Pelecypods of the Lower Cretaceous Clearwater Formation, Northern Alberta[1]

By F. H. McLEARN, F.R.S.C.

The Clearwater formation was described by R. G. McConnell in 1893.[2] It outcrops along Athabaska river from Point La Biche, in about township 86, range 17 west of 4, to below McMurray. At Point La Biche only the top shows near river level. Downstream the Clearwater beds rise higher and higher and at Boiler rapids the base is exposed and the McMurray formation comes up from below it. From thence downstream the Clearwater rises still higher on the valleysides, so that near McMurray only the base is exposed at the top of the cliffs of McMurray sandstone. The thickness is estimated to be about 275 feet.

The sediments include grey, dark grey to almost black, greenish grey and brownish shales, grey sandstones, greenish glauconitic sandstones and some hard concretionary layers. The bedding in places is from one to ten feet, but there is also in places a very fine bedding. Thin irregular lenses of sandstone occur occasionally in shale and lenses of shale in sandstone. The contacts with the Grand Rapids above and the McMurray below are apparently conformable. The contact with the McMurray is drawn at the base of a greenish sandstone or arenaceous shale. The Clearwater fauna does not appear to go below this layer.

The entire formation is marine and the marine *Deshayesites, Beudanticeras affine,* or *Inoceramus dowlingi* fauna ranges throughout it. This fauna has been dated Aptian on the basis of the ammonoid genus *Deshayesites* and similar *Deshayesites* are said to occur in the Aptian of India.[3] The fauna includes the ammonoids *Deshayesites mcconnelli* (Whiteaves), two new species of *Deshayesites, Beudanticeras affine* (Whiteaves), pelecypods and rare gastropods.[4] A very similar fauna, but without *Deshayesites* occurs in the lower part of the lower sandstone member of the Peace River formation on Peace River and has been collected along the river from about the middle of township 86,

[1]Published with the permission of the Director, Geological Survey of Canada, Department of Mines, Ottawa.

[2]McConnell, R. G., Geol. Surv. Can., Ann. Rept., new ser., 5, pt. 1, pp. 57D-58D, (1893).

[3]Spath, L. F., Brit. Pal. Soc., Mon. Ammonoidea Gault, pt. 8, p. 341 (1931).

[4]See McLearn, F. H., Trans. Roy. Soc. Can., 3rd Ser., vol. 25, Sec. IV, p. 3 (1931).

range 20, west of 5 to about the southern part of township 94, range 21, west of 5. *Deshayesites* occurs in the Loon River formation on Loon River. Wickenden has located the Clearwater fauna in deep boreholes in southern Saskatchewan by means of foraminifera.[5] The palæogeography has been discussed in a former paper.[6] The most extensive Lower Cretaceous flooding of the northern interior may be inferred to have taken place in Clearwater, *i.e.*, Aptian, time, from the evidence now available. The only probable rival would be the late Albian sea, the extent of which is not at present known. The Clearwater sea probably did not extend very far south of the international border however.

The Pelecypod Fauna

The Clearwater pelecypod fauna includes *Nucula athabaskensis* McLearn, *Yoldia kissoumi* McLearn, *Inoceramus dowlingi* McLearn, *Entolium irenense* n. sp., *Pecten alcesianus* n. sp., *Camptonectes matonabbei* n. sp., *Brachydontes athabaskensis* McLearn, *Goniomya matonabbei* n. sp., *Psilomya peterpondi* n. sp., *Psilomya elongatissima* n. sp., *Arctica limpidiana* n. sp., *Protocardia alcesiana* n. sp., *Integricardium* (*Onestia*) *onestæ* (McLearn), *Tellina dowlingi* McLearn and *Turnus lacombi* n. sp. The similar fauna on Peace River, in the lower part of the lower sandstone member of the Peace River formation, includes the pelecypods, *Nucula athabaskensis* McLearn, *Nucula* sp., *Yoldia kissoumi* McLearn, *Nemodon mcconnelli* McLearn, *Pinna curvimarginata* McLearn, *Oxytoma camselli* McLearn, *Entolium irenense* n. sp., *Thracia kissoumi* n. sp., *Psilomya peterpondi* n. sp., *Integricardium* (*Onestia*) *onestæ* (McLearn) and *Tellina dowlingi* McLearn. The following pelecypods are common to the two faunas, *Nucula athabaskensis* McLearn, *Yoldia kissoumi* McLearn, *Entolium irenense* n. sp., *Psilomya peterpondi* n. sp., *Integricardium* (*Onestia*) *onestæ* McLearn and *Tellina dowlingi* McLearn.

The pelecypods have some chronological value, but none comparable with that of the ammonoids, of course. As pointed out below *Inoceramus dowlingi* indicates an Aptian dating of the Clearwater fauna, confirming the dating by ammonoids. The pelecypod genus *Oxytoma* in the Canadian interior seems to show an increase in obliquity of outline and in size during the Cretaceous. However these

[5]Wickenden, R. T. D., Trans. Roy. Soc. Can., 3rd Ser., vol. 26, Sec. IV, p. 192 (1932).

[6]McLearn, F. H., Trans. Roy. Soc. Can., 3rd Ser., vol. 26, Sec. IV, pp. 171-173, fig. 5 (1932).

changes are not sufficiently established and may not be uniform enough to be of chronological value.

Nine new species are described. A few species that have been hitherto inadequately described and figured are redescribed and properly illustrated.

Class Pelecypoda Goldfuss
Order Prionodesmacea Dall
Family NUCULIDAE ADAMS
Genus *Nucula* Lamarck
Nucula athabaskensis McLearn
Plate 1, figures 11 to 15.

1931. *Nucula athabaskensis* McLearn, Trans. Roy. Soc. Can., 3rd Ser., Vol. 25, Sec. IV, p. 7, pl. 1, fig. 5.

This is a subovate, only moderately convex species, somewhat narrowed anteriorly. The beaks are near the posterior end of the shell. The postero-dorsal margin is long and nearly straight. The escutcheon is fairly long and is bordered by a broad shallow furrow, deepest below. The lunule is long, very narrow and is bordered by a low ridge or angle. The inner margin is smooth. The posterior adductor scar is bordered anteriorly by a low ridge or buttress. The chondrophore is fairly large and is directed antero-ventrally. The teeth are long. The surface has fine irregular growth lines and is almost smooth. Scarcely perceptible radiating striæ appear on a few specimens.

Compared with *Nucula planimarginata* Meek and Hayden,[7] this species has only very rare and very faint radiating striæ and probably more excavated muscle scars. *Nucula gabbi* Stanton[8] from the Knoxville of California has more even growth lines.

The measurements of the holotype are:

Height 17.5 mm.
Length 24.5 mm.

Horizon and Locality. The lower part of the lower sandstone member of the Peace River formation, Peace River, and Clearwater formation, Athabaska River.

Types. National Museum of Canada; holotype, Cat. No. 6348; plesiotypes, Cat. Nos. 7406-7408.

Nucula sp.

[7]See Meek, F. B., U.S.G.S. Terr., vol. 9, p. 101, pl. 15, figs. 8a, b; pl. 29, fig. 16 (1876).

[8]Stanton, T. W., Bull. U.S.G.S. 133, p. 51, pl. 6, figs. 11, 12 (1896).

There is a species of *Nucula* in the fauna on Peace River distinct from the above. None of the specimens available are good enough to describe, however. It differs from *Nucula athabaskensis* by having a striate inner margin, radiating structure of subsurface layers of the shell and a more strongly delimited escutcheon.

Horizon and Locality. Lower part of the lower sandstone member of the Peace River formation, Peace River.

Family NUCULANIDAE STOLICZKA
Genus *Yoldia* Moller
Yoldia kissoumi McLearn
Plate 1, figures 1 to 3.

1931. *Yoldia kissoumi* McLearn, Trans. Roy. Soc. Can., 3rd ser., Vol. 25, Sec. IV, p. 7, pl. 1, figs. 2, 3.

This is a fairly convex species, depressed posteriorly. In outline it is longest at the hingeline, rounded anteriorly and narrowed posteriorly. The lunule is poorly defined. The escutcheon is bordered by a ridge and the two halves meet at a sharp angle. The surface has fine even growth lines and in addition, horizontal almost straight striæ on the sides which transgress the growth lines.

The outline is somewhat like that of *Yoldia microdonta* Meek[9] from the Cretaceous of Kansas. The ornament is different however. *Yoldia scitula* Meek and Hayden[10] and *Yoldia evansi* Meek and Hayden[11] of the Upper Cretaceous of the United States interior both differ in outline and lack the peculiar horizontal striations of this species.

The measurements of plesiotype, Cat. No. 7409 are:

Height 7.5 mm.
Length 14.5 mm.

Horizon and Locality. Clearwater formation, Athabaska River, and lower part of the lower sandstone member of the Peace River formation, Peace River.

Types. National Museum of Canada; holotype, Cat. No. 6346; paratype, Cat. No. 6347; plesiotype, Cat. No. 7409.

Family PERNIDAE ZITTEL
Genus *Inoceramus* Sowerby
Inoceramus dowlingi McLearn

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[9]Meek, F. B., U.S.G.S. Terr., vol. 9, p. 109, pl. 2, fig. 2 (1876).
[10]Meek, F. B., U.S.G.S. Terr. vol. 9, p. 110, pl. 28, fig. 9 (1876).
[11]Meek, F. B., U.S.G.S. Terr., vol. 9, p. 111, pl. 28, figs. 10a-c (1876).

1919. *Inoceramus dowlingi* McLearn, Geol. Surv. Can., Mus. Bull., 29, p. 11, pl. 3, figs. 7, 8.

The place of this species in the evolutionary sequence and its chronological value are worth considering. The succession of species of *Inoceramus* in the British Cretaceous has been studied by Henry Woods.[12] He interprets *Inoceramus neocomiensis* d'Orbigny as an early Aptian stage from which *Inoceramus anglicus* Woods arose in the Gault and was followed by *Inoceramus crippsi* Mantell and *Inoceramus pictus* Sowerby in the Lower Chalk or Cenomanian, each of which gave rise to an independent stock in the remaining part of the Cretaceous.

The succession in the Cretaceous of the Canadian interior, although it has its own peculiarities is at least partly the same. *Inoceramus dowlingi* McLearn with its even regular concentric ribs, evenly and moderately compressed form and upright outline is in the same stage of development as the Aptian *Inoceramus neocomiensis*. It is succeeded by the Lower Fort St. John *Inoceramus cadottensis* McLearn which shows an advance over it similar to that of *I. anglicus* over *I. neocomiensis*. The Upper Fort St. John *I. nahwisi* McLearn does not appear to have any counterpart in the British Cretaceous. The succeeding Dunvegan *Inoceramus dunveganensis* McLearn, however is in a stage of development somewhat similar to that of the Lower Chalk and Cenomanian *I. crippsi* var. *reachensis* Etheridge. The outline is becoming slightly oblique and the ribs fewer and more irregular.

So the succession is in part similar to that of the British Cretaceous and must have some chronological value. *Inoceramus dowlingi* supports the Aptian dating of the Clearwater formation based on the ammonoid *Deshayesites*.

Horizon and Locality. Rare, Clearwater formation, Athabaska River, Alberta.

Types. National Museum of Canada; holotype, Cat. No. 5398; paratype, Cat. No. 5399.

Family PTERIIDAE MEEK

Genus *Oxytoma* Meek

Oxytoma camselli McLearn

Plate 1, figures 4, 5.

1931. *Oxytoma camselli* McLearn, Trans. Roy. Soc. Can., 3rd ser., vol. 25, Sec. IV, p. 5, pl. 1, figures 7, 8.

[12]Woods, Henry, Quart. Jour. Geol. Soc. Lond., vol. 68, pp. 1-19, text figures (1912).

The left valve is moderately convex, about as long as high and slightly oblique in outline. The anterior wing is small and convex. Just below it the surface is concave. The posterior wing is large and its posterior border somewhat emarginate below. The surface has radiating fairly even striae. The interior shows a pronounced ridge along the lower border of the anterior wing.

Only the interior of the right valve is preserved in any of the available specimens. The right valve is much less convex than the left and there are faint broad radiating striæ on the interior. The byssal notch is not well preserved.

This species is smaller and less oblique than *Oxytoma nebrascensis* (Evans and Shumard).[13] In ornament it of course resembles those species of *Oxytoma* with even or nearly even radiating striae. It differs in ornament from those species of *Oxytoma* so characteristic of the Jurassic and early Cretaceous, including the genotype, which have distant coarse radiating striae with finer striae between.

The figured specimens are not complete enough for measurement. An unfigured specimen measures as follows:

Length 12.7 mm.
Height 11.2 mm.

Horizon and Locality. Lower part of the lower sandstone member of the Peace River formation, Peace River.

Types. National Museum of Canada;holotype, Cat. No. 6341; paratype, Cat. No. 6342.

Family PECTINIDAE LAMARCK
Genus *Entolium* Meek
Entolium irenense n. sp.
Plate 1, figures 9, 10.

The shell is depressed, rounded and somewhat higher than long. The ears are subequal, of about average size for the genus and diverge a little above the beaks. The surface is almost smooth. The growth lines are very fine, but coarser at intervals. The interior shows a large muscle scar just posterior to the middle, fairly well-defined crural ridges, the anterior of which is the longer. Each ridge ends in a small tubercle or pseudo-tooth. There is a resilium and a ligamental groove bordered by low ridges.

The height of the holotype is 41 mm., the length 37 mm., and the

[13] See Meek, F. B., U.S.G.S. Terr. vol. 9, p. 34, pl. 16, figs. 3a-b, pl. 28, fig. 11, (1876).

apical angle about 103 degrees. The apical angle varies from 102 to 115 degrees.

This species is somewhat larger than the Jurassic species *Entolium leachi* McLearn,[14] and on the average has somewhat larger ears. It has considerably larger ears than *Entolium hertleini* Crickmay.[15] The divergence of the ears is not so great as in *Amusium lenticulare* Whiteaves.[16] The concentric ridges and furrows of *Pecten* (*Syncyclonema*) *orbicularis* (Sowerby)[17] are not present.

Irenea is a classical name for the Peace country.

Horizon and Locality. Lower part of the lower sandstone member of the Peace River formation, Peace River, and Clearwater formation, Athabaska River.

Types. National Museum of Canada; holotype, Cat. No. 7410; paratype, Cat. No. 7411.

Genus *Pecten* Muller

Pecten alcesianus n. sp.

Plate 3, figure 3

This is an almost circular species a little higher than long. The left valve is moderately convex and the right slightly convex. The ears are of moderate size, nearly equilateral and the anterior is a little larger than the posterior. The surface is not well preserved, but was apparently covered by irregular and fairly well defined varices of growth. The measurements of the holotype, a left valve, are:

Length—86 mm.

Height—96.5 mm.

The exact generic position of this species is difficult to determine. There does not appear to be any surface *Camptonectes* ornament. *Pecten silentiensis* McLearn[18] is a smoother shell with differently shaped ears.

Horizon and Locality. Clearwater formation, Athabaska River, Alberta.

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[14]McLearn, F. H., Trans., Royal Soc. Can., vol. 18, sec. 4, p. 48, pl. 5, figs. 3, 11 (1924).

[15]Crickmay, C. H., Nat. Mus. Can. Bull. 63, p. 52, pl. 14, fig. 1 (1930).

[16]Whiteaves, J. F., Geol. Surv. Can., Mes. Foss., vol. 1, p. 242, pl. 32, fig. 5 (1884).

[17]Woods, Henry, Mon. Cretac. Lam., Pal. Soc. Lond., vol. 1, pt. 4, p. 145, pl. 27 and text fig. 1 (1902).

[18]McLearn, F. H., Geol. Surv. Can., Mus. Bull. 42, p. 124, pl. 22, figs. 1, 2, pl. 23, fig. 8 (1926).

Type. National Museum of Canada; holotype, Cat. No. 7412.

Genus *Camptonectes* Agassiz
Camptonectes matonabbei n. sp.
Plate 2, figures 11 to 13

The left valve is quite convex, somewhat higher than long, inequilateral, has the concave sloping antero-dorsal margin much longer than the postero-dorsal and has the anterior ear much larger than the posterior. The surface of the shell of the holotype is not preserved but that of a small paratype has radiating striae on the ears. The outlines of two specimens of right valves in the collections appear to be of this species. They are very gently convex in the umbonal part, flattened ventrally and almost smooth. Measurements of the holotype are:

Height—46 mm.
Length—40 mm.

Due to the proportionately greater length of the antero-dorsal margin, the outline is more inequilateral than that of *Camptonectes platessa* White[19] from the Upper Cretaceous of Arizona and Utah. The posterior margin is more rounded, the postero-dorsal margin is shorter, the outline is more inequilateral and the radiating striations on the ears are more distinct than in *Camptonectes cottaldinus* (d'Orbigny),[20] from the English Lower Cretaceous.

Matonabbee is the name of an Indian chief.

Horizon and Locality. Clearwater formation, Athabaska River, Alberta.

Types. National Museum of Canada; holotype, Cat. No. 7413; paratype, Cat. No. 7414.

Family Mytilidae Fleming
Genus *Brachydontes* Swainson
Brachydontes athabaskensis McLearn

1919. *Brachydontes athabaskensis* McLearn, Geol. Surv. Can., Mus. Bull. 29, p. 12, pl. 5, figs. 1, 2.

The radiating sculpture is exceedingly fine and increasingly so from the postero-dorsal part of the shell to below the postumbonal slope,

[19]White, C. A., U.S. Geol. Surv. West 100th Meridian, vol. 4, p. 176, pl. 17, fig. 5a (1876).

[20]Woods, Henry, Mon. Cretac. Lam., Pal. Soc., vol. 1, part 4, p. 156, pl. 29, figs. 1, 2a, b, 3a, b (1902).

where the radiating lines seem to be absent. The very fine striae only show on the mold of the exterior and on the paratype which is the mold of the holotype. Other specimens may be of this species, but the surface is not well enough preserved to show whether the fine radiating ornament is present.

Horizon and Locality. Clearwater formation, Athabaska River.

Types. National Museum of Canada; holotype, Cat. No. 5403; paratype, Cat. No. 5404.

Order Anomalodesmacea Dall
Family PHOLADOMYACIDAE GRAY
Genus *Goniomya* Agassiz
Goniomya matonabbei n. sp.
Plate 1, figure 8

A broadly ovate, moderately convex species, rounded anteriorly and obliquely truncate posteriorly. The surface has rather irregular concentric ridges. The V-shaped ornament does not descend to the ventral part of the shell, at least on the left valve. Dentition and interior are not known. Measurements of the holotype are:

Height—33 mm.
Length—66 mm.

This is a more broadly ovate species than *Goniomya americana* Meek and Hayden,[21] and the V-shaped ornament appears to cover less of the surface.

A few specimens, poorly preserved, in the collections may be of another species.

Matonabbee is the name of an Indian chief.

Horizon and Locality. Clearwater formation, Athabaska River, Alberta.

Type. National Museum of Canada; holotype, Cat. No. 7415.

Family THRACIIDAE DALL
Genus *Thracia* Leach
Thracia kissoumi n. sp.
Plate 1, figures 6, 7

This is a semiovate, fairly convex species with the right valve considerably deeper than the left. The umbones and beaks are not prominent. The outline is broad and rounded anteriorly and narrower and

[21] Meek, F. B., U.S. Geol. Surv. Terr., vol. 9, p. 221, pl. 30, figs. 12a, b (1876).

rounded-truncate posteriorly. The somewhat depressed postero-dorsal part of the valve is separated from the rest by a low carina. The surface is not well preserved but is marked by irregular concentric growth ridges. The measurements of the holotype are:

Height—28 mm.
Length—37 mm.

Compared with *Thracia phillipsi* Roemer[22] from the Lower Cretaceous Speeton clay of England, this species is smaller, somewhat less elongate, has less prominent umbones and beaks and is more inequivalve. It is smaller and less elongate than *Thracia prouti* Meek and Hayden[23] from the American Upper Cretaceous and much less elongate than *Thracia gracilis* Meek and Hayden.[24]

Horizon and Locality. Lower part of the lower sandstone member of the Peace River formation, Peace River, Alberta.

Type. National Museum of Canada; holotype, Cat. No. 7416.

Family POROMYACIDAE DALL
Genus *Psilomya* Meek
Psilomya peterpondi n. sp.
Plate 2, figures 6, 7; plate 3, figure 1

This is a thin-shelled, quite convex species of semiovate outline. The umbones are broad and high above the hingeline. The beaks are small, incurved and slightly curved forward and situated a little in front of middle to one-third distance from the anterior end. The surface is flattened to slightly concave on the middle of the sides. The postumbonal slope is well rounded and above it the surface is inflected, but well rounded. The anterior margin is well rounded, the ventral margin straight to slightly emarginate and the posterior margin rounded below and obliquely truncate above. There is a short external ligament posterior to the beaks. The shell is slightly gaping posteriorly. It is apparently covered with fine and low varices of growth. No granules or radial lines are observed, but not enough of the surface is present to say they are absent.

The interior has low concentric undulations. The pallial line is

[22]See Woods, Henry, Mon. Cretac. Lam., Pal. Soc., vol. 2, part 6, p. 240, pl. 39, figs. 7-9 (1909).

[23]See Meek, F. B., U.S. Geol. Surv. Terr., vol. 9, p. 225, pl. 37, figs. 6a, b (1876).

[24]See Meek, F. B., U.S. Geol. Surv. Terr., vol. 9, p. 224, pl. 39, figs. 6a, b (1876).

not distinct. There is apparently no actual pallial sinus, but the pallial line is straight to slightly emarginate below the posterior adductor scar. The dentition is unknown.

Measurements of the holotype are:

Height—20 mm.
Length—28.5 mm.

Measurements of paratype No. 7418 are:

Height—25 mm.
Length—36 mm.

There is no very closely similar species. It differs from *Psilomya lata* Forbes[25] from the Indian Cretaceous in the presence of an obliquely truncate, not rounded, posterior outline, the well defined postumbonal slope, concave lateral slopes and the apparent absence of granules, radial lines, etc.

The proportions are somewhat similar to those of *Liopistha* (*Psilomya*) *concentrica* Stanton[26] from the Coloradoan of the United States interior, but there are important differences in posterior outline, shape of sides, etc.

Although the dentition is not preserved the species is provisionally referred to *Psilomya* on the basis of general form and lack of pallial sinus.

Named for Peter Pond, trader and explorer.

Horizon and Locality. Clearwater formation, Athabaska River, and lower part of the lower sandstone member of the Peace River formation, Peace River, Alta.

Types. National Museum of Canada; holotype, Cat. No. 7417; paratype, Cat. No. 7418.

Psilomya elongatissima n. sp.
Plate 3, figure 2

This is a moderately convex elongate thin-shelled species. The beaks are situated a little in front of the middle to about one-quarter the length from the anterior end. The shell is evenly convex, and somewhat compressed posteriorly. The anterior margin is well rounded, the ventral margin rounded and the posterior margin obliquely truncate above. Very little of the surface is preserved and it shows low varices of growth. Low concentric undulations show in the mold

[25]See Stoliczka, Ferd., Pal. Indica, Cretac. Fauna Southern India, vol. 3, Pelecypoda, p. 47, pl. 2, figs. 8, 9, pl. 16, fig. 17 (1871).

[26]Stanton, T. W., U.S. Geol. Surv. Bull. 106, p. 119, pl. 26, figs. 8-10 (1893).

of the interior. The pallial line and dentition are not known. The species is referred provisionally to *Psilomya,* on basis of general form, but with less certainty than *P. peterpondi* n. sp.

Measurements of holotype are:

Height—29 mm.
Length—45.5 mm.

This species is more elongate than *P. peterpondi* n. sp., is more evenly convex, less convex and more compressed postero-ventrally. It is very close to *Liopistha* (*Psilomya*) *elongata* Stanton[27] from which it differs mainly in being more elongate and a little larger. If these shells could be shown to be as similar in dentition and other interior characters as they appear to be in external form, a closer relationship would have to be inferred.

Horizon and Locality. Clearwater formation, Athabaska River, Alta.

Type. National Museum of Canada; holotype, Cat. No. 7419.

Order Teleodesmacea Dall
Family PLEUROPHORIDAE DALL
Genus *Arctica* Shumacher
Arctica limpidiana n. sp.
Plate 2, figures 3 to 5

This is a quite convex species of somewhat less than average size. It is longer than high, somewhat obliquely truncate posteriorly and rounded anteriorly. The umbones are broad. The beaks are a little in advance of the middle. The rounded postumbonal slope has the surface inflected above it. On this inflected surface a narrow sulcus sets off a narrow escutcheon adjacent to the dorsal margin. No lunule is defined. The surface is fairly smooth with low varices of growth.

The external ligament is rather short. The dentition is of *Arctica* (*Cyprina*) pattern. In the right valve the posterior cardinal is thick and divided. The middle cardinal is narrow, almost plate-like. The anterior cardinal is below the middle cardinal. Above it is a socket for the anterior cardinal of the left valve. There is a fairly long posterior lateral tooth and socket above it. In the left valve, the posterior cardinal is long and narrow, the middle cardinal divided and the anterior cardinal narrow. The posterior lateral dentition not well preserved. The pallial line is entire.

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[27]Stanton, T. W., U.S. Geol. Surv., Bull. 106, p. 119, pl. 26, figs. 11, 12 (1893).

The measurements of paratype are as follows:

Height—17.2 mm.

Length—22.5 mm.

Cyprina saussuri (Brongniart)[28] from the Aptian of France and Lower Greensand of England is larger and has an angular postumbonal slope. *Cyprina sedgwicki* (Walker)[29] from the Lower Greensand of England, is larger and more rounded posteriorly.

The dentition is much like that of a modern *Arctica,* e.g. *Arctica islandica.* The right posterior cardinal tooth is not so broad, the left middle cardinal tooth is broader and left posterior cardinal is not relatively so long as in that species however.

Horizon and Locality. Clearwater formation, Athabaska River, Alberta.

Types. National Museum of Canada; holotype, Cat. No. 7420; paratype, Cat. No. 7421.

Family CARDIIDAE FISCHER

Genus *Protocardia* Beyrich

Protocardia alcesiana n. sp.

Plate 2, figures 14 to 16

A small, very convex species with subcentral beaks, abruptly rounded postumbonal slopes and rounded anterior, ventral and posterior margins. There are wide low radiating ribs on the postumbonal slope and just in front of it and finer ribs behind it. Pallial line and dentition not known.

Measurements of holotype:

Height—14.5 mm.

Length—17.0 mm.

Two crushed specimens are considerably larger than the type.

Compared with *Protocardia borealis* Whiteaves,[30] the anterior part of the shell, in front of the beaks, is longer and more broadly rounded, and the posterior part, behind the beaks, is less oblique, *i.e.,* is less produced postero-ventrally. It differs considerably from *Protocardia hillana* (Sowerby),[31] *e.g.,* it is smaller and less rounded in outline.

[28]Woods, Henry, Mon. Cretac. Lam., Pal. Soc. Lond., vol. 2, pt. 3, p. 131, pl. 19, figs. 7-13 (1906).

[29]Woods Henry, Mon. Cretac. Lam., Pal. Soc. Lond., vol. 2, pt. 4, p. 133, pl. 19, fig. 14, pl. 20, figs. 1-5 (1907).

[30]Whiteaves, J. F., Geol. N.H. Surv. Can., Contr. Can. Pal., vol. 1, part 1, p. 41, pl. 6, figs. 1, 1a, 2, 2a (1885).

[31]See Woods, Henry, Mon. Cretac. Lam., Pal. Soc. Lond., vol. 2, pt. 5, p. 197, pl. 31, figs. 6a-c; pl. 32, figs. 1-6 (1908).

Alcesia is a Latin rendering of the name Athabaska.

Horizon and Locality. Clearwater formation, Athabaska River, Alberta.

Types. National Museum of Canada; holotype, Cat. No. 8001; paratype, Cat. No. 8002.

Genus *Integricardium* Rollier
Subgenus *Onestia* n. subgen.

Generic reference:

1912. *Integricardium* Rollier, Mem. Soc. Pal. Suisse, vol. 38, pt. 2, p. 127.

The subgenus is made for subquadrate fairly convex shells without radial ornament and with smooth inner margin and in the right valve with two conical and somewhat arched cardinal teeth, anterior and posterior lateral dental sockets at some considerable distance from the cardinals and small, little projecting lateral teeth. On the interior an illdefined ridge runs from in front of the posterior adductor towards, but not to, the beaks. The external ligament is short and set in a deep groove.

Typical *Integricardium* (genotype, *Cardium dupinianum* d'Orbigny), has a more *Arctica*-like outline and larger, more projecting lateral teeth.

The outline and form are much as in *Thetironia* Stoliczka[32] and the dentition is similar. The internal angular rib and surface radiating lines, pits or spines of *Thetironia* are absent, however. *Laevicardium* Swainson has a different outline, more fragile shells, some, if faint, radial ornament, deeper lateral dental sockets, and more prominent lateral teeth. *Serripes* Beck has some, if reduced, radial ornament and reduced dentition.

The sub-genotype is *Laevicardium onestae* McLearn.

Integricardium (*Onestia*) *onestae* (McLearn)
Plate 2, figures 8 to 10

1931. *Laevicardium onestae* McLearn, Trans. Roy. Soc. Can., 3rd ser. vol. 25, Sec. IV, p. 7, pl. 1, fig. 1.

This is a subquadrate, moderately to fairly convex species with the umbones a little anterior to the middle. The posterior margin is

[32]Stoliczka, Ferd., Pal. Indica, Cretaceous Fauna of Southern India, vol. 3, p. 158 (1870).

oblique, very slightly convex and nearly truncate above. The anterior and basal margins are very moderately convex. The hingeline is moderately long. The postumbonal slope is abruptly rounded and the surface has only fine irregular lines and varices of growth. The ligament is short, lies between the beak and the posterior dental groove and is set in a deep groove. On the plesiotype specimens the anterior cardinal tooth of the right valve is somewhat arched and conical or produced. Posterior to it is a deep almost cylindrical rounded socket. Then follows a large tooth, likely conical, but the top is broken off. Posterior to it is a broad shallow groove. This part of the dentition is much like that of *Cardium*. Shallow dental lateral sockets and little projecting lateral teeth are situated some distance anterior and posterior to the cardinal teeth. The adductor scars are somewhat subquadrate in outline. There is no pallial sinus, but the pallial line is slightly sinuous and vertical below the posterior adductor scar. An ill-defined ridge runs from in front of the posterior adductor scar towards, but not to, the beaks.

In appearance this species resembles those of *Thetironia,* but it lacks the ornament and internal rib of that genus, as noted above.

The measurements of the holotype are:

Height—25 mm.
Length—32 mm.

Horizon and Locality. Clearwater formation, Athabaska River, and in the lower part of the lower sandstone member of the Peace River formation, Peace River, Alberta.

Types. National Museum of Canada; holotype, Cat. No. 6345; plesiotypes, Cat. Nos. 8003, 8004.

Family TELLINIDAE DESHAYES
Genus *Tellina* Linnaeus
Tellina dowlingi McLearn

1919. *Tellina dowlingi* McLearn, Geol. Surv. Can., Mus. Bull. 29, p. 12, pl. 5, figs. 3-6.

There are really two varieties of this species. The holotype (fig. 3) and the paratype No. 5406 (fig. 6) are rather compressed. The other variety including paratypes Nos. 5406a (fig. 5) and 5406b (fig. 4) is much more convex. There does not seem to be any necessity for giving the more convex variety a new name however.

Horizon and Locality. Clearwater formation, Athabaska River,

and lower part of the lower sandstone member of the Peace River formation, Peace River, Alberta.

Types. National Museum of Canada; holotype, Cat. No. 5405; paratypes, Cat. Nos. 5406, 5406a and 5406b.

Family PHOLADIDAE FISCHER
Genus *Turnus* Gabb
Turnus lacombi n. sp.
Plate 2, figures 1, 2

The somewhat elongate globose shell has a gently sinuous concave anterior margin without any rectangular notch. The umbonal sulcus is a little oblique. The anterior part of the surface is ornamented by very fine, but elevated costae and the posterior part by rather regular varices of growth. The internal umbonal rib is fairly stout and somewhat crenate. The posterior internal rib is not far behind the umbonal internal rib and is quite elevated. Approximate measurements of the holotype are:

Length—30 mm.
Height—23 mm.

Compared with *Turnus dallasi* (Walker),[33] the outline is not quite so elongate and the internal posterior rib is closer to the umbonal, *i.e.*, is directed less posteriorly. This species appears to be more closely related to *Turnus plenus* Gabb[34] from the "Shasta group" of Cottonwood creek, California, in general form and in the position of the posterior internal rib. The surface ornament posterior to the umbonal sulcus is less regular however.

The species name is given for Father Lacombe.

Horizon and Locality. Clearwater formation, Athabaska River, Alberta.

Types. National Museum of Canada; holotype, Cat. No. 8005; paratype, Cat. No. 8006.

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[33]See Woods, Henry, Mon. Cretac. Lam., Pal. Soc., vol. 2, pt. 6, p. 233, pl. 38, figs. 14a, b and 15 (1909).

[34]Gabb, W. M., Pal. California, vol. 1, p. 146, pl. 22, fig. 116 (1864).
Stewart, Ralph B., Acad. Nat. Sci. Phil., Spec. Publ. 3, Gabb's California Cretac. and Tert. Type Lamellibranchs, p. 296, pl. 4, fig. 3 (1930).

EXPLANATION OF PLATES

(All figures are of natural size, unless otherwise indicated.)

PLATE 1

Yoldia kissoumi McLearn (page 142)

FIGURE 1.—Right valve of holotype. Nat. Mus. Can., Cat. No. 6346.

FIGURE 2.—Right valve of plesiotype. Nat. Mus. Can., Cat. No. 7409.

FIGURE 3.—Left valve of paratype X 2. Nat. Mus. Can., Cat. No. 6347.

Oxytoma camselli McLearn (page 143)

FIGURE 4.—Left valve of holotype. Nat. Mus. Can., Cat. No. 6341.

FIGURE 5.—Left valve of paratype X 2. Nat. Mus. Can., Cat. No. 6342.

Thracia kissoumi McLearn (page 147)

FIGURE 6.—Left valve of holotype. Nat. Mus. Can., Cat. No. 7416.

FIGURE 7.—Anterior view of same.

Goniomya matonabbei McLearn (page 147)

FIGURE 8.—Mold exterior both valves of holotype. Nat. Mus. Can., Cat. No. 7415.

Entolium irenense McLearn (page 144)

FIGURE 9.—Exterior of paratype. Nat. Mus. Can., Cat. No. 7411.

FIGURE 10.—Interior of right valve of holotype. Nat. Mus. Can., Cat. No. 7410.

Nucula athabaskensis McLearn (page 141)

FIGURE 11.—Posterior view of plesiotype X 2. Nat. Mus. Can., Cat. No. 7408.

FIGURE 12.—Interior left valve of plesiotype. Nat. Mus. Can., Cat. No. 7406.

FIGURE 13—Interior left valve of plesiotype. Nat. Mus. Can., Cat. No. 7407.

FIGURE 14.—Right valve of holotype. Nat. Mus. Can., Cat. No. 6348.

FIGURE 15.—Dorsal view of plesiotype X 2. Nat. Mus. Can., Cat. No. 7408.

PLATE 2

Turnus lacombi McLearn (page 154)

FIGURE 1.—Right valve of holotype. Nat. Mus. Can., Cat. No. 8005.

FIGURE 2.—Internal umbonal rib of paratype X 2. Nat. Mus. Can., Cat. No. 8006.

Arctica limpidiana McLearn (page 150)

FIGURE 3.—Right valve of paratype. Nat. Mus. Can., Cat. No. 7421.

FIGURE 4.—Interior right valve of holotype. Nat. Mus. Can., Cat. No. 7420.

FIGURE 5.—Dorsal view of same.

Psilomya peterpondi McLearn (page 148)

FIGURE 6.—Right valve of holotype. Nat. Mus. Can., Cat. No. 7417.

FIGURE 7.—Dorsal view of same.

Integricardium (Onestia) onestae McLearn (page 152)

FIGURE 8.—Interior right valve plesiotype. Nat. Mus. Can., Cat. No. 8004.

FIGURE 9.—Interior right valve plesiotype. Nat. Mus. Can., Cat. No. 8003.

FIGURE 10.—Left valve of holotype. Nat. Mus. Can., Cat. No. 6345.
Camptonectes matonabbei McLearn (page 146)

FIGURE 11.—Ears of specimen of figure 13 X 2.

FIGURE 12.—Left valve of holotype. Nat. Mus. Can., Cat. No. 7413.

FIGURE 13.—Left valve of paratype. Nat. Mus. Can., Cat. No. 7414.
Protocardia alcesiana McLearn (page 151)

FIGURE 14.—Posterior view of paratype X 2. Nat. Mus. Can., Cat. No. 8002.

FIGURE 15.—Right valve of paratype. Nat. Mus. Can., Cat. No. 8002.

FIGURE 16.—Left valve of holotype. Nat. Mus. Can., Cat. No. 8001.

PLATE 3

Psilomya peterpondi McLearn (page 148)

FIGURE 1.—Left valve of paratype. Nat. Mus. Can., Cat. No. 7418.
Psilomya elongatissima McLearn (page 149)

FIGURE 2.—Right valve of holotype. Nat. Mus. Can., Cat. No. 7419.
Pecten alcesianus McLearn (page 145)

FIGURE 3.—Shell of holotype mostly exfoliated. Nat. Mus. Can., Cat. No. 7412.

PLATE I


1


2

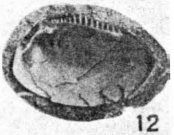

×2 3


4


10


×2 11


×2 5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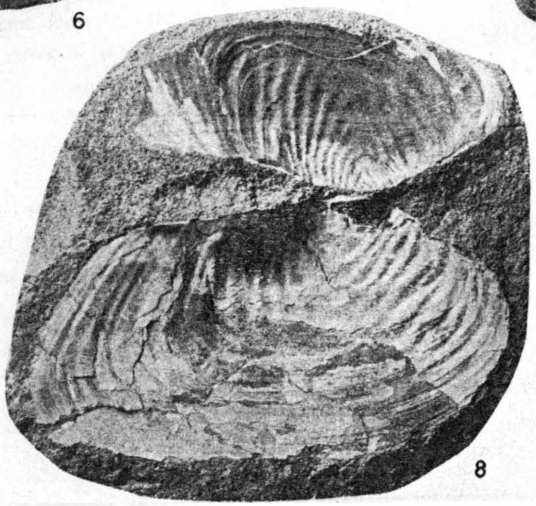
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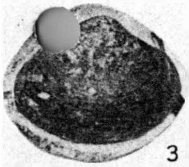
×2 15

PLATE II



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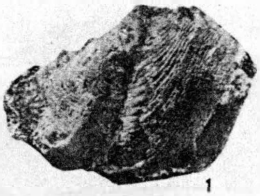

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X 2

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X 2

14

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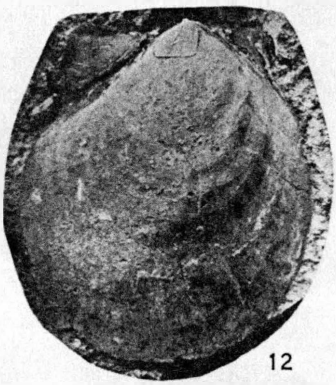

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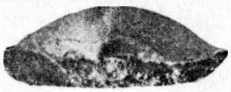

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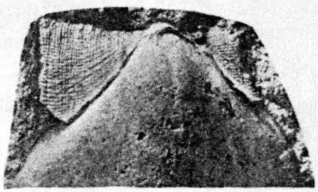

X 2

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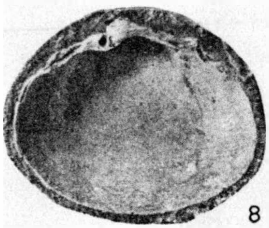

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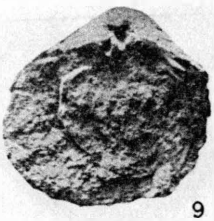

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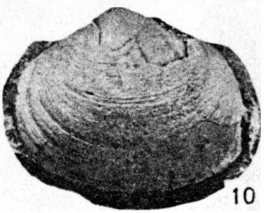

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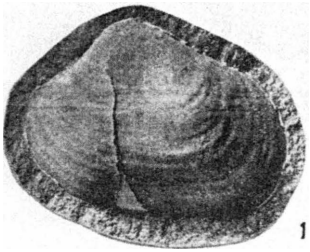

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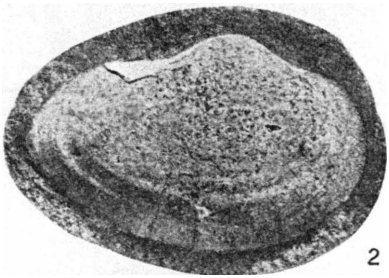

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