventral margin.

dipping at a moderately steep angle, which becomes smaller towards ventral margin of shell. Interspaces between ribs triangular in cross-section, becoming somewhat more rounded towards the ventral margin. Ribs of left valve narrow and acutely triangular in cross-section. Interspaces always wider than ribs and with slightly concave bottoms. All auricles carry several fine radial riblets.

Ribs also present on shell interior, but style of ribbing very different from external ornamentation. In both valves each external rib corresponds to a rib on the shell interior. Internal ribs of left valve consisting of very fine, central ridge with flat to very gently outward dipping surfaces on both sides of ridge. Each of these surfaces is separated from interspaces by a narrow, rounded ridge, which forms the most prominent part of each rib (Text-fig. 15B). Interspaces feebly concave and commonly with centrally placed, delicate, radial riblet. Internal mould of left valve often preserved in a way that fill of interspaces and fill between prominent ridges of each rib appear as positive relief. At the ventral margin these fills are about equal in size, and from internal moulds alone it cannot be determined which one correlates with external ribs and interspaces respectively (Text-fig. 15D).

Internal ribs of right valve, also correlating with external ribs, consist of broadly rounded main ridges (Text-fig. 15A). Towards the ventral margin one accompanying ridge branches off on each side of main ridge. Interspaces feebly concave with a centrally placed, low, radial riblet. Towards the ventral margin the main ridges become continuously weaker, and finally the pattern of ribs and interspaces is reversed and an interspace is developed corresponding to the position of main ridges of earlier growth stages (Text-fig. 15C).

Resilifer of left valve wide and deep, triangular in outline, and centrally placed just ventral to umbo on a surface that dips slightly towards interior of right valve. Ventral parts of inner surface of both left auricles with several auricular crura that are sub-parallel to dorsal margin. Other internal characters unknown.

Remarks. The only other known species of *Weyla* with a biconvex shell is *W. (Lywea) unca* (PHILIPPI 1899). The latter can be readily distinguished from *W. yukonensis* by its ornamentation, which consists of V-shaped ribs and interspaces on both valves. Similarly, *W. meeki* can be separated from *W. yukonensis* by the presence of triangular ribs and interspaces on both valves. In addition, the left valve of *W. meeki* is flat.

The strongly convex right valves of *W. alata* and *W. bodenbenderi* differ from right valves of *W. yukonensis* by the development of slightly concave to flat interspaces between ribs rather than triangular interspaces as is typical of *W. yukonensis*. Left valves of *W. alata* and *W. bodenbenderi* are flat and in this respect differ from the convex left valves of *W. yukonenesis*. Furthermore, *W. yukonensis* lacks the flanking riblets typical of left valves of *W. alata*, and, in contrast to left valves of *W. bodenbenderi*, its ribs are triangular in cross-section rather than flat-topped.

Subclass Isofilibranchia IREDALE 1939

Order Mytiloida FÉRUSSAC 1822

Family **Mytilidae** RAFINESQUE 1815

Genus *Modiolus* LAMARCK 1799

Subgenus *Modiolus* LAMARCK 1799

Type species. *Mytilus modiolus* LINNÉ 1758; by subsequent designation (GRAY 1847).

Modiolus (Modiolus) mandannaensis (LEES 1934)

Pl. 17, Fig. 1; Pl. 18, Figs. 1, 3, 8, 9

v 1934 *Modiola mandannaense* sp. nov. - LEES: 43, pl. 4, fig. 3.
v 1934 *Mytilus (Pharomytilus)* near *glendayi* WEIR - LEES: 43, pl. 4, fig. 4.
v 1964 *Modiola mandannaense* LEES - FREBOLD: pl. 3, fig. 7 (refigured from LEES 1934: pl. 4, fig. 3).

Material. 4 left valves (including GSC 112572), 2 right valves (including GSC 112570), and 2 articulated specimens from GSC locality 10243; 1 left valve and 2 right valves from GSC locality 10246; 3 left valves and 1 right valve from GSC locality 95015; 9 left valves (including GSC 112563) and 5 right valves (including GSC 112569, 112571) from GSC locality C-81311. Predominantly as internal moulds and in shell preservation.

Stratigraphic range. Sinemurian.

Description. *Modiolus (M.) mandannaensis* is characterized by a fairly sharp umbonal ridge, which extends from the umbo to the postero-ventral corner of the shell and which is preceeded anteriorly by a shallow sulcus. The ornament consists of commarginal growth lines and irregularly spaced rugae, the latter being restricted to an area postero-dorsally of the umbonal ridge; a radial ornament is absent. Due to the presence of a shallow sulcus, the ventral margin is slightly sinuous.

Remarks. Examination of the specimens studied by LEES (1934) shows that morphological differences between *Modiola mandannaense* (LEES 1934: 43, pl. 4, fig. 3) and *Mytilus (Pharomytilus)* near *glendayi*

WEIR (LEES 1934: 43, pl. 4, fig. 4) are due to post-depositional distortion and both taxa belong to the same species, i.e. *Modiolus mandannaensis*. Deformation was such that in the former the size of the antero-dorsal region was increased and the strength of the umbonal ridge became reduced. In *Mytilus (Pharomytilus)* near *glendayi*, in contrast, deformation resulted in reduction of the region anterior to the ridge and a produced ridge. In this respect, the specimens figured in the present monograph are intermediate.

The very similar *Modiolus (M.) glendayi* (WEIR 1929: 29, pl. 2, fig. 14; JAITLY et al. 1995: 203, pl. 21, figs. 10-11, pl. 22, figs. 1-3) is a typical faunal element of the southern margin of the Tethys. In contrast to *M. mandannaensis*, its commarginal rugae are much more conspicuous and extend onto a rather broad umbonal ridge.

Modiolus (Modiolus) cf. *scalprum* J. SOWERBY 1821

Pl. 17, Figs. 2-4, 7; Pl. 18, Figs. 6, 11, 12

cf. 1821 *Modiola scalprum* sp. nov. - J. SOWERBY: 87, pl. 248, fig. 2.
v 1934 *Modiola* aff. *scalpra* (GOLDFUSS) - LEES: 44, pl. 4, fig. 5.
v 1991 *Modiolus* sp. - POULTON: 25, pl. 9, fig. 5.
1992 *Modiolus* sp. - THOMSON & SMITH: pl. 2, fig. 7a-b.

Material. 2 left valves (including GSC 112576) and 3 steinkerns (including GSC 112565) from GSC locality 62403; 1 left valve from GSC locality 88525; 1 steinkern (GSC 112566) from GSC locality 94205; 1 left valve, 2 right valves (including GSC 112577), and 2 steinkerns (including GSC 112567) from GSC locality 94240; 1 steinkern from GSC locality C-80232; 2 right valves (including GSC 112578) from GSC locality C-90901; 1 left valve from GSC locality C-90903; 1 left valve from GSC locality C-117277; 1 left valve (GSC 112564) from GSC locality C-117279. Predominantly preserved as internal moulds.

Stratigraphic range. Hettangian to Toarcian.

Description. Characteristic features of *Modiolus (M.)* cf. *scalprum* are an elongated shape with the dorsal and ventral margins more or less sub-parallel to each other, and the presence of a low and broad umbonal ridge, which is not preceeded by a sulcus anteriorly.

Remarks. From the vast number of nominal species of Jurassic *Modiolus*, the Canadian specimens have strongest affinities to *Modiolus (M.) scalprum* from the Sinemurian to Pliensbachian of Europe (e.g. J. SOWERBY 1821: 87, pl. 248, fig. 2; PHILLIPS 1871: 136, pl. 8, fig. 22). Compared to European representatives, the posterior region of the shell is more extended in many Canadian specimens and for this reason the latter are placed in *M. scalprum* only with reservation.

In comparison, *M. (M.) mandannaensis* (LEES) exhibits a much more distinct carina preceeded by a sulcus, and its dorsal margin is much shorter.

Acknowledgements

I would like to thank T.P. POULTON (Geological Survey of Canada, Calgary), H.W. TIPPER (Geological Survey of Canada, Vancouver), G.K. JAKOBS (University of British Columbia, Vancouver), and J. PÁLFY (University of British Columbia, Vancouver) for providing access to the GSC collections in Calgary and Vancouver as well as for numerous valuable informations on GSC fossil localities. Additional thanks are due B. RUTLEY, Calgary, and H. SCHÖNIG and B. SCHROEDER, both Würzburg, who carried out the photographic work. I am particularly thankful to M. STRENG, University Würzburg, for drawing most of the fossil reconstructions, to B. KRISCH, Würzburg and M. HRUDKA, Edmonton, for the translation of Russian bivalve literature, to C.M. TANG (University of California Museum of Paleontology, Berkeley) for arranging the loan of type material, and to W. WERNER (Bayerische Staatssammlung für Paläontologie und Historische Geologie, Munich) for the supply of obscure bivalve literature. Finally, I would like to thank F.T. FÜRSICH and M. HEINZE (both University Würzburg), and T.P. POULTON, who critically read various parts of the manuscript. The study was financially supported by a postdoctoral grant from the Deutsche Forschungsgemeinschaft (Fu 131/17-1).

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Appendix I

List of GSC fossil localities in the Canadian Cordillera yielding Early Jurassic bivalves

Details of the GSC fossil localities include, where available, collector; year; field number; name and short description of locality; latitude; longitude; name of 1:250000 scale map sheet; and age (zone/assemblage if known). All collections are deposited in the Geological Survey of Canada.

GSC loc. 324. C.W. Drysdale, 1912. Field No. D-84. West shore of Thompson River, opposite from Lowell Ranch, 1.6 km north of old mill, mouth of Bonaparte Creek; Ashcroft map-area; Late Pliensbachian, Kunae Zone.

GSC loc. 6577, 6578. F.H. McLearn, 1915. North slope of Bluff Mountain, on brook flowing west along north face of Bluff Mountain; Fernie map-area; Sinemurian(?).

GSC loc. 10080. C.H. Crickmay, 1939. Tyaughton Lake area, 8 km east of Gun Creek and about 1.6 km south of Spruce Lake; Pemberton map-area; Late Sinemurian.

GSC loc. 10109. C.H. Crickmay, 1939. Field No. 1353. Tyaughton Lake area, Last Creek tributary, elevation 2050 m; Taseko Lakes map-area; Early Sinemurian probably.

GSC loc. 10240. E.J. Lees, 1930. Laberge area, 6.5 km southeast of the southern end of Frank Lake, in sandstone west of contact with limestone belt; Laberge map-area; Early Jurassic.

GSC loc. 10243. E.J. Lees, 1930. Laberge area, 4.8 km southeast of the southern end of Frank Lake; Laberge map-area; Sinemurian probably.

GSC loc. 10244. E.J. Lees, 1930. Laberge area, 4.8 km southeast of the southern end of Frank Lake, on higher hills west of the limestone belt; Laberge map-area; Sinemurian probably.

GSC loc. 10246. E.J. Lees, 1930. Laberge area, 0.8 km west of lot 74; Laberge map-area; Sinemurian(?).

GSC loc. 10247. E.J. Lees, 1930. Laberge area, same locality as lot 74 and 5 m above it; Laberge map-area; Sinemurian(?).

GSC loc. 10248. E.J. Lees, 1930. Laberge area, higher hills on east side of the western branch of Mandanna Lake; Laberge map-area; Early Sinemurian.

GSC loc. 13086. W.E. Cockfield, 1946. East of Fish Lake; Whitehorse map-area; Toarcian probably.

GSC loc. 13096. W.E. Cockfield, 1946. South slope of Golden Horn Mountain; Whitehorse map-area; Toarcian probably.

GSC loc. 14269. O.A. Erdman, Gulf Research, 1944. Field No. E266. Alexo area, west side of Saunders sheet on ridge east of 2022 m peak of Alexo sheet, 130 m west of Cadomin signal; Brazeau map-area; Sinemurian.

GSC loc. 14270. O.A. Erdman, Gulf Research, 1944. Field No. E312. Alexo area, upper part of creek south of Lundine Creek, 100 m up creek from Cadomin-Nikanassin contact; Brazeau map-area; Sinemurian(?).

GSC loc. 14276. O.A. Erdman, Gulf Research, 1944. Field No. E244. Alexo area, west margin of Alexo sheet, on first creek north of Lundine Creek, 70 m below Cadomin-Nikanassin contact; Brazeau map-area; Early Jurassic.

GSC loc. 14333. C.S. Lord, 1945. Field No. FT28d. 3.2 km south of Dewar Peak; McConnell Creek map-area; Pliensbachian.

GSC loc. 14437. J. Spivak, 1944. Pierre Greys Lakes map sheet; Mount Robson map-area; Early Pliensbachian probably.

GSC loc. 14713. C.O. Hage, 1943. Pink Mountain, the "notch", from 30 cm of conglomerate limestone, Alaska Highway; Halfway River map-area; Sinemurian.

GSC loc. 14716. C.O. Hage, 1943. Pink Mountain Pass, south side, about 14.5 km north of Halfway River, close to crest of Pink Mountain anticline, Alaska Highway; Halfway River map-area; Late Pliensbachian.

GSC loc. 14718. C.O. Hage, 1942. Field No. D16. Dyson Creek, south of Burn's Mine; Kananaskis Lakes map-area; Toarcian.

GSC loc. 14720. H.H. Beach, 1941. Top of mountain immediately south of Marble Mountain; Brazeau map-area; Sinemurian probably.

GSC loc. 18925. H. Frebold, 1950. Adanac Mine road, east limb of anticline; Fernie map-area; Toarcian.

GSC loc. 19040. J.A. Jeletzky, 1950. Field No. 100/9. 1 km north of mouth of Tatchu Creek; taken from lowermost beds of sandstone horizon; 49°53'31"N; 127°10'30"W; Nootka Sound map-area; Pliensbachian.

GSC loc. 19303. J.A. Jeletzky, 1950. Field No. 100-56-a. 6 to 6.5 km west of the tip of Seal Point, taken at east shore of shallow channel between the rocky fringe around Seal Point and the first rocky islet offshore in a bed of shale about 1.2 m thick; Nootka Sound map-area; Early Jurassic.

GSC loc. 19365. J.A. Jeletzky, 1950. Flat rocky bench below high tide mark, 100-300 m from the tip of Seal Point, beyond fault zone; Nootka Sound map-area; Late Pliensbachian.

GSC loc. 19373. J.A. Jeletzky, 1950. Field No. 116/6. About 30 m south of Liver Point; Nootka Sound map-area; Late Pliensbachian.

GSC loc. 19374. J.A. Jeletzky, 1950. Field No. 100/36. About 50 m south of the tip of Seal Point and about 1 km north of the mouth of Black Bear Creek; Nootka Sound map-area; Pliensbachian.

GSC loc. 19376. J.A. Jeletzky, 1950. Field No. 115/7. 2 m from the tip of gravel spit terminating Liver Point; Nootka Sound map-area; Pliensbachian(?).

GSC loc. 19382. Jeletzky, 1950. Field No. 118/1. Lowermost exposed siltstone on Kidney Point; Nootka Sound map-area; Early Jurassic.

GSC loc. 19392. J.A. Jeletzky, 1950. About 50 m west of the tip of Seal Point; Nootka Sound map-area; Early Jurassic.

GSC loc. 19395. J.A. Jeletzky, 1950. Field No. 100/56c. About 60 m west of the tip of Seal Point; Nootka Sound map-area; Late Pliensbachian.

GSC loc. 19397. J.A. Jeletzky, 1950. Field No. 122/1. Northwestern shore of broad bay between Mushroom Point and the one farther south; 49°55'30"N; 127°12'10"W; Nootka Sound map-area; Early Jurassic.

GSC loc. 19398. J.A. Jeletzky, 1950. Field No. 122/4. Southern extremity of Hoadley Point; Nootka Sound map-area; Early Jurassic.

GSC loc. 19399. J.A. Jeletzky, 1950. 200 m north of the tip of Seal Point; Nootka Sound map-area; Early Jurassic.

GSC loc. 19419. J.A. Jeletzky, 1950. Field No. 85/2. West side of Funny Point; Nootka Sound map-area; Early Jurassic, Sinemurian probably.

GSC loc. 19557. B.R. McKay, 1939. Opposite the George Creek valley; Brazeau map-area; Early Toarcian, Falciferum Zone.

GSC loc. 19568. H.H. Beach, 1944. Field No. No. 10. Headwaters of Collie Creek, Hay Mountain; Wapiti map-area; Pliensbachian(?).

GSC loc. 19569. H.H. Beach, 1944. Field No. 11. West Smoky region, on a tributary of Whistlers Creek, 3.2 km southwest of Big Cave Cabin; Canoe River map-area; Pliensbachian.

GSC loc. 19572. R.G. McConnell, 1886. Field No. 98. 5 km north of Devils Lake, 5 km east of Cascade Trough; Calgary map-area; Toarcian(?).

GSC loc. 19578. W.E. Cockfield, 1931. Field No. Lot E. Seven Mile Creek, 1.5 km above junction with Quesnel River; Quesnel Lake map-area; Early Sinemurian probably.

GSC loc. 20013. D.J. McLaren, 1951. Field No. 11-6a. Falls of Snake Indian River; Edson map-area; Early Sinemurian.

GSC loc. 20118. H.W. Tipper, 1951. Field No. 3-51T. 0.4 km west of the outlet of Bryant Arm on Tetachuk Lake; Nechako River map-area; Early Jurassic.

GSC loc. 20306. J.O. Wheeler, 1951. Field No. 51/F/19. Whitehorse area, on Gray Ridge, directly east of Annie Lake, elevation 1070 m; Whitehorse map-area; Pliensbachian-Toarcian boundary(?).

GSC loc. 20318. J.O. Wheeler, 1951. Field No. F-3-W. 5 km northeast of Dundalk, elevation 1980 m; 60°05'06"N;

134°46'15"W; Whitehorse map-area; Toarcian.
GSC loc. 21052. H. Frebold, 1951. Field No. Mo.-1-51. Morris Creek, west of Fiddle Creek Road; Brazeau map-area; Early(?) Pliensbachian.
GSC loc. 21387. H. Frebold, 1952. Field No. Mo.-2-52. Morris Creek Bridge; Brazeau map-area; Early(?) Pliensbachian.
GSC loc. 21402, 21696. H. Frebold, 1952. Field Nos. Sn2-d, Sn-2. Bridge crossing Snake Indian River; Edson map-area; Sinemurian.
GSC loc. 21697. H. Frebold, 1952. Field No. Sn-2b. Snake Indian River, about 0.8 km from the bridge crossing river; Edson map-area; Sinemurian.
GSC loc. 21700. H. Frebold, 1952. Field No. Sn-3. Bridge crossing Snake Indian River; Edson map-area; Pliensbachian.
GSC loc. 22702. D. Kingston, Sun Oil, 1952. Snake Indian River, black shale zone; Edson map-area; Early Toarcian.
GSC loc. 22709. D. Kingston, Sun Oil, 1952. Prine Creek, Edson map-area; Sinemurian or Pliensbachian.
GSC loc. 22713. H. Belyea, Hudson's Bay Union Eaglesham, 1952. Field No. 1, 5-13-77-26W5. Drill hole, 1074 m depth; Winagami map-area; Pliensbachian probably.
GSC loc. 22765, 22766, 22768, 22769. Hudson's Bay Union Eaglesham, 1953. Field No. 2, 6-32-77-25W5. Drill hole, 1064.1 m depth, 1065 m depth, 1050 m depth, 1048 m depth; Whitecourt map-area; Pliensbachian probably.
GSC loc. 23015. Evans, 1928. Field No. Rm.25-3. At forks of Ram River; Rocky Mountain House map-area; Sinemurian or Pliensbachian.
GSC loc. 23030. H. Frebold, 1953. Field No. CUC53. Cuthead Creek, near construction camp, 27 km north of Minnewanka Wardens Cabin; Calgary map-area; Sinemurian.
GSC loc. 23130. H. Frebold, 1953. Field No. Snb. Bridge crossing Snake Indian River; Edson map-area; Sinemurian.
GSC loc. 23131, 23242. H. Frebold, 1953. Field Nos. Bi-53, Bi-2-53. Bighorn Creek; Calgary map-area; Late Pliensbachian.
GSC loc. 24311. J.A. Jeletzky, 1954. Field No. 244-9. 300 m northwest of Monkey Creek, south shore of Quatsino Sound; Nootka Sound map-area; Early Pliensbachian.
GSC loc. 24692. E.J.W. Irish, 1954. Adams Lookout West, 2.5 km up creek entering Sulphur River from east, just below junction of Sulphur River and Southern Sulphur River; Edson? map-area; Sinemurian.
GSC loc. 24701. E.J.W. Irish, 1954. Field No. 5. Canyon of Ziggy Creek; Mount Robson map-area; Sinemurian or Pliensbachian.
GSC loc. 24838. J.O. Wheeler, 1954. Field No. Idaho-9. On ridge between Idaho Hill and Mountain Bush, elevation 1590 m; 60°18'57"N; 135°02'42"W; Whitehorse map-area; Pliensbachian.
GSC loc. 25592. H. Frebold, 1955. Field No. A3-55. Adanac Mine road; Fernie map-area; Sinemurian(?).
GSC loc. 27193. Triad Oil Co., 1955. Field No. F.A. 172. Clearwater Range, Fall Creek; Golden map-area; Sinemurian (or possibly Early Pliensbachian).
GSC loc. 28500. J.O. Wheeler, 1956. Field No. 56-2. On west side of Peak 734 m on Yukon River; 300 m north of Collection 56-1; Glenlyon map-area; Early Jurassic, Sinemurian probably.
GSC loc. 28809. Triad Oil Co., 1956. Field No. FCA-64. Trench Creek; Mount Robson map-area; Pliensbachian(?).
GSC loc. 28814. Triad Oil Co., 1956. Field No. FCA-71. Femme Creek; Mount Robson map-area; Pliensbachian or Toarcian.
GSC loc. 28922. L.H. Green, 1956. Field No. CB 1-3F. West side of Cold Fish Lake; Spatsizi River map-area; Pliensbachian.
GSC loc. 28923. L.H. Green, 1956. Field No. GC-56-M-F2. Ridge due south of north end of Cold Fish Lake; Spatsizi River map-area; Early Pliensbachian.
GSC loc. 31369. E.W. Mountjoy, 1957. Field No. MJ 896. Jacque Pass; Mount Robson map-area; Pliensbachian(?).
GSC loc. 31417. H. Frebold, 1957. Field No. FE-248. Hill northeast of Parks; Nelson map-area; Early Jurassic.
GSC loc. 31420. H. Frebold, 1957. Field No. FE-158.C. Bridge crossing Snake Indian River; Edson map-area; Toarcian.
GSC loc. 31437. H. Frebold, 1957. Field No. FE-317. Fording River; Fernie map-area; Toarcian.
GSC loc. 31443. H. Frebold, 1957. Adanac Mine road, east limb of Turtle Mountain anticline; Fernie map-area; Toarcian.
GSC loc. 32786. J. Souther, 1957. Field No. SE-23b7. Klastline Plateau, east of Nuttlude Lake; Telegraph Creek map-area; Pliensbachian (or possibly Sinemurian).
GSC loc. 36981. A. Sutherland Brown, 1958. Field No. 58-AB-362. Tasu area, Sedgwick Bay; Moresby Island map-area; Sinemurian.
GSC loc. 40241. E.W. Mountjoy, 1959. Field No. MJ-7M. Mouth of Mowitch River; Mount Robson map-area; Early Sinemurian.
GSC loc. 40242. E.W. Mountjoy, 1959. Field No. MJ-264. Blue Creek area; head of Deer Creek; Mount Robson map-area; Early Sinemurian.
GSC loc. 40422. J. Souther, 1959. Field No. DH-132A-59. South of west end of King Salmon Lake, elevation 1480 m; 58°39'58"N; 132°54'30"W; Tulsequah map-area; Late Pliensbachian, Kunae Zone.
GSC loc. 40423. J. Souther, 1959. Field No. SE Dh131c-59. 3 km south of King Salmon Lake; Tulsequah map-area; Late Pliensbachian, Kunae Zone.
GSC loc. 40424. J. Souther, 1959. Field No. DH131b-59. Traverse 41-59, south of west end of King Salmon Lake, elevation 1467 m; 58°41'09"N; 132°55'04"W; Tulsequah map-area; Late Pliensbachian, Kunae Zone.
GSC loc. 40425. J. Souther, 1959. Field No. SE41B59. 1.5 km west of Hidden Lake; Tulsequah map-area; Late Pliensbachian.
GSC loc. 40430. J. Souther, 1959. Field No. SE98a-59. West end of One-Way Lake; 58°37'39"N; 132°33'42"W; Tulsequah map-area; Early Toarcian.
GSC loc. 40438. J. Souther, 1959. Field No. D.H. 137a-59. South of west end of King Salmon Lake, elevation 1455 m; 58°41'13"N; 132°13'42"W; Tulsequah map-area; Early Toarcian.
GSC loc. 40451. J. Souther, 1959. Field No. DH 135b-59. Ridge 3 km south of King Salmon Lake; Tulsequah map-area; Late Pliensbachian.
GSC loc. 40472. J. Souther, 1959. Field No. SE-117a-59. 3 km southwest of King Salmon Lake; Tulsequah map-area; Early Jurassic.
GSC loc. 40473. J. Souther, 1959. Field No. SE-125a-59. 0.8 km southwest of Harrison Lake; 58°36'10"N; 132°35'48"W; Tulsequah map-area; Late Pliensbachian.
GSC loc. 40941. A. Sutherland Brown, 1959. Field No. 59 AB 66. Lomgon Bay; Moresby Island map-area; Sinemurian.
GSC loc. 42091. E.W. Mountjoy, 1960. Field No. MJ-E150. Strawberry Creek; Mount Robson map-area; Sinemurian.
GSC loc. 42530. E.J.W. Irish, 1960. Field No. IA-M7. 0.8 km north of second base camp on Graham River; Halfway River map-area; Sinemurian(?).
GSC loc. 43660. J. Souther, 1960. Field No. SE-88b-60. 3 km south of King Salmon Lake; 58°40'42"N; 132°55'45"W; Tulsequah map-area; Late Pliensbachian, Kunae Zone.
GSC loc. 43661. J. Souther, 1960. 3 km south of King Salmon Lake; Tulsequah map-area; Early Jurassic.
GSC loc. 43668. J. Souther, 1960. Field No. MP-154b-60. Bug Mountain; 58°41'45"N; 133°04'24"W; Tulsequah map-area; Late Pliensbachian, Kunae Zone.
GSC loc. 44413. G.W.H. Norman, Newmont Min., 1960. Field No. 3. Unuk River area, Cassiar District; 56°35'N; 130°21'W; Iskut River map-area; Early Jurassic.
GSC loc. 44419. G.W.H. Norman, Newmont Min., 1960. Field No. 9. Unuk River area, Cassiar District; 56°34'N; 130°25'W; Iskut River map-area; Early Sinemurian probably.
GSC loc. 45111. H.W. Little, 1961. Field No. LF61-F8. Bath Creek Road from Fruitvale; Nelson map-area; Early Toarcian.
GSC loc. 48564. A. Sutherland Brown, 1961. Field No. 61-AB-302. Cumshewa to Skidegate Inlets, Queen Charlotte Islands; 53°11'15"; 132°10'30"; Graham Island map-area; Pliensbachian.
GSC loc. 48565. A. Sutherland Brown, 1961. Field No. 61-AB-247. Graham Island; 53°27'N; 132°18'W; Graham Island map-area; Toarcian.
GSC loc. 51225. E.J.W. Irish, 1962. Field No. 1AR62-F26. Trutch

area, bearing 171 degrees, 12 km from peak at elevation 2023 m; Trutch map-area; Early Jurassic.

GSC loc. 51337. E.J.W. Irish, 1962. Field No. 1AR62-F12. Halfway River, bearing 24 degrees, 4.3 km from peak at elevation 2004 m (in saddle); Halfway River map-area; Middle(?) Toarcian.

GSC loc. 51338. E.J.W. Irish, 1962. Field No. 1AR62-F6. Halfway River, bearing 23 degrees, 4.5 km from peak at elevation 2012 m; Halfway River map-area; Early Pliensbachian, Davoei(?) Zone.

GSC loc. 51788. B.R. Pelletier, 1962. Field No. 62-15-PI-B. Hill, 8 km northeast of Mount Stearns and about 13 km north of Halfway River; Trutch map-area; Early Jurassic.

GSC loc. 52223. D. Stott, 1962. Field No. SI-62-3-21. Ridge north of Mount Woolever; Trutch map-area; Sinemurian(?).

GSC loc. 52224, 52226. D. Stott, 1962. Field Nos. SI-62-4-10B, SI-62-3-2. Ridge west of Headstone Creek; Trutch map-area; Early Jurassic.

GSC loc. 52228. D. Stott, 1962. Field No. SI-62-6-13B. Station 6596 between Chawade and Cypress Creeks; Halfway River map-area; Sinemurian probably.

GSC loc. 52229. D. Stott, 1962. Field No. SI-62-5-19. Halfway River, east flank of syncline; 56°55'N; 123°15'W; Halfway River map-area; Early Jurassic.

GSC loc. 52231. D. Stott, 1962. Field No. SI-62-7-3. East flank of anticline south of Nevis Creek; 57°20'N; 123°23'W; Trutch map-area; Early Jurassic.

GSC loc. 52329. A. Sutherland Brown, 1962. Field No. 62AB-34. Skowkona Creek, station 30; Graham Island map-area; Toarcian or Aalenian.

GSC loc. 56416. E.T. Tozer, 1963. Field No. TE-322A. Section at head of Last Creek; Taseko Lakes map-area; Sinemurian.

GSC loc. 62355. H.W. Tipper, 1964. Field No. U-116TD. Last Creek, below limestone, where two main creeks meet; Taseko Lakes map-area; Early Jurassic, Sinemurian probably.

GSC loc. 62362. H.W. Tipper, 1964. Field No. U-107c-TD. Approximately 1.3 km northeast of Castle Mountain; Taseko Lakes map-area; Late Hettangian, Canadensis Zone.

GSC loc. 62370. H.W. Tipper, 1964. Field No. F-6G-222TD. Headwaters of Last Creek; Taseko Lakes map-area; Sinemurian, "Coroniceras" Assemblage.

GSC loc. 62403. H.W. Tipper, 1964. Field No. F3h-222TD. Head of Last Creek, south side; Taseko Lakes map-area; Hettangian.

GSC loc. 62496. H.W. Tipper, 1964. Field No. F-6x-222TD. Headwaters of Last Creek; Taseko Lakes map-area; Early Sinemurian, "Coroniceras" Assemblage.

GSC loc. 64821. H.W. Tipper, 1964. Field No. F2-230-TD. North of Mount Tatlow, 5 km southwest of west end of Konni Lake; Taseko Lakes map-area; Early Sinemurian probably.

GSC loc. 65057. N.C. Ollerenshaw, 1964. Field No. CB-163. Limestone Mountain, west side of forestry road, in gully; 51°55'10"N; 115°25'30"W; Calgary map-area; Sinemurian-Pliensbachian.

GSC loc. 69414. J.A. Coates, 1965. Field No. CU-65-230. Manning Park, on burnt over ridge, 2.8 km north of Hope-Princeton Highway and east of Cambie Creek, elevation 1662 m; 49°08'25"N; 129°50'25"W; Hope map-area; Sinemurian(?).

GSC loc. 69415. J.A. Coates, 1965. Field No. CU-65-230C. Manning Park, on burnt over ridge, 2.8 km north of Hope-Princeton Highway and east of Cambie Creek, elevation 1662 m; 49°08'32"N; 129°50'13"W; Hope map-area; Early Jurassic.

GSC loc. 75323, 75324. H. Frebold, 1966. Field Nos. FE43-a-66, FE43-a-66. Miette area, Morris Creek; Brazeau map-area; Pliensbachian probably.

GSC loc. 77062. N.C. Ollerenshaw, 1966. Field No. OB-66-1-17. Marble Mountain area, Clearwater River; Rocky Mountain House map-area; Sinemurian(?).

GSC loc. 77063. N.C. Ollerenshaw, 1966. Field No. OB-66-1-7. Marble Mountain area, Clearwater River; Rocky Mountain House map-area; Late Pliensbachian(?).

GSC loc. 78595. H.W. Frebold, 1967. Field No. FE-12-67. Lodgepole area, south of Fernie; Fernie map-area; Late Sinemurian.

GSC loc. 78843. H. Frebold, 1967. Field No. FE3-67. Bighorn Creek, at Yahatinda Ranch; Fernie map-area; Early Toarcian.

GSC loc. 79004. H.W. Tipper, 1967. Field No. F1-10F-TD. Mount Waddington area, 1 km east of road and Gymkana Grounds; 51°41'N; 124°23'W; Mount Waddington map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. 79678. H. Frebold, 1966. Field No. FE3-66. Sheeps Head, Wigmore Creek; Calgary map-area; Early Toarcian.

GSC loc. 79680. H. Frebold, 1966. Field No. FE7-66. Sheeps Head; Wigmore Creek; Calgary map-area; Pliensbachian-Toarcian.

GSC loc. 79693. H.W. Tipper, 1967. Field No. F1-10P-TD. Mount Waddington area, 1 km east of road and Gymkana grounds; 51°41'N; 124°23'W; Mount Waddington map-area; Sinemurian or Early Pliensbachian probably.

GSC loc. 79743. H. Frebold, 1967. Field No. FE-4b-67. Bighorn Creek, Yahatinda Ranch area; Fernie map-area; Late Pliensbachian probably.

GSC loc. 79776. H. Frebold, 1966. Field No. FE-15a-66. Sheep Creek, near Red Deer and Panther Rivers; Calgary map-area; Pliensbachian-Toarcian.

GSC loc. 79778. H. Frebold, 1966. Field No. FE-15c-66. Sheep Creek, near Red Deer and Panther Rivers; Calgary map-area; Late Pliensbachian.

GSC loc. 79797. H. Frebold, 1966. Field No. FE-9-66. Limestone Mountain; Kananaskis Lakes map-area; Sinemurian.

GSC loc. 79802. H. Frebold, 1966. Field No. FE-16b,c,d66. Bighorn Creek; Calgary map-area; Late Pliensbachian.

GSC loc. 79915. H. Frebold, 1966. Field No. FE-41-66. Snake Indian River, near the bridge crossing river north of Jasper; Edson map-area; Middle Toarcian.

GSC loc. 79916. H. Frebold, 1966. Field No. FE-41c-66. Syncline at bridge crossing Snake Indian River; Edson map-area; Early Toarcian.

GSC loc. 80831. E.W. Mountjoy, 1967. Field No. 67-MJ-6. Scalp Creek; 51°48'N; 115°39'W; Calgary map-area; Pliensbachian probably.

GSC loc. 82365. E.D. Kindle, 1939. Field No. 52-39. Limestone horizon on Silver Creek Mining Property, 1 km east of Lower Silver Lake, elevation 1680 m; Smithers map-area; Late Sinemurian probably.

GSC loc. 82577. D.F. Stott, 1968. Field No. SI68-1-43B. South of Halfway River; Halfway River map-area; Late Sinemurian or Early Pliensbachian probably.

GSC loc. 82578. D.F. Stott, 1968. Field No. SI62-2-1B. Station 6596 near Cypress Creek; Halfway River map-area; Sinemurian probably.

GSC loc. 82579. D.F. Stott, 1968. Field No. SI68-2-13B. South of Cypress Falls; Halfway River map-area; Pliensbachian(?).

GSC loc. 82845. J.E. Muller, 1968. Field No. 68-43D. North side of Moketas Island, above slide on road; 50°05'12"N; 127°13'00"W; Alert Bay map-area; Early Sinemurian.

GSC loc. 82860. J.E. Muller, 1968. Field No. 68-359D. Point west of Experiment Bight; 50°47'05"N; 128°23'01"W; Cape Scott map-area; Early Jurassic.

GSC loc. 82866. J.E. Muller, 1968. Field No. 68-363D. North side of Cox Island, off Cape Scott; 50°48'18"N; 128°35'00"W; Cape Scott map-area; Early Jurassic.

GSC loc. 82900. J.E. Muller, 1968. Field No. 68-21A. Southeast of McQuarrie Islet; 49°53'45"N; 127°10'50"W; Nootka Sound map-area; Early Jurassic.

GSC loc. 83263. D. Brown, Falconridge Nickel Mines Ltd., 1968. Field No. 26. Telkwa Mountains, between Webster and Goathorn Creeks, about 29 km south of Smithers, elevation 1530 m; Smithers map-area; Late Sinemurian probably.

GSC loc. 83477. D.D. Caimes, 1906. Toric Mountain, 11 km west of Robinson; Laberge map-area; Toarcian(?).

GSC loc. 83995. H.W. Tipper, 1969. Field No. F7TD-1s. Small island 500 m northeast of Snowshoe Island in Babine Lake; 54°54'45"N; 126°10'05"W; Smithers map-area; Late Sinemurian.

GSC loc. 83998. H.W. Tipper, 1969. Field No. F8TD-4s. Small island northeast of Snowshoe Island, 100 m north of Fahrni locality in Babine Lake; 54°54'45"N; 126°10'05"W; Smithers

map-area; Late Sinemurian.
GSC loc. 84001. H.W. Tipper, 1969. Field No. F8TD-5s. Southwest point of Sterrett Island, Babine Lake; 54°54'55"N; 126°13'05"W; Smithers map-area; Early Pliensbachian probably.
GSC loc. 84002. H.W. Tipper, 1969. Field No. F9TD-3. Southwest point of Sterrett Island, Babine Lake; 54°55'15"N; 126°13'05"W; Smithers map-area; Early Pliensbachian probably.
GSC loc. 84047. J. Muller, 1969. Field No. 69-S1-10. Cape Parkins Section; 50°26'46"N; 128°02'52"W; Cape Scott map-area; Sinemurian probably.
GSC loc. 84078. J.E. Muller, 1969. Field No. 69-130A. North side of Cox Island off Cape Scott; 50°48'43"N; 128°34'57"W; Cape Scott map-area; Early Jurassic.
GSC loc. 84160. D.F. Stott, 1969. Field No. SI 69-8-3. Pine Pass, Pine River Bridge, railroad cut, Hart Highway; Pine Pass map-area; Early Sinemurian probably.
GSC loc. 84186. H.W. Tipper, 1969. Field No. F19TD-8. Hudson Bay Mountain, 1.5 km south of Shufer Lake; 54°50'N; 127°21'W; Smithers map-area; Late Sinemurian probably.
GSC loc. 84187. H.W. Tipper, 1969. Field No. F19TD-6. Telkwa Mountains, Hunter Basin between Webster and Goathorn Creeks; 54°31'N; 127°05'W; Smithers map-area; Late Sinemurian probably.
GSC loc. 84188. H.W. Tipper, 1969. Field No. F19TD-4. 14 km northwest of McDonnell Lake; 54°50'N; 127°51'W; Smithers map-area; Late Sinemurian probably.
GSC loc. 84189. H.W. Tipper, 1969. Field No. F11TD-1W. Babine Lake, southwest tip of Sterrett Island below powerline; 54°54'55"N; 120°13'05"W; Smithers map-area; Early Pliensbachian probably.
GSC loc. 84190. H.W. Tipper, 1969. Field No. F8TD-5W. Babine Lake, southwest point of Sterrett Island; 54°54'55"N; 120°13'05"W; Smithers map-area; Sinemurian(?).
GSC loc. 84191. H.W. Tipper, 1969. Field No. F8TD-4W. Babine Lake, small island northeast of Snowshoe Island, 100 m north of Fahrni locality; 54°54'15"N; 126°10'05"W; Smithers map-area; Late Sinemurian.
GSC loc. 84192. H.W. Tipper, 1969. Field No. F8TD-1W. Babine Lake, north end of small island 3 km southeast of Newman Peninsula; 54°53'35"N; 126°10'05"W; Smithers map-area; Sinemurian(?).
GSC loc. 84193. H.W. Tipper, 1969. Field No. F7TD-1W. Babine Lake, small island 500 m northeast of Snowshoe Island; 54°54'45"N; 126°10'05"W; Smithers map-area; Late Sinemurian.
GSC loc. 85098. J.E. Souther, 1970. Field No. SE 2407 69. Telegraph Creek; Telegraph Creek map-area; Toarcian.
GSC loc. 85305. H.W. Tipper, 1969. Field No. F 8 1. Babine Lake, north end of small island 3 km southeast of Newman Peninsula; 54°53'35"N; 126°10'05"W; Smithers map-area; Early Jurassic.
GSC loc. 85326. H.W. Tipper, 1970. Field No. 20-70P-F-TD. Babine Lake, tiny island south of the southwest end of Sterrett Island; 54°55'N; 126°10'W; Smithers map-area; Late Sinemurian.
GSC loc. 85329. H.W. Tipper, 1970. Field No. F-16-70P-1TD. Due east of Deception Lake, on small knobby hill; 54°42'N; 126°41'W; Smithers map-area; Early Pliensbachian.
GSC loc. 85333. H.W. Tipper per R. Park, 1970. Field No. J6-71-HF. Babine Lake, southwest end of Sterrett Island, approximately 100 m to north from barge dock; 54°55'N; 126°11'W; Smithers map-area; Early Pliensbachian probably.
GSC loc. 85334. H.W. Tipper, 1970. Field No. 19-70P-32FTD. Babine Lake, southwest corner of Sterrett Island, east side of barge dock; 54°55'N; 126°11'W; Smithers map-area; Early Pliensbachian probably.
GSC loc. 85335. H.W. Tipper per R. Park., 1970. Field No. 20-70P-2F-TD. Babine Lake, larger of two tiny islands south of SW end of Sterrett Island; 54°55'N; 126°10'W; Smithers map-area; Late Sinemurian.
GSC loc. 85338. H.W. Tipper per R. Park, 1970. Field No. 14-70P-6F-TD. East of Deception Lake; 54°42'N; 126°41'W; Smithers map-area; Early Jurassic.
GSC loc. 85340. H.W. Tipper per R. Park, 1970. Field No. 16-70P-2F-TD. East of Deception Lake, 60 m west of creek and 300 m below chopper landing hill; 54°42'N; 126°41'W; Smithers map-area; Early Jurassic.
GSC loc. 85399. H.W. Tipper, 1970. Field No. 40-70P-1E-TD. In small saddle slightly north of southwest-northeast running ridge on east side of ridge and approximately 3 m from the top; 54°50'N; 127°50'W; Smithers map-area; Late Sinemurian.
GSC loc. 85416. H.W. Tipper, 1970. Field No. 65-70R-4cFTD. Telkwa Mountains, near head of Huston Tommy Creek; 54°23'N; 127°07'W; Smithers map-area; Late Sinemurian probably.
GSC loc. 85418. H.W. Tipper, 1970. Field No. 65-70R-4AFTD. Telkwa Mountains, head of Huston Tommy Creek; 54°23'N; 127°07'W; Smithers map-area; Late Sinemurian probably.
GSC loc. 85424. H.W. Tipper, 1970. Field No. 65-70R-2-FTD. Telkwa Mountains, near head of Houston Tommy Creek; 54°23'N; 127°27'W; Smithers map-area; Late Sinemurian probably.
GSC loc. 85438. H.W. Tipper, 1970. Field No. F19-TD-5. Telkwa Mountains, Hunter Basin between Webster and Goathorn Creeks; Smithers map-area; Late Sinemurian probably.
GSC loc. 85449. H.W. Tipper, 1970. Field No. 35-70P-1F-TD. Dome Mountain, at head of Federal Creek; 54°44'N; 126°38'W; Smithers map-area; Pliensbachian.
GSC loc. 86264. B.C. Dept. of Mines, 1970. Field No. 67-F-10. Iskut-Bowser; 56°33'N; 130°25'W; Iskut River map-area; Late Hettangian or Early Sinemurian possibly, Canadensis Zone possibly.
GSC loc. 86265. B.C. Dept. of Mines, 1970. Field No. 67-F-9. Iskut-Bowser; 56°31'N; 130°26'W; Iskut River map-area; Late Hettangian or Early Sinemurian possibly, Canadensis Zone possibly.
GSC loc. 87382. H.W. Tipper, 1971. Field No. F17-71-N4-TD. Astlais Mountain, 4 km on bearing 337 degrees from peak of Astlais Mountain; Smithers map-area; Early Jurassic.
GSC loc. 88013, 88014. H. Frebold, 1971. Field Nos. FE-1-71, FE-2-71. Bridge crossing Snake Indian River; Edson map-area; Pliensbachian.
GSC loc. 88495. T.P. Poulton, 1971. Field No. PU-24-71-2F. Babine Lake, small island south of Sterrett Island; 54°54'29"N; 126°10'18"W; Smithers map-area; Late Sinemurian.
GSC loc. 88498. T.P. Poulton, 1971. Field No. PU-24-71-6F. Babine Lake, southwest corner of Sterrett Island, just south of ferry landing, just north of causeway; 54°54'55"N; 126°11'W; Smithers map-area; Early Pliensbachian probably.
GSC loc. 88500. T.P. Poulton, 1971. Field No. PU-24-71-8F. Babine Lake, southern half of west coast of Sterrett Island, about 300 m north of ferry landing; 54°55'N; 126°11'W; Smithers map-area; Early Pliensbachian probably.
GSC loc. 88525. T.P. Poulton, 1971. Field No. PU-36-71-1F. Ashman Ridge, Jurassic Ridge 3 km due west of Bud Lake; 54°50'20"N; 127°51'W; Smithers map-area; Late Sinemurian.
GSC loc. 88598. T.P.Poulton, 1971. Field No. PU-40-71-19F. Telkwa Mountains, near head of Houston Tommy Creek, top of NE-facing bluff, about 30 m southeast of limestone reef; 54°22'50"N; 127°07'20"W; Smithers map-area; Late Sinemurian probably.
GSC loc. 88599. T.P. Poulton, 1971. Field No. PU-40-71-20F. Telkwa Mountains, near head of Houston Tommy Creek, calcareous tuff 20 m down a north-facing spur, 700 m northwest of limestone reef; 54°23'N; 127°07'25"W; Smithers map-area; Late Sinemurian probably.
GSC loc. 88601. T.P. Poulton, 1971. Field No. PU-40-71-26F. Telkwa Mountains, near head of Houston Tommy Creek, brow of hill above bulldozer cut, 0.8 km south-southwest of limestone reef; 54°22'35"N; 127°07'20"W; Smithers map-area; Late Sinemurian probably.
GSC loc. 88602. T.P. Poulton, 1971. Field No. PU-40-71-27F. Telkwa Mountains, head of Houston Tommy Creek, Smithers map-area; Late Sinemurian.
GSC loc. 88604. T.P. Poulton, 1971. Field No. PU-43-71-1F. Telkwa Mountains; Smithers map-area; Late Sinemurian

probably.

GSC loc. 88735. H.W. Tipper, 1971. Field No. F5x-71TD. Telkwa Mountains, south side near Houston Tommy Creek; 54°21'N; 127°06'W; Smithers map-area; Late Sinemurian probably.

GSC loc. 89003. W.J. McMillan, 1971. Field No. 8-122A. 50°43'45"N; 121°14'50"W; Ashcroft map-area; Sinemurian probably.

GSC loc. 89010. W.J. McMillan, 1971. Field No. 10-166. Ashcroft; 50°42'N; 121°13'59"W; Ashcroft map-area; Sinemurian or Pliensbachian.

GSC loc. 89090. J.E. Muller, 1970. Field No. 70-19S-ME. Cowichan Lake area, F. P. Logging Road C5, 11.3 km east of Nitinat Lake; 48°49'55"N; 124°31'25"W; Cape Flattery map-area; Early Jurassic.

GSC loc. 89623. T. Richards, 1972. Field No. 72C-1-72D-RW. Bait Range; 55°35'N; 126°25'W; Hazelton map-area; Middle Toarcian.

GSC loc. 89670. T. Richards, 1972. Field No. SK. Mount Cassiar, Skutsil Knob; 55°50'00"N; 126°37'00"W; Hazelton map-area; Sinemurian or Early Pliensbachian probably.

GSC loc. 90785. J. Monger, Field No. MV-73-1546. Lord's fossil locality 13; McConnell Creek map-area; Early Pliensbachian.

GSC loc. 90949. T. Richards, 1973. Field No. 45A-B73-RW. Small ridge northwest of Frypan Peak; 55°29'36"N; 126°19'36"W; Hazelton map-area; Middle Toarcian.

GSC loc. 90952. T. Richards, 1973. Field No. 69A-B73-RW. Headwaters of Driftwood River at sharp jog in creek after long straight stretch; 55°51'15"N; 126°47'45"W; Hazelton map-area; Toarcian.

GSC loc. 90953. T. Richards, 1973. Field No. 70B-B73-RW. Headwaters of Driftwood River, east of Bait Range, at point where stream enters creek from left side; 55°36'N; 126°47'30"W; Hazelton map-area; Middle Toarcian.

GSC loc. 90976. T. Richards, 1973. Field No. 47B-B73-RW. Kotsine River, on east spur of cirque north of Kotsine River and Bait Range; 55°55'75"N; 126°54'18"W; Hazelton map-area; Early Toarcian.

GSC loc. 90981. T. Richards, 1973. Field No. 45A-R73-RW. Frypan Peak; 55°28'N; 126°15'W; Hazelton map-area; Late Sinemurian(?).

GSC loc. 90984. T. Richards, 1973. Field No. 43B-B73-RW. Small ridge northwest or Frypan Peak; 55°29'18"N; 126°19'36"W; Hazelton map-area; Toarcian.

GSC loc. 90986. T.P. Poulton, 1973. Field No. PU-16-73-11F. South end of Nilkitkwa Range, 3 km east of Nilkitkwa River; 55°50'06"N; 126°50'36"W; Hazelton map-area; Early Pliensbachian.

GSC loc. 91052. T. Richards, 1973. Field No. 115C-73-RW. North end of northern Nilkitkwa Range; 55°55'42"N; 126°54'18"W; Hazelton map-area; Early Jurassic.

GSC loc. 91088. T. Richards, 1973. Field No. 169A-73-RW. North end of Carrall Ridge; 55°49'30"N; 120°05'48"W; Dawson Creek map-area; Early Jurassic.

GSC loc. 91138. T.P. Poulton, 1973. Field No. PU-10-73-4F. North of head of Frypan Creek, southern Bait Range; 55°30"68'N; 126°23'42"W; Hazelton map-area; Middle Toarcian(?).

GSC loc. 91774. D. Templeman-Kluit, 1974. Field No. TO 74-16a. On east bank of Yukon River; 62°14'N; 136°20'30"W; Carmacks map-area; Late Pliensbachian.

GSC loc. 91818. H.W. Tipper, 1974. Field No. M3K-TD-74. South side of Maude Island; Graham Island map-area; Early Pliensbachian (or possibly Early Toarcian).

GSC loc. 91827, 91828, 91833. H.W. Tipper, 1974. Field Nos. M3N-TD-74 , M3NA-TD-74 , M4A-TD-74. South side of Maude Island; Graham Island map-area; Late Pliensbachian.

GSC loc. 91994. W.J. MacMillan, B. C. Mines, 1974. Field No. J-20. Ashcroft; 50°43'76"N; 121°13'82"W; Ashcroft map-area; Sinemurian or Late Pliensbachian.

GSC loc. 92079. J.A. Jeletzky, 1972. Field No. JA-F72-23-9. Manning Park, upper part of Lookout Road; Hope map-area; Late Pliensbachian or Toarcian(?).

GSC loc. 93131. H.W. Tipper, 1975. Field No. F16-11TD-75. Section 11TD on ridge bearing 178 degrees from Mount Carruthers; 56°12'30"N; 126°21'W; McConnell Creek map-area; Middle Toarcian.

GSC loc. 93174, 93175. H.W. Tipper, 1975. Field Nos. F10-13TD-75 , F15-13TD75. Lord's locality 13, 2.5 km on bearing 128 degrees from Dewar Peak; 56°42'30"N; 126°47'W; McConnell Creek map-area; Early Pliensbachian, Ibex Zone.

GSC loc. 93184. H.W. Tipper, 1975. Field No. F1-21T75. 11 km on bearing of 170 degrees from Willow Creek; 56°30'12"N; 126°09'30"W; McConnell Creek map-area; Pliensbachian probably.

GSC loc. 93191. T.A. Richards and H.W. Tipper, 1975. Field No. F169A73RWTD. Iktlaki Peak; Hazelton map-area; Early Jurassic.

GSC loc. 93221, 93225. H.W. Tipper, 1975. Field Nos. F13A-16TD-75, F12C-16TD-75. Center of ridge on west side of Two Lake Creek, 12.8 km from mouth; 56°42'24"N; 126°50'W; McConnell Creek map-area; Early Pliensbachian, Kunae Zone.

GSC loc. 93252. H.W. Tipper, 1975. Field No. F6-12TD-75. Section 12TD-75 on ridge 6 km on bearing 55 degrees from mouth of Yuen Creek; 56°12'N; 126°19'W; McConnell Creek map-area; Late Pliensbachian, probably Kunae Zone.

GSC loc. 93272. H.W. Tipper, 1975. Field No. F3-14TD-75. Section 14TD, 3.8 km on bearing of 125 degrees from Dewar Peak; McConnell Creek map-area; Late Pliensbachian, Kunae Zone.

GSC loc. 93277. L.J. Werner, 1975. Field No. 57A-RWW-75. West side of Bear Lake; 56°07'30"N; 126°01'W; McConnell Creek map-area; Late Pliensbachian.

GSC loc. 93307, 93313, 93327, 93328. H.W. Tipper, 1975. Field Nos. F13-13TD-75, FW-13TD-75, F5T-13TD-75, F14-13-TD-75. Lord's locality 13, 2.5 km on bearing 128 degrees from Dewar Peak; 56°42'30"N; 126°47'W; McConnell Creek map-area; Early Pliensbachian.

GSC loc. 93324. L.J. Werner, 1975. Field No. 56A-RWw-75. West side of Bear Lake. At locality shown on Lord's map; 56°06'30"N; 126°50'30"W; McConnell Creek map-area; Late Pliensbachian, Margaritatus Zone.

GSC loc. 93334. R.G. Andersson and T. Eadie, 1975. Field No. RWA-75-7. Upper Lions Creek, 3.8 km northeast of Scallop Mountain; 56°04'N; 126°27'W; McConnell Creek map-area; Early Pliensbachian.

GSC loc. 93350. H.W. Tipper, 1975. Field No. F2-10TD-75. Ridge 3 km from Mount Carruthers on a bearing of 180 degrees; 56°21'N; 126°21'W; McConnell Creek map-area; Early Jurassic.

GSC loc. 93352. H.W. Tipper, 1975. Field No. F2-14TD-75. Section 14 TD, 3.8 km on a bearing of 125 degrees from Dewar Peak; 56°43'N; 126°45'W; McConnell Creek map-area; Early Pliensbachian probably.

GSC loc. 93563. H.W. Tipper, 1975. Field No. F5-30TD-75. Whiteaves Bay, southwest of Alliford Bay, Moresby Islands; 53°10'N; 132°02'W; Graham Island map-area; Early Pliensbachian, Jamesoni Zone.

GSC loc. 93587. H.W. Tipper and J. E. Muller, 1975. Field No. 75-30B. Pacific Logging Co. road, north of head of Harris Creek; 48°44'45"N; 124°10'50"W; Cape Flattery map-area; Late Pliensbachian, Kunae Zone.

GSC loc. 93618. T.A. Richards, 1975. Field No. PETE-RWp75-F11g. Southwest of head of Bird Flat Creek; 56°37'30"N; 126°55'42"W; McConnell Creek map-area; Early Jurassic.

GSC loc. 93619. H.W. Tipper, 1975. Field No. F13B-16TD-75. Ridge on west side of Two Lake Creek, 1.5 km east of F13A-16TD-75; McConnell Creek map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. 93707, 93716. H.W. Tipper, 1976. Field Nos. F10a-CHC76TD, F13CHC-76TD. North shore of Parson Bay on Harbledown Island; 50°35'05"N; 126°40'10"W; Alert Bay map-area; Late Sinemurian, Raricostatum Zone.

GSC loc. 93721. H.W. Tipper, 1976. Field No. F5a-76TD. 3 km north of north end of Yakoun Lake on Graham Island, south of intersection of Phantom Creek and Yakoun River; 53°22'45"N; 132°16'20"W; Graham Island map-area; Pliensbachian.

GSC loc. 93727. H.W. Tipper, 1976. Field No. 3-76-TD. Road outcrop 2.5 km south-southeast of intersection between Phantom Creek and Yakoun River on Graham Island; 53°21'55"N; 132°15'50"W; Graham Island map-area; Late Sinemurian, Raricostatum Zone.

GSC loc. 93728. H.W. Tipper, 1976. Field No. Ghost1-76-TD. 2.5 km from Queen Charlotte bridge on Ghost Creek Road; 53°25'20"N; 132°18'W; Graham Island map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. 94205. T.P. Poulton, 1976. Field No. PU-33-76-1F. Head of Last Creek, nose of hill on southwest side of creek; 51°05'18"N; 123°00'18"W; Taseko Lakes map-area; Hettangian - Early Sinemurian.

GSC loc. 94210. T.P. Poulton, 1976. Field No. PU-33-76-7F. Head of Last Creek; 51°05'15"N; 123°00'45"W; Taseko Lakes map-area; Early Sinemurian.

GSC loc. 94240. T.P. Poulton, 1976. Field No. PU-33-76-36F. Head of Last Creek; 51°05'29"N; 123°00'40"W; Taseko Lakes map-area; Early Sinemurian, Canadensis Zone.

GSC loc. 94241. T.P. Poulton, 1976. Field No. PU-33-76-37F. Head of Last Creek; 51°05'29"N; 123°00'40"W; Taseko Lakes map-area; Early Sinemurian and possibly Hettangian.

GSC loc. 94242. T.P. Poulton, 1976. Field No. PU-33-76-38F. Head of Last Creek; 51°05'29"N; 123°00'40"W; Taseko Lakes map-area; Early Sinemurian, probably Bucklandi Zone.

GSC loc. 94869. H.W. Tipper, 1976. Field No. F8aRC TD76. Slope west of Relay Creek Camp; 51°06'46"N; 123°01'19"W; Taseko Lakes map-area; Middle Toarcian.

GSC loc. 94898. Field No. FS-32RC-76TD. Head of south branch of Relay Creek, Warner Pass; Taseko Lakes map-area; Early Sinemurian.

GSC loc. 94934. 1976. 5 km south of Spruce Lake; Taseko Lakes map-area; Late Sinemurian.

GSC loc. 94993. H.W. Tipper, 1977. Field No. F8-6TD-77. 13 km southeast of Turnagain Lake; 58°09'N; 128°58'30"W; Cry Lake map-area; Late Sinemurian.

GSC loc. 94994. H.W. Tipper, 1977. Field No. F3-8TD-77. 16 km southeast of camp; 58°10'N; 128°58'W; Cry Lake map-area; Late Pliensbachian, probably Kunae Zone.

GSC loc. 95015. H.W. Tipper, 1977. Field No. F2-18TD-77. 6.8 km west of McBride River; 58°10'N; 129°W; Cry Lake map-area; Sinemurian.

GSC loc. 95021. H.W. Tipper, 1977. Field No. F3A-8TD-77. 6.8 km west of McBride River; 58°11'N; 128°59'W; Cry Lake map-area; Late Pliensbachian.

GSC loc. 95092. H.W. Tipper, 1977. Field No. F7-19TD-77. About 20 km on bearing 200 degrees from Mount Shea; 58°08'N; 129°W; Cry Lake map-area; Late Sinemurian.

GSC loc. 95096. H.W. Tipper, 1977. Field No. F2-19TD-77. About 20 km on bearing 190 degrees from Mount Shea; 58°09'N; 129°W; Cry Lake map-area; Early Toarcian.

GSC loc. 95263, 95265. H.W. Tipper, 1977. Field Nos. F1-27TD-77, F3-26TD-77. 17.2 km on a bearing of 200 degrees from Mount Shea; 58°10'N; 129°02'W; Cry Lake map-area; Toarcian.

GSC loc. C-17988. D.K. Norris, 1972. Field No. 2327-2F. Headwaters of Ridge Creek, Livingstone Range; 50°05'48"N; 114°21'48"W; Kananaskis Lakes map-area; Sinemurian.

GSC loc. C-53514. H.W. Tipper, 1978. Field No. 78-TD-ASH-4B. Rattlesnake Hill, north of Ashcroft, near top of hill, gully on west side; 50°46'N; 121°13'W; Ashcroft map-area; Late Pliensbachian, Kunae Zone.

GSC loc. C-56785. ?, 1988. Field No. 83. North of Louise Island; Moresby Island map-area; Early Pliensbachian probably.

GSC loc. C-56954. H.W. Tipper, 1988. Quarry on logging road, south of Rennell Junction gully, Queen Charlotte Islands; ?map-area; Late Pliensbachian.

GSC loc. C-80215, C-80218, C-80224, C-80229 to C-80232, C-80235 to C-80239. B.E.B. Cameron, 1978. Field Nos. 78-BC230P-2F, 78-BC245P, 78-BC254P-2F, 78-BC263P-2F, 78-BC263P-2F, 78-BC265P-2F, 78-BC265T-2F, 78-BC271A-2F, 78-BC271P, 78-BC294P, 78-BC301P, 78-BC308P. South shore of Maude Island, Queen Charlotte Islands; 53°11'55"N; 132°03'30"W; Graham Island map-area; Pliensbachian.

GSC loc. C-80249. B.E.B. Cameron, 1978. Field No. 78-BC-3F-60T. South shore of Skidegate Inlet, Queen Charlotte Islands; 53°10'N; 132°02'W; Graham Island map-area; Early Pliensbachian, Ibex Zone.

GSC loc. C-80765, C-80767 to C-80769. H.W. Tipper and B.E.B. Cameron, 1978. Field Nos. BC-78-3F144P, BC-78-3F147A, BC-78-3F148P, BC-78-3F160F. South shore of Skidegate Inlet, Queen Charlotte Islands; 53°10'N; 132°02'W; Graham Island map-area; Late Pliensbachian.

GSC loc. C-80770. H.W. Tipper and B.E.B. Cameron, 1978. Field No. BC-78-3F240P. South shore of Skidegate Inlet, Queen Charlotte Islands; 53°10'N; 132°02'W; Graham Island map-area; Pliensbachian.

GSC loc. C-80791, C-80793, C-80794, C-80798. Intercoast Resources, 1978. Field Nos. BCI178-121.5, BCI178-126.5, BCI178-139TD, BCI178-186TD. Drill hole, Yakoun Lake; Graham Island map-area; Sinemurian(?).

GSC loc. C-80802. Intercoast Resources, 1978. Field No. BC-I-78-TD. Quarry along road near Ghost Creek, Graham Island, Queen Charlotte Islands; 53°24'N; 132°18'W; Graham Island map-area; Early Pliensbachian.

GSC loc. C-80812. H.W. Tipper and B.E.B. Cameron, 1978. Field No. T78-1-MF9-BC. Suzy Creek, east extremity of Ells Bay, south side of Maude Island, Queen Charlotte Islands; 53°12'03"N; 132°02'30"W; Graham Island map-area; Late Toarcian, Thouarsense(?) Zone.

GSC loc. C-80834. H.W. Tipper, 1978. Field No. T104-78TD-E. Ells Bay, south shore of Maude Island, Queen Charlotte Islands; 53°11'50"N; 132°03'50"W; Graham Island map-area; Early Toarcian.

GSC loc. C-80837. H.W. Tipper, 1978. Field No. T104-78TD-H. Ells Bay, south shore of Maude Island, Queen Charlotte Islands; 53°11'50"N; 132°03'50"W; Graham Island map-area; Late Pliensbachian probably.

GSC loc. C-80838. H.W. Tipper, 1978. Field No. T105-78TD-H. Ells Bay, south shore of Maude Island, Queen Charlotte Islands; 53°11'50"N; 132°03'50"W; Graham Island map-area; Early Pliensbachian, Ibex Zone.

GSC loc. C-80839. H.W. Tipper, 1978. Field No. T105-78TD-J. Ells Bay, south shore of Maude Island, Queen Charlotte Islands; 53°11'50"N; 132°03'50"W; Graham Island map-area; Late Pliensbachian, Kunae Zone.

GSC loc. C-80843. H.W. Tipper, 1978. Field No. T104-78TD-N. Ells Bay, south shore of Maude Island, Queen Charlotte Islands; 53°11'50"N; 132°03'50"W; Graham Island map-area; Pliensbachian.

GSC loc. C-80897. T.P. Poulton, 1979. Tributary of Nordeskold River, 5 km north-northeast of Mount Vowles; 61°27'30"N; 136°09'30"W; Aishihik Lake map-area; Toarcian(?).

GSC loc. C-81306. T.P. Poulton, 1979. Just north of Five Finger Rapid, east side of Yukon River; 62°16'15"N; 136°21'W; Carmacks map-area; Toarcian.

GSC loc. C-81308 to C-81311. T.P. Poulton, 1979. East of Mandanna Creek, 8 km northeast of Cone Hill; 61°44'N; 135°41'W; Laberge map-area; Sinemurian.

GSC loc. C-81316, C-81317. T.P. Poulton, 1979. East of Mandanna Creek, 8 km northeast of Cone Hill; 62°00'07"N; 135°48'W; Glenlyon map-area; Sinemurian.

GSC loc. C-81318. T.P. Poulton, 1979. Eaglenest Bluff, southwest corner of Yukon River; 62°00'07"N; 135°48'W; Glenlyon map-area; Early Jurassic.

GSC loc. C-81319. T.P. Poulton, 1979. East of Mandanna Creek, 8 km northeast of Cone Hill; 62°00'07"N; 135°48'W; Glenlyon map-area; Sinemurian.

GSC loc. C-81322, C-81323. D. Templemen-Kluit, 1979. East of Mandanna Creek, 8 km northeast of Cone Hill; 61°44'N; 135°41'W; Laberge map-area; Sinemurian.

GSC loc. C-81519. J. Monger, 1979. Field No. MV79c. 8 km north-northwest of north end of Trapper Lake; 58°33'55"N; 133°39'45"W; Tulsequah map-area; Late Pliensbachian.

GSC loc. C-81703. H.W. Tipper, 1982. Field No. 82-TD-136FA. Ghost Creek, quarry at end of road north of Ghost Creek Road; 53°25'10"N; 132°17'W; Graham Island map-area; Late Pliensbachian.

GSC loc. C-81704. H.W.Tipper, 1982. Field No. 82-TD-?. Central

Graham Island, road 59; 53°23'00"N; 132°15'30"W; Graham Island map-area; Late Toarcian to Early Aalenian.

GSC loc. C-81707. H.W. Tipper, 1982. Field No. 82-TD-144FA. West of Yakoun River on road; 53°24'35"N; 132°18'W; Graham Island map-area; Pliensbachian.

GSC loc. C-81709. H.W. Tipper, 1982. Field No. 82-TD-122FA. Graham Island, last quarry on road 57; 53°24'21"N; 132°15'20"W; Graham Island map-area; Late Pliensbachian.

GSC loc. C-81730. H.W. Tipper, 1982. Field No. 82-TD-130FA. In quarry, on road north of Ghost Creek; 53°25'10"N; 132°17'15"W; Graham Island map-area; Pliensbachian probably.

GSC loc. C-81733. H.W. Tipper, 1982. Field No. 82-TD-137FA. Quarry west of Yakoun River, on mountain southeast of Ghost Creek; 53°24'42"N; 132°17'30"W; Graham Island map-area; Early Pliensbachian.

GSC loc. C-81735. H.W. Tipper, 1982. Field No. 82-TD-111FA. Northwest of Ghost Creek on road; 53°25'25"N; 132°18'00"W; Graham Island map-area; Middle Toarcian.

GSC loc. C-81947, C-81948. H.W. Tipper, 1979. Field Nos. 79TD-186FA, 79TD-187FA. 8 km south of narrows in King Salmon Lake; 58°40'05"N; 132°54'40"W; Tulsequah map-area; Late Pliensbachian, Kunae Zone.

GSC loc. C-81950. H.W. Tipper, 1979. Field No. 79TD-253FP. Northeast valley of mountain south of King Salmon Lake; 58°39'10"N; 132°52'30"W; Tulsequah map-area; Late Pliensbachian, Kunae(?) Zone.

GSC loc. C-81971. H.W. Tipper, 1979. Field No. 79TD-214FW. 5 km southwest of Black Fox Lake; 57°42'N; 128°55'W; Spatsizi River map-area; Late Sinemurian.

GSC loc. C-81972. H.W. Tipper, 1985. Field No. 79-TD-214FP. 5 km southwest of Black Fox Lake; 57°42'N; 128°55'W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-81974. H.W. Tipper, 1979. Field No. 79TD-219FP. Gladys Lake; 57°29'30"N; 128°55"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-81975. H.W. Tipper, 1979. Field No. 79TD-219FA. Joan Lake; 57°29'30"N; 128°55'00"W; Spatsizi River map-area; Early Pliensbachian, Ibex Zone.

GSC loc. C-81978. H.W. Tipper, 1979. Field No. 79TD-183FP. 8 km south of narrows in King Salmon Lake; 58°40'05"N; 132°54'40"W; Tulsequah map-area; Late Pliensbachian.

GSC loc. C-86364. T.P. Poulton, 1979. Field No. 79-PU. Whiteaves Point, Moresby Island; Graham Island map-area; Middle Toarcian.

GSC loc. C-86367. T.P. Poulton, 1979. Field No. 79-PU. West side of Ells Bay, west of camp, Maude Island; Graham Island map-area; Pliensbachian.

GSC loc. C-86379. T.P. Poulton, 1980. Field No. 80-PU. Bighorn Creek, Yahatinda Ranch; Calgary map-area; Pliensbachian or Toarcian.

GSC loc. C-86397. T.P. Poulton, 1980. Field No. 80-PU. 1.8 km north of mouth of Canyon Creek; Calgary map-area; Toarcian.

GSC loc. C-86503, C-86504. H.W. Tipper, 1979. Field Nos. 79TD-101FA, 79TD-103FA. Bug Mountain syncline, southwest of King Salmon Lake, section on north limb of syncline; 58°39'N; 133°05'W; Tulsequah map-area; Middle Toarcian, Bifrons Zone.

GSC loc. C-86506. H.W. Tipper, 1979. Field No. 79TD-105FA. Bug Mountain syncline, southwest of King Salmon Lake, section on north limb of syncline; 58°39'N; 133°05'W; Tulsequah map-area; Early Toarcian, Falciferum Zone.

GSC loc. C-86513. H.W. Tipper, 1979. Field No. 79TD-112FA. Bug Mountain syncline, southwest of King Salmon Lake, section on north limb of syncline; 58°39'N; 133°05'W; Tulsequah map-area; Late Pliensbachian, Kunae Zone.

GSC loc. C-86676. H.W. Tipper, 1979. Field No. 79TD-176FP. North side of mountain south of King Salmon Lake; 58°42'30"N; 132°53'W; Tulsequah map-area; Late Pliensbachian.

GSC loc. C-86677. H.W. Tipper, 1979. Field No. 79TD-113FP. West ridge of Bug Mountain, above Frozen Lake, southwest of King Salmon Lake; 58°40'30"N; 133°04'W; Tulsequah map-area; Piensbachian probably.

GSC loc. C-86682. H.W. Tipper, 1979. Field No. 79TD-250FP. Northeast valley of mountain south of King Salmon Lake; 58°39'10"N; 132°52'30"W; Tulsequah map-area; Late Pliensbachian.

GSC loc. C-86684. H.W. Tipper, 1979. Field No. 79TD-159FP. West side of northeast valley of mountain, south of King Salmon Lake; 58°39'30"N; 132°53'00"W; Tulsequah map-area; Late Pliensbachian probably.

GSC loc. C-86807. D.Tempelman-Kluit, 1979. Field No. TOG-79-10-8B. 6.5 km southeast of Prospector Mount; 61°47'00"N; 135°28'00"W; Laberge map-area; Late Pliensbachian.

GSC loc. C-86819. H.W. Tipper, 1979. Field No. 79TD-253FA. Section in northeast valley of mountain south of King Salmon Lake; 58°39'10"N; 132°52'30"W; Tulsequah map-area; Late Pliensbachian, Kunae Zone.

GSC loc. C-87113, C-87123. H.W. Tipper, 1980. Field Nos. 80TD-85FP, 80TD-76FP. Yakoun River, 1.8 km upstream from the confluence of Ghost Creek, Queen Charlotte Islands; 53°25'05"N; 132°16'04"W; Graham Island map-area; Toarcian.

GSC loc. C-87212. H.W. Tipper, 1980. Field No. 80-TD-26FA. Yakoun River, central Graham Island; 53°25'20"N; 132°15'45"W; Graham Island map-area; Late Toarcian.

GSC loc. C-87219. H.W. Tipper, 1980. Field No. 80-TD-54FA. Yakoun River, lower locality, 1.5 km above Ghost Creek; 53°25'10"N; 132°16'04"W; Graham Island map-area; Middle Toarcian.

GSC loc. C-87221. H.W. Tipper, 1980. Yakoun River, central Graham Island; 53°25'05"N; 132°15'30"W; Graham Island map-area; Late Toarcian.

GSC loc. C-87246. H.W. Tipper, 1981. Field No. 81-TD-55-2A. 0.5 km west of Joan Lake camp; 57°29'46"N; 128°53'50"W; Spatsizi River map-area; Late Pliensbachian.

GSC loc. C-87450. J. Monger, 1982. Field No. MVV-82-41. 2.7 km west-northwest of junction of Betty and Shuta Creeks; 50°13'20"N; 120°43'10"W; Ashcroft map-area; Early or Middle Jurassic probably.

GSC loc. C-88151. D. Thorkelson, 1987. Field No. 87GAT-126-5. In creek 6.5 km north of Ice Box Canyon; 57°42'50"N; 129°03'40"W; Spatsizi River map-area; Early Pliensbachian probably.

GSC loc. C-88230. H. Gabrielse, 1983. Field No. 83-GA-S-106c. 2 km west of Joan Lake; 57°30'N; 128°55'15"W; Spatsizi River map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. C-90518 to C-90520, C-90524. H.W. Tipper, 1981. Field Nos. 81-TD-56-4, 81-TD-56-5, 81-TD-56-6, 81-TD-56-11. Section 6 on south side of Joan Lake anticline; 57°28'22"N; 128°56'15"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-90532. H.W. Tipper, 1979. Field No. 79-TD-11-507. Intercoast Resources drill hole, central Graham Island; 53°24'35"N; 132°18'30"W; Graham Island map-area; Sinemurian.

GSC loc. C-90545. H.W. Tipper, 1978. Field No. 76-TD-FM4C. Fannin Bay; 53°11'55"N; 132°03'20"W; Graham Island map-area; Late Pliensbachian.

GSC loc. C-90614. H.W. Tipper, 1982. Maude Island; 53°11'55"N; 132°03'30"W; Graham Island map-area; Late Pliensbachian.

GSC loc. C-90615. H.W. Tipper, 1982. Maude Island; 53°11'55"N; 132°03'20"W; Graham Island map-area; Pliensbachian-Toarcian boundary.

GSC loc. C-90659. H. Gabrielse, 1981. Field No. 81GAR-25. Eaglenest Range, 12 km north-northeast of headwaters of Conglomerate Creek; 57°29'N; 128°52'30"W; Spatsizi River map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. C-90664. H. Gabrielse, 1981. Field No. 81-GA-R-31-1. Eaglenest Range, 10.5 km north-northwest of headwaters of Conglomerate Creek; 57°29'50"N; 128°56'W; Spatsizi River map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. C-90811. H. Gabrielse, 1983. Field No. GAT(F)83-23A. Joan Lake area, Gladys Lake section 1; 57°29'15"N; 128°53'20"W; Spatsizi River map-area; Toarcian.

GSC loc. C-90835, C-90836. H. Gabrielse, 1983. Field Nos. 83-

GAT-35b, 83-GAT-36a. Joan Lake, section 2; 57°29'15"N; 128°53'20"W; Spatsizi River map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. C-90843. H. Gabrielse, 1983. Field No. 83GAT-51a. Joan Lake, near section 1; 57°29'15"N; 128°53'20"W; Spatsizi River map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. C-90901. H.W. Tipper, 1981. Field No. 81-TD-5-1a. 0.4 km west of Joan Lake camp, Pliensbachian section north of anticline; 57°29'55"N; 128°54'12"W; Spatsizi River map-area; Early Pliensbachian, Whiteavesi Zone.

GSC loc. C-90902 to C-90909. H.W. Tipper, 1981. Field Nos. 81-TD-5-2a, 81-TD-5-3a, 81-TD-5-3B, 81-TD-5-3c, 81-TD-5-4a, 81-TD-5-4B, 81-TD-52-1a, 81-TD-52-3A. 0.4 km west of Joan Lake camp, section north of anticline; 57°29'55"N; 128°54'12"W; Spatsizi River map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. C-90910 to C-90912, C-90914, C-C-90917, C-90919 to C-90928, C-90930 to C-90933. H.W. Tipper, 1981. Field Nos. 81-TD-52-3B, 81-TD-52-4a, 81-TD-52-5a, 81-TD-52-5c, 81-TD-52-6B, 81-TD-52-6d, 81-TD-52-6E, 81-TD-52-6f, 81-TD 52-6g, 81-TD-52-6h, 81-TD-53-5a, 81-TD-53-4c, 81-TD-53-4B, 81-TD-53-4a, 81-TD-53-3b, 81-TD-53-1a, 81-TD-54-2a, 81-TD-54-3a, 81-TD-54-3b. 0.4 km west of Joan Lake camp, section north of anticline; 57°29'55"N; 128°54'12"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-103070, C-103072, C-103074, C-103077. H. Gabrielse, 1983. Field Nos. 83-GA-S-67A, 83-GA-S-57A, 83-GA-S-62A, 83-GA-S-60A. 200 m west of Joan Lake; 57°29'50"N; 128°54'12"W; Spatsizi River map-area; Early Pliensbachian, probably Freboldi Zone.

GSC loc. C-103078, C-103079, C-103082. H. Gabrielse, 1983. Field Nos. 83-GA-S-74B, 83-GA-S-75B, 83-GA-S-71B. 50 m east of Joan Lake; 57°29'30"N; 128°53'40"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-103088. H. Gabrielse, 1983. Field No. 83-GA-S-37A. 500 m east of Joan Lake; 57°29'30"N; 128°53'30"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-103091. H. Gabrielse, 1983. Field No. 83-GA-S-78A. 50 m east of Joan Lake; 57°29'30"N; 128°53'40"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-103093. H. Gabrielse, 1983. Field No. 83-GA-S-61A. 200 m west of Joan Lake; 57°29'50"N; 128°54'12"W; Spatsizi River map-area; Early Pliensbachian, probably Freboldi Zone.

GSC loc. C-103096. H. Gabrielse, 1983. Field No. 83-GA-S-73C. 500 m east of Joan Lake; 57°29'30"N; 128°53'40"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-103099. H. Gabrielse, 1983. Field No. 83-GA-S-96A. 200 m east of Joan Lake; 57°29'27"N; 128°53'30"W; Spatsizi River map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. C-103104, C-103114. H. Gabrielse, 1983. Field Nos. 83-GA-T-62A, 83-GA-T-28a. Joan Lake, section 4; 57°28'55"N; 128°56'10"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-103127. H. Gabrielse, 1983. Field No. GAT(F)83-71B. Joan Lake area, near Gladys Lake, section 1; 57°29'15"N; 128°57'20"W; Spatsizi River map-area; Late Toarcian.

GSC loc. C-103136, C-103140. H. Gabrielse. Field Nos. 83-GA-T-77A, 83-GA-T-78A. Deathstar; 57°37'00"N; 128°58'00"W; Spatsizi River map-area; Middle Toarcian.

GSC loc. C-103198. H. Tipper, 1985. Field No. 83-TD-39F. Spatsizi, south of Nation Peak; 57°37'50"N; 128°53'30"W; Spatsizi River map-area; Early Pliensbachian, Freboldi Zone.

GSC loc. C-103204. H. Gabrielse, 1983. Field No. 83-GA-T-94B. Joan Lake, section 1; 57°29'15"N; 128°53'20"W; Spatsizi River map-area; Early Toarcian.

GSC loc. C-103303, C-103305, C-103307, C-103310. H. Gabrielse, 1983. Field Nos. 83-GAT-4a, 83-GAT-4c, 83-GAT-5b, 83-GAT-5e. Joan Lake, section 1; 57°29'15"N; 128°53'20"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-103312. H. Gabrielse, 1983. Field No. 83-GAT-2a. Spatsizi, west side of anticline section; 57°29'15"N; 128°53'20"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-103318, C-103326, C-103327. H. Gabrielse, 1983. Field Nos. 83-GAT-6e, 83-GA-T-99a, 83-GA-T-9b. Joan Lake, section 1; 57°29'15"N; 128°53'20"W; Spatsizi River map-area; Pliensbachian.

GSC loc. C-103406. H. Gabrielse, 1983. Field No. 8377a. Plateau southwest of Gladys Lake; 57°44'N; 128°51'00"W; Spatsizi River map-area; Pliensbachian-Toarcian.

GSC loc. C-103446. H.W. Tipper, 1983. Field No. 83TD-60aF. 4.8 km southwest of Nation Peak; 57°35'05"N; 128°59'47"W; Spatsizi River map-area; Late Toarcian.

GSC loc. C-116290. P.B. Read, 1983. Field No. 83JFP-P277d. Telegraph Creek; 57°01'N; 130°37'05"W; Telegraph Creek map-area; Middle to Late Toarcian probably.

GSC loc. C-116863. H. Gabrielse, 1986. Field No. 7. Spatsizi, west side of ridge 5 km east-northeast of Nation Peak; 57°40'05"N; 128°50'30"W; Spatsizi River map-area; Pliensbachian.

GSC loc. C-116869. H. Gabrielse, 1986. Field No. 107. Spatsizi, top of cirque 4.3 km northwest of Mount Will; 57°34'35"N; 128°50'30"W; Spatsizi River map-area; Late Pliensbachian.

GSC loc. C-117021. H.W. Tipper, 1986. Renner Point, Louise Island, Cumsleeve Inlet; 53°02'05"N; 131°07'47"W; Hecate Strait map-area; Early Pliensbachian.

GSC loc. C-117274. C. Evenchick and H. Gabrielse, 1985. Field No. GAE-85-77. 5 km northeast of Nation Peak; 57°40'10"N; 128°50'35"W; Spatsizi River map-area; Early Pliensbachian probably.

GSC loc. C-117277. C. Evenchick and H. Gabrielse, 1985. Field No. GAE-85-73. 3.5 km northeast of Nation Peak; 57°40'00"N; 128°51'45"W; Spatsizi River map-area; Early Pliensbachian, Whiteavesi Zone.

GSC loc. C-117279. D.J. Alldrick, 1985. Alice Arm area, Kitsault Lake, 6179000N 469080E; Nass River map-area; Middle Toarcian.

GSC loc. C-117280. D.J. Alldrick, 1985. Alice Arm area, Kitsault, 6173230N, 467550E; Nass River map-area; Middle Toarcian.

GSC loc. C-118954. P.B. Read, 1985. Field No. R85-4F-PBR. 5.2 km at a bearing of 150 degrees from Tuktsayda Mountain, elevation 1540 m; 57°45'14"N; 130°03'37"W; Telegraph Creek map-area; Early Jurassic.

GSC loc. C-127463. T.P. Poulton, 1983. South side of Clearwater River, 0.5 km west of Forestery Road bridge; 51°58'30"N; 115°14'40"W; Calgary map-area; Sinemurian.

GSC loc. C-127465. T.P. Poulton, 1983. Limestone Mountain, 1.5 km south of Peak; 51°55'20"N; 115°26'W; Calgary map-area; Sinemurian.

GSC loc. C-127470. T.P. Poulton, 1983. Ridge Creek, 3.8 km south-southeast of Mount Livingstone; 50°06'N; 114°21'20"W; Kananaskis Lakes map-area; Sinemurian probably.

GSC loc. C-127477. T.P. Poulton, 1984. Head of Green Creek, east side of syncline, 8 km north of Bellevue; 49°39'N; 114°21'30"W; Fernie map-area; Sinemurian.

GSC loc. C-142906. R.I. Thompson, 1987. Field No. 87TW-382B. Moresby Island, Queen Charlotte Islands; 53°10'36"N; 132°01'00"W; Graham Island map-area; Late Sinemurian.

GSC loc. C-143074. P. Desjardins and D. MacIntyre, 1988. Field No. PDE88-257B. East side of Webster Creek; Smithers map-area; UTM 623369E 6042026N. Late Sinemurian probably.

GSC loc. C-143287. H.W. Tipper, 1986. Field No. 22B-F. Tyaughton Creek, southwest of Cardtable Mountain, south of Relay Mountain on east enroute to claim post; 51°05'14"N; 122°59'05"W; Taseko Lakes map-area; Late Hettangian.

GSC loc. C-143307, C-143309, C-143310, C-143316, C-143319, C-143321. H.W. Tipper, 1986. Field Nos. 12A-F, 12C-F, 12D-F, 14B-t, 15B-F, 15D-F. Tyaughton Creek, ridge on Castle Peak pass; 51°05'10"N; 122°57'37"W; Taseko Lakes map-area; Late Hettangian.

GSC loc. C-143324. H.W. Tipper, 1986. Field No. 17B-f. Tyaughton Creek, south side of Castle Peak pass; 51°05'08"N; 122°57'34"W; Taseko Lakes map-area; Late Hettangian.

GSC loc. C-143329. H.W. Tipper, 1986. Field No. 19A-F. Tyaughton Creek, north side of Castle Peak pass (base camp); 51°05'11"N; 122°58'01"W; Taseko Lakes map-area; Early Pliensbachian.

GSC loc. C-153916. M. Mihalynuk, 1987. Field No. 87MM-PF45-2. 2.5 km east of Racine Lake; 59°44'60"N; 134°34'75"W; Skagway map-area; Toarcian probably.

GSC loc. C-153926. M. Mihalnyuk, 1988. Field No. 88-MM-CW24-9. 2 km south-southwest of south end of Racine Lake; 59°41'55"N; 134°22'03"W; Skagway map-area; Toarcian probably.

GSC loc. C-153971. M. Mihalynuk, 1989. Field No. 89-NW1-44-3. Ridge leading to 2064 m peak north of Mount Cameron; 59°25'58"N; 134°04'28"W; Skagway map-area; Sinemurian.

GSC loc. C-156304. H.W. Tipper, 1989. Field No. KP-4. Sandilands Island, Queen Charlotte Islands; 53°54'45"N; 133°09'05"W; Graham Island map-area; Hettangian.

GSC loc. C-156308, C-156314, C-156317 to C-156320, C-156328, C-156345. H.W. Tipper, 1989. Field Nos. KP-7a, KP-8c, KP-12c, KP-12d, KP-12e, KP-12f, KP-16e, KP-29. Kennecott Point, Graham Island; 53°54'45"N; 133°09'05"W; Graham Island map-area; Hettangian.

GSC loc. C-156378. G. Jakobs, 1989. Yakoun River, central Graham Isand, section 10; 53°25'00"N; 132°16'05"W; Graham Island map-area; Middle to Late Toarcian.

GSC loc. C-156401, C-156411, C-156415. J. Palfy, 1989. Field No. 611I, 612E, 614D. Kennecott Point, Graham Island; 53°54'45"N; 133°09'15"W; Graham Island map-area; Hettangian-Sinemurian boundary, Canadensis Zone.

GSC loc. C-156434. J. Palfy, 1989. Field No. 722B. Graham Island, east of Tasu Sound; 52°48'05"N; 132°01'25"W; Moresby Island map-area; Early Sinemurian, Arnouldi Assemblage.

GSC loc. C-156885. G. Jakobs, 1988. Skidegate Inlet, Maude Island, section 16; 53°12'00"N; 132°02'30"W; Graham Island map-area; Middle to Late Toarcian.

GSC loc. C-156891. G. Jakobs, 1988. Central Graham Island, road 59, section 7; 53°23'00"N; 132°15'30"W; Graham Island map-area; Late Toarcian to Aalenian.

GSC loc. C-157630. H.W. Tipper, 1987. Field No. 211. Kennecott Point, Graham Island; 53°54'45"N; 133°09'05"W; Graham Island map-area; Hettangian.

GSC loc. C-157663. H.W. Tipper, 1984. Field No. 306a. Tyaughton Creek area; Taseko Lakes map-area; Hettangian.

GSC loc. C-157702. G. Jakobs, 1987. Central Graham Island, Creek 57, section 5; 53°23'35"N; 132°15'30"W; Graham Island map-area; Aalenian probably.

GSC loc. C-157706. G. Jakobs, 1987. Central Graham Island, Creek 57, section 6; 53°23'35"N; 132°15'30"W; Graham Island map-area; Middle Toarcian.

GSC loc. C-157720. G. Jakobs, 1987. Yakoun River, central Graham Island, section 10; 53°25'00"N; 132°16'05"W; Graham Island map-area; Middle Toarcian.

GSC loc. C-157740, C-157748. G. Jakobs, 1987. Yakoun River, central Graham Island, section 10; 53°25'00"N; 132°16'05"W; Graham Island map-area; Late Toarcian.

GSC loc. C-157749, C-157750. G. Jakobs, 1987. Yakoun River, central Graham Island, section 10; 53°25'00"N; 132°16'05"W; Graham Island map-area; Aalenian probably.

GSC loc. C-158027, C-158035, C-158036, C-158040, C-158043. G. Jakobs, 1987. Yakoun River, central Graham Island, section 9; 53°25'02"N; 132°15'30"W; Graham Island map-area; Early to Middle Toarcian.

GSC loc. C-158047, C-158052. G. Jakobs, 1987. Yakoun River, central Graham Island, section 1; 53°25'05"N; 132°15'30"W; Graham Island map-area; Late Toarcian to Aalenian.

GSC loc. C-158059, C-158062, C-158063. G. Jakobs, 1987. Yakoun River, central Graham Island, section 10; 53°25'00"N; 132°16'05"W; Graham Island map-area; Middle Toarcian.

GSC loc. C-158083. G. Jakobs, 1987. Central Graham Island, Creek 57, section 3; 53°23'35"N; 132°15'30"W; Graham Island map-area; Late Toarcian to Early Aalenian.

GSC loc. C-158084, C-158085. G. Jakobs, 1987. Central Graham Island, Creek 57, section 3; 53°23'35"N; 132°15'30"W; Graham Island map-area; possibly Aalenian.

GSC loc. C-158089. G. Jakobs, 1987. Central Graham Island, Creek 57, section 4; 53°23'35"N; 132°15'30"W; Graham Island map-area; Early Aalenian(?).

GSC loc. C-159257, C-159258, C-159259. J. Palfy, 1989. Field Nos. 606A, 606B, 606C. Kennecott Point, Graham Island; 53°54'20"N; 133°09'10"W; Graham Island map-area; Hettangian-Sinemurian boundary, Canadensis Zone.

GSC loc. C-159412. J. Palfy, 1989. Field No. YL12. Yakoun River, central Graham Island; 53°24'40"N; 132°16'20"W; Graham Island map-area; Late Sinemurian, Varians Assemblage.

GSC loc. C-159414, C-159417, C-159423, C-159429, C-159431, C-159435. J. Palfy, 1989. Field Nos. YL14, YL-17, YL23, YL29, YL31, YL35. Yakoun River, central Graham Island; 53°24'40"N; 132°16'20"W; Graham Island map-area; Late Sinemurian, Harbledownense Assemblage.

GSC loc. C-159437, C-159439 to C-159442,C-159444. J. Palfy, 1989. Field Nos. YL37, YL39, YL42, YL46, L48. Yakoun River, central Graham Island; 53°24'40"N; 132°16'20"W; Graham Island map-area; Sinemurian-Pliensbachian boundary, Tetraspidoceras Assemblage.

GSC loc. C-175206, C-175208. J. Palfy, 1990. Field Nos. 24G, 24I. Kennecott Point, central Graham Island; 53°54'50"N; 133°09'05"W; Graham Island map-area; Hettangian-Sinemurian boundary, Canadensis Zone.

GSC loc. C-175222, C-175224, C-175225. J. Palfy, 1990. Field Nos. 28A1, 28A3, 28A4. South shore of Maude Island; 53°11'50"N; 132°03'05"W; Graham Island map-area; latest Sinemurian or earliest Pliensbachian, Tetraspidoceras Assemblage.

GSC loc. C-175233. H.W. Tipper, 1990. Field No. 90-TD-JP-1A3. Yakoun Lake area, Ghost Main Road; 53°25'10"N; 132°18'05"W; Graham Island map-area; Sinemurian.

GSC loc. C-175234. J. Palfy, 1989. Field No. 1A4. Ghost Main Road, Graham Island; 53°25'10"N; 133°18'05"W; Graham Island map-area; Sinemurian-Pliensbachian boundary, Tetraspidoceras Assemblage.

GSC loc. C-175242. J. Palfy, 1989. Field No. 1A13. Ghost Main Road, Graham Island; 53°25'10"N; 133°18'05"W; Graham Island map-area; Early Pliensbachian, Imlayi Zone.

GSC loc. C-175695. C. Evenchick, 1989. Field No. 89-EP-310. 1 km northeast of Todagin Mountain; Spatsizi River map-area; Middle or Late Toarcian probably.

GSC loc. C-177610. J. Palfy, 1989. Field No. 707O. Kunga Island, southeast shore, Queen Charlotte Islands; 52°45'40"N; 131°33'W; Moresby Island map-area; latest Sinemurian or earliest Pliensbachian, Tetraspidoceras Assemblage.

GSC loc. C-186954. H. Grond for D.J. Tempelman-Kluit, 1979. Field No. TOG-79-10-8W; 6.5 km southeast of Prospector Mountain; 61°47'00"N; 135°28'00"W; Laberge map-area; Early Jurassic.

GSC loc. C-186955. H.W. Tipper, 1979. Field No. 79-TD-221-FA. Gladys Lake; 57°29'30"N; 128°54'45"W; Spatsizi River map-area; Early Pliensbachian.

GSC loc. C-186957. R.L. Christie, 1974. McConnell Creek map-area; Early Jurassic.

GSC loc. C-186958. R.L. Christie, 1974. Field No. CB-F29-40-74. Spur east of Lord's fossil locality 13; McConnell Creek map-area; Early Jurassic.

GSC loc. C-186959. H.W. Tipper, 1979. Field No. 79TD-159FW. West side of northeast valley of mountain south of King Salmon Lake; 58°39'30"N; 132°53'00"W; Tulsequah map-area; Late Pliensbachian.

GSC loc. C-187092. T. Poulton, 1989. Field No. 89-PU-5-1F. South side of 2011 m peak, 27 km west-southwest of Brady Ranch; 56°47'15"N; 123°03'45"W; Halfway River map-area; Sinemurian probably.

GSC loc. C-203258. G. Johannson, 1993. Field No. GGAJ-93-4-FB. Atlin Lake; 59°20'N; 133°43'W; Atlin Lake map-area; Late Pliensbachian, Kunae Zone.

GSC loc. C-210902. Palfy, 1994. Field No. 94JP2. Roadcut west of Takhini microwace tower; 60°55'05"N; 135°13'45"W; Whitehorse map-area; Late Pliensbachian, Kunae Zone.

GSC loc. C-210911. J. Palfy, 1994. Field No. 94JP9. Miners Range, 5.5 km southeast of Flat Mountain; 60°57'05"N; 135°18'15"W; Whitehorse map-area; Late Pliensbachian, Carlottense Zone.

GSC loc. C-210959. J. Pálfy, 1994. Field No. 94JP58. West of

Mount Brock; 57°52'N; 129°34'W; Spatsizi River map-area; Early Toarcian.

GSC loc. C-212407. Manning Park on Lookout Road; Hope map-area; Toarcian(?).

Appendix II

List of TMP fossil localities in the Canadian Cordillera yielding Early Jurassic bivalves

Details of the TMP fossil localities include, where available, name of locality; latitude; longitude; name of 1:250000 scale map sheet; and age. Note that TMP locality numbers and TMP type numbers are identical. All collections are deposited in the Royal Tyrrell Museum of Palaeontology.

TMP 83.168.10, 83.168.19, 83.168.21. Bighorn Creek; 51°44'30"N, 115°32'30"W; Calgary map-area; Toarcian.

TMP 92.64.5. Snake Indian River, Jasper National Park; Edson map-area; Toarcian.