#### JURASSIC (OXFORDIAN) AMMONITES FROM THE FERNIE FORMATION OF WESTERN CANADA: A GIANT PELTOCERATINID, AND CARDIOCERAS CANADENSE WHITEAVES

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#### Abstract

A new occurrence of a giant peltoceratinid ammonite is described from southern Alberta. It is closely associated with Buchia concentrica (Sowerby) and a small perisphinctid fragment, which are also figured. New material of Cardioceras canadense Whiteaves from its type locality in southeastern British Columbia is figured. Both occurrences are in the Oxfordian beds ('Green beds') of the Fernie Formation.

#### Résumé

De nouvelles observations faites dans le sud de l'Alberta ont permis de relever la présence d'une ammonite géante de type peltoceratinidé. Cette devinère est étroitement associée à *Buchia concentrica* (Sowerby) et à un petit fragment de périsphinctidé qui est également figuré. De nouveaux spécimens de *Cardioceras canadense* Whiteaves prélevés dans leur localité type dans le sud-est de la Colombie-Britannique sont figurés. Dans les deux cas, les spécimens observés se trouvaient dans les couches oxfordiennes ("couches vertes") de la formation de Fernie.

### INTRODUCTION

The purpose of this report is twofold: first, to describe and illustrate the first occurrence in Canada, and possibly in North America, of a giant peltoceratinid ammonite (family Aspidoceratidae Zittel, 1895) and second, to illustrate new topotypes of the cardioceratid ammonite *Cardioceras canadense* Whiteaves. Both occurrences are from Oxfordian beds, the first from southwestern Alberta, the second from southeastern British Columbia. Both collections come from the 'Green beds' of the Fernie Formation.

Ammonites of the Tethyan family Aspidoceratidae are most uncommon in Canada where Upper Jurassic faunas are doininated by Boreal taxa, belonging mainly to the family Cardioceratidae Siemiradzki, 1891. In Canada, only *Physodoceras* sp. has been illustrated previously (Poulton et al., 1988). Elsewhere in North America the family is represented by *Peltoceras* from California and Mexico and *Aspidoceras* from Mexico, Texas and Cuba (summarized by Imlay, 1980).

Upper Jurassic perisphinctid and other ammonites have recently been described from southwestern British Columbia (Poulton et al., 1988), but Alaskan occurrences of two significant specimens were overlooked. They were described by Imlay (1981) as Aulacosphinctoides and Subplanites(?), These occurrences extend the range of these lower Tithonian taxa from Mexico and the Caribbean to Alaska. They may not be identical with the Canadian Discosphinctoides(?) aff. D. neohispanicum Burckhardt or Lithacoceras(?) respectively, both described by Poulton et al. (1988), but their close morphological similarities, probably similar or identical age, and paleobiogeographic significance are noteworthy. Another giant ammonite, '*Titanites*' occidentalis Frebold, 1957 occurs in probably latest Jurassic basal beds of the Kootenay Formation at Coal Creek near Fernie, and a fragment that may be of the same species has been found north of Sparwood (Hamblin and Walker, 1979). Because of the presence of this other specimen, there has been confusion and speculation regarding the identification, age, and stratigraphic position of the ammonite described here for the first time, but already widely known among the specialist community. The two giant specimens are not to be confused.

The first specimens of *Cardioceras canadense* Whiteaves to be found since the original description in 1903 are figured and described, confirming the hitherto uncertain locality suggested for that original collection. This species had been considered a doubtful indicator of the presence of Oxfordian material because its locality was thought to be suspect, or possibly to involve transported material (Frebold, 1957).

#### SYSTEMATIC DESCRIPTIONS

Superfamily PERISPHINCTACEAE Steinmann, 1890

Family ASPIDOCERATIDAE Zittel, 1895

Subfamily PELTOCERATINAE Spath, 1924

Peltoceratinid ammonite, indet.

Plate 7.1, figures 1-3.

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Description. The specimen is ornamented with 14 pronounced ribs that are simple, straight, and continuous across the venter. The cross-section of each rib is gently rounded as are the intercostal spaces, which are about as wide as the ribs. The cross-section and strength of each rib are very regular on the smaller end of the whorl preserved, but the ribs become more subdued and irregular in strength and spacing toward the larger, adoral end. This specimen does not exhibit the tubercles or other knobs and modified ribbing on the body chamber that characterize most other macroconch peltoceratinids.

The cross-section of the shell is subquadrate, with gently rounded ventrolateral edges bordering a flattened narrow venter. The ribs are mildly strengthened along the ventrolateral rounded edges. The flanks are very gently rounded and gently convergent toward the venter.

Measurements. The small remaining portion of a giant outer whorl measures 120 cm along the venter, subtending a chord of 113 cm. Different calculations, derived from the ratios of various measurements made on the specimen itself and a scale drawing, result in approximations of the diameter of a circle which includes the fragmentary periphery preserved, varying from 2 to 3 metres. Most methods result in circular diameters between 200 and 240 cm, and the figure resulting from the best fit of the periphery of the specimen to a curve, results in a circular diameter of 216 cm. Because of postmortem distortion resulting in a very uneven periphery , and accumulated error in gluing the individual fragments together in reconstruction, these approximations are crude.

Western Canadian giant perisphinctid, Another 'Titanites' occidentalis Frebold, has an ultimate whorl height/diameter ratio of about 35 per cent, similar to that of several published peltoceratinid specimens (Arkell et al., 1957). Assuming a constant rate of expansion, the diameter of the giant peltoceratinid described here can be calculated using this ratio, to be have been about 178 cm, placing it amongst the largest ammonites known. Another (unfigured) fragment of the same giant ammonite is larger than any of the other pieces, and indicates a whorl height well in excess of its measurable 32 cm; this does not extend to either the umbilical or ventrolateral edges. Such a size is consistent with an approximate diameter of 1.78 m or larger. All of the pieces available are non-septate, indicating that the specimen is represented only by body chamber fragments.

Occurrence and age. This giant ammonite specimen was collected by the late H. Frebold 30 to 35 years ago, in the 'Green beds' of the Fernie Formation along Carbondale River, southwestern Alberta. Frebold hired a local blaster to use explosives to remove the specimen. It was then shipped to Ottawa where efforts to restore it were not completed, and the specimen was put into dead storage and assumed lost until now. Because of the character of the shipping container, the size of the specimen, and the lithology of the matrix, the specimen described here is almost certainly the one collected by Frebold. Only a small portion of a giant whorl, and a few other smaller pieces remain. How much of the giant ammonite was originally collected and shipped is not known. The remaining fragments were assembled by Roger Michie.

From various localities, the 'Green beds' have yielded lower Oxfordian Cardioceras and Goliathiceras species, and upper Oxfordian (or lower Kimmeridgian?) Buchia concentrica (Sowerby), as well as a rich variety of other fossils, including various bivalves, gastropods, belemnites, vertebrates and microfauna (Lambe, 1914; Frebold, 1957; Frebold et al., 1959; Poulton, 1984). The lower beds of the stratigraphically equivalent unit in the western interior U.S.A., i.e. the lower part of the Swift Formation (Reeside, 1919; Imlay, 1980), contain the upper Callovian ammonite *Quenstedtoceras collieri* Reeside as well as lower Oxfordian ammonites and the upper Oxfordian bivalve *Buchia concentrica*. An upper Callovian through Oxfordian range for the giant is thus permissible, the same range as the subfamily Peltoceratinae worldwide. *Buchia concentrica* (Sowerby) occurs in what is probably the same outcrop on Carbondale River, giving a late Oxfordian or early Kimmeridgian age for some of the beds, but not necessarily the same bed that yielded the giant.

The green and rusty ochre-coloured sandstone matrix of the specimen confirms the origin of the peltoceratinid as being in the 'Green beds'. There is only one outcrop of the 'Green beds' along Carbondale River from which the ammonite could have come. It is on the north bank, south of Hillcrest, about 1.6 to 1.8 km east of the bridge over Lynx Creek, about 49°27.5'N latitude, 114°23'W longitude and is shown in the southern part of the tightly deformed core zone of the Turtle Mountain Anticlinorium by Norris (1959; see also McLearn, 1929 [as "Castle River"]; Frebold, 1957; Price, 1962; Hall and Stronach, 1982; Hall, 1984). The beds are disturbed by faulting and folding and thicknesses cannot be measured accurately, but there are about 12 to 16 m of 'Green beds'. Fossils collected in 1958 by D.K. Norris from what must be the same outcrop (GSC locality 41490) include an indeterminable perisphinctid ammonite fragment (Pl. 7.1, fig. 4) and Buchia concentrica (Sowerby) (Pl. 7.1, figs. 5,6). Additionally H. Frebold (pers. comm. to D.K. Norris, 1960) identified Cardioceras(?) and belemnites. The last two taxa cannot be confirmed in the existing collections, and are missing. Buchia concentrica from this locality has been figured previously (Frebold, 1957, Pl. XXXVIII, figs. 4a,b; 1964, Pl. XLVII, fig. 7). These fossils come from the upper part of the 'Green beds'. Other fossils reported from this locality include the gastropod "Turbo" ferniensis Frebold (1957; Hall and Stronach, 1982).

Superfamily STEPHANOCERATACEAE Neumayr, 1875

Family CARDIOCERATIDAE Siemiradzki, 1891

Subfamily CARDIOCERATINAE Siemiradzki, 1891

Genus Cardioceras Neumayr and Uhlig, 1881

Cardioceras canadense Whiteaves, 1903

Plate 7.1, figures 7-13.

Cardioceras canadense Whiteaves, 1903, p. 66, figs. la,b.

- non Cardioceras canadense Whiteaves. Reeside, 1919, p. 20, Pl. XVII, figs. 5-11.
- Cardioceras canadense Whiteaves. Frebold, 1957, Pl. XXIV, figs. 2a,b; Frebold, 1964, Pl. XLVII, figs. 3a,b.
- ?Cardioceras (Vertebriceras) whiteavesi Reeside. Imlay, 1981, p. 34, Pl. 7, figs. 4-6.
- non Cardioceras (Subvertibriceras) canadense Whiteaves. Imlay, 1982, p. 38, Pl. 26, figs. 14-33.
- Cardioceras (Cawtoniceras) canadense Whiteaves. Callomon, 1984, p. 156.

Occurrence. The present specimens were collected by D.W. Gibson on the northwest, upper slopes of Fernie Ridge, in outcrops on the old Hosmer road from Fernie (UTM coordinates: Zone 11, 438867) (GSC locality C-142226). This locality conforms well with that described for the holotype of the specimen (Whiteaves, 1903; Frebold, 1957), and its proximity to the trail from Fernie makes it highly probable that this was Whiteaves' original locality: "near the top of a ridge running North 20 degrees East and situated 2 1/4 miles [3.62 km] North 70 degrees East from Fernie, B.C., about 4,000 feet [1219] m above sea level".

Remarks. The holotype has been described well and figured repeatedly (Whiteaves, 1903, figs. 1,1a; Frebold, 1957, Pl. XXXIV, figs. 1,2; 1964, Pl. XLVII, figs. 3a,b; 1970, Pl. XXII, fig. 12) and no description is repeated here. It is noteworthy that neither the holotype nor the newly discovered topotypes exhibit well developed bifurcating secondary ribs, a characteristic feature of the subgenus Cawtoniceras (Arkell et al., 1957), of Cardioceras (Cawtoniceras) cawtonense Blake and Hudleston (1877), with which Callomon (1984) compared C. canadense, and of those specimens from the American Western Interior that were erroneously identified as C. canadense by Reeside (1919) and Imlay (1982). Bifurcation of a few secondary ribs can be seen vaguely on only two specimens (Pl. 7.1, figs. 7 and 11). The American species also contain much more finely spaced secondary ribs, and the connecting riblets between the ventrolateral nodes and the keel are stronger. There is, in the Canadian species therefore, a feebly developed, nearly smooth or weakly ornamented spiral band between the two (Pl. 7.1, figs. 9-12), as there is also between the lateral and ventrolateral rows of nodes (Pl. 7.1, figs. 9,11,13). The spiral, nearly smooth, bands are ornamented only with the very weak fading extensions of the nodes that lie in the umbilical direction from them. The secondary ribs at intermediate growth stages are nodes or tubercles, only slightly elongated radially, and the ventral ends of the primary ribs are also enlarged into nodes. Only in the largest growth stage seen (Pl. 7.1, fig. 7) is there a significant elongation of the weak secondary ribs.

One specimen from Alaska, identified probably erroneously as C. (Vertebriceras) whiteavesi Reeside by Imlay (1981, p. 34, Pl. 7, figs. 4-6) may be identical with C. canadense, especially in view of the variability in strength and spacing of the ventrolateral nodes/secondary ribs in C. canadense (compare Pl. 7.1, fig. 13 of this report with Pl. 7, fig. 5 of Imlay, 1981). However, identity cannot be firmly established on the basis of the single partial specimen from Alaska, which represents a different growth stage from those preserved in Canada.

In spite of the differences of C. canadense from the American species mentioned above, the general similarities probably justify their interpretation as approximate ageequivalents. The same holds true of the detailed differences from, but general similarities with. C. cawtonense and with other species mentioned below, so that the correlation with the upper Maltonense Subzone of the Middle Oxfordian Densiplicatum Zone (Callomon, 1984) is probably valid. Of several similar species worldwide, the closest to C. canadense with nearly smooth or very weakly ornamented spiral bands seems to be C. schellwieni Boden, 1911 from Lithuania and from the uppermost Densiplicatum or lowermost Tenuiserratum zones ("St. Ives Rock") of England (Arkell, 1941; Wright and Callomon, 1980). Also, close similarities exist with Cardioceras (Maltoniceras) brightoni Arkell (1941, 1942) from the same beds in England, although its primary ribs are stated to be entirely suppressed, in contrast to those of C. canadense.

The presence of a fragment reportedly undifferentiable from C. canadense from the Lilloett area, southwestern British Columbia (Reeside, 1919; Frebold, 1957), cannot be confirmed or disproven because it was never illustrated nor was any unique identifying number given to it. It is probably not the same specimen described as C. lillooetense by Reeside (1919) and Imlay (1981), which differs from C. canadense in the regularity of the ribbing and its the entire flank. "Čardioceras continuity over (Subvertebriceras) cf. C. (S.) canadense (Whiteaves)" reported by Frebold and Tipper (1975) from west central British Columbia differs in its continuity of primary and secondary ribs.

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# PLATE 1

Figures 1-3. Peltoceratinid ammonite.

Figured specimen GSC 89748, from Carbondale River south of Hillcrest, Fernie map-area (82G), Alberta. Lateral view (adoral direction to the left) and oblique ventral and lateral views (adoral direction to the right), x0.155. Total (straight) length of specimen 113 cm.

Figure 4. Perisphinctid ammonite, indet.

Small fragment (figured specimen GSC 87190) from GSC locality 41490; probably same locality as specimen in figures 1-3. Actual size.

Figures 5, 6. Buchia concentrica (Sowerby).

Figured specimens GSC 87191 and 87192 from GSC locality 41490; probably same locality as specimen in figures 1-3. Actual size.

Figures 7-13. Cardioceras (Cawtoniceras) canadense Whiteaves.

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Latex casts of topotypes GSC 87193 to GSC 87197 (5 specimens) from GSC locality C-142226, Fernie Ridge northeast of Fernie, Fernie map-area (82G), British Columbia. Actual size.

