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THE PRE-CAMBRIAN (BELTIAN) ROCKS OF SOUTHEASTERN BRITISH COLUMBIA AND THEIR CORRELATION

by

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By S. J. Schofield.

INTRODUCTION.

The Beltian rocks of the Galton range and of the Purcell range in southeastern British Columbia have been called the Galton series and the Purcell series respectively by Daly[1], in his study of a section across these ranges, along the International Boundary line. These and equivalent series in Idaho have not previously been seen in their stratigraphical relationship to the fossiliferous Palæozoic. Hence the age of these rocks, based entirely on correlation by lithologic resemblances, has been a matter of controversy; Walcott placing the whole of the Beltian in the Pre-Cambrian, and Daly on the other hand postulating that only the lower and smaller portion of the Beltian is Pre-Cambrian and the remainder or upper part is Cambrian. In 1913, the writer discovered a section near Elko (see map, Fig. 7), British Columbia, where the Pre-Cambrian-Palæozoic contact is well exposed and the interpretation of the field facts at Elko places the whole of the Beltian in the Pre-Cambrian.

[1]Daly, R. A., Geol. Sur. Can., Ann. Rept., 1904, p. 91A.
Report of Chief Astronomer of Can. Ann. Rept., 1905, p. 279.
Geol. Sur. Can., Memoir No. 38, 1913, pp. 99-139.

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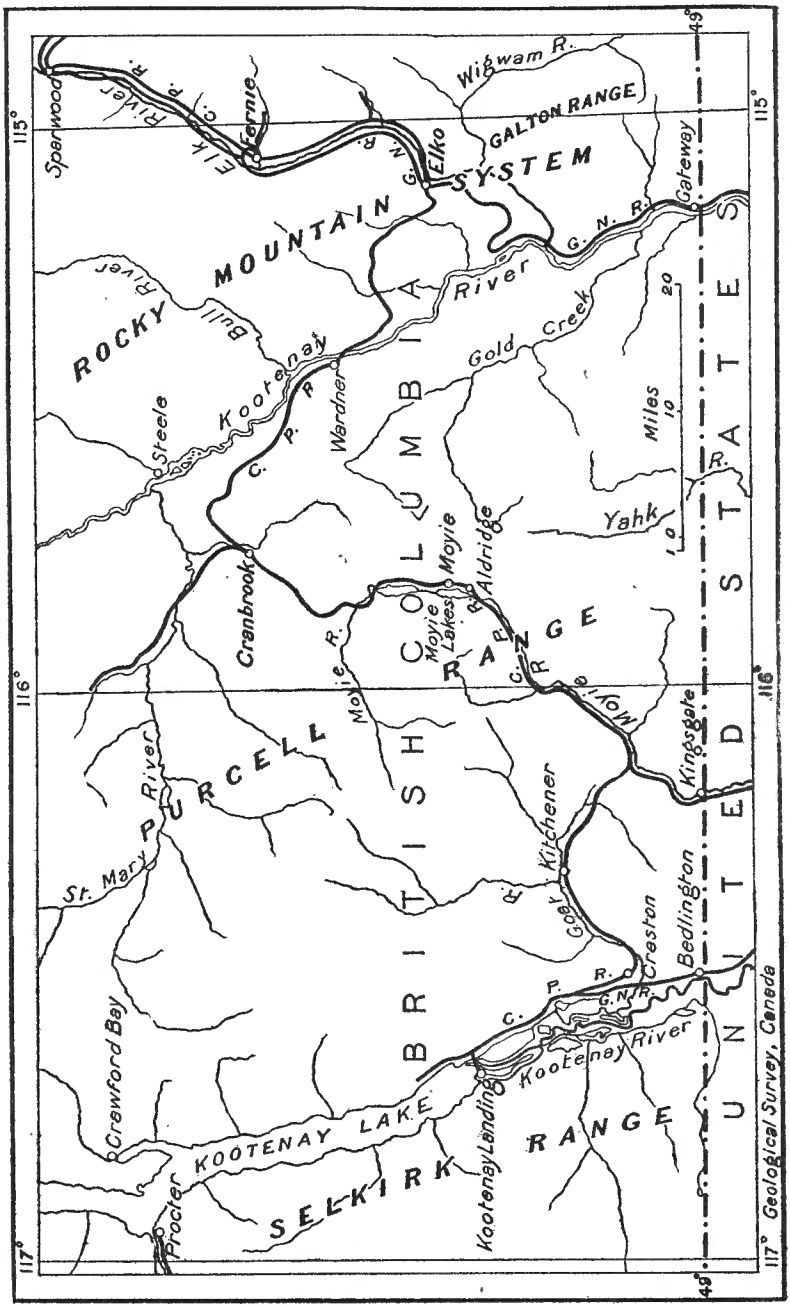

FIG. 7. Map of southeast Kootenay.

PRE-CAMBRIAN-PALÆOZOIC SECTION AT ELKO, BRITISH COLUMBIA.

The mountains to the north of the Elk River valley at Elko, form the most westerly part of the Rocky Mountain system. The structure of these mountains is of the nature of a syncline striking northwest–southeast. The eastern limb of the syncline is cut off by a northwest-southeast fault which brings the Devono-Carboniferous limestone in contact with the Roosville formation. The strata forming the western limb of the syncline and incidentally the western face of the Rocky mountains, dip, on an average, 45 degrees to the northeast.

Elko, a station on the Crowsnest branch of the Canadian Pacific railway, is situated on the western slope of the Rocky Mountain system, at the Elk River portal to the Kootenay valley or Rocky Mountain trench. The section exposed at Elko can be most easily expressed in a stratigraphical column.

		feet.
Devonian	Jefferson limestone	300+
Silurian, Ordovician, or Cambrian	Elko formation	90±
Lowest—Middle Cambrian	Burton formation	80±
	Unconformity.	
Beltian	Roosville formation	1000
	Phillips formation	500
	Gateway formation	1000+

The Gateway, Phillips, and Roosville belong to the Galton series of Daly.[1]

Gateway Formation. The lower part of the formation consists of alternating bands of massive, concretionary, siliceous dolomite and limestone weathering buff, and massive, light grey quartzites. These are succeeded by thin-bedded, sandy argillites, and greenish grey, siliceous argillites. The sandy argillites weather

[1]Daly, R. A., Geol Surv. Can., Memoir 38, p. 97.

a light buff and are characterized by the presence of abundant casts of salt crystals.

Phillips Formation. The Gateway formation passes gradually into the overlying Phillips formation which consists mainly of dark purplish and red metargillites, sandy argillites, sandstones, and quartzites. At several horizons are intercalated thin laminæ of green, siliceous argillite. These rocks are exposed in a rock cut on the Great Northern railway, 1½ miles east of Elko, from which point they rise to the east in the hill to the north of the track.

Roosville Formation. The Phillips is overlain conformably by the Roosville which is composed mostly of massive, laminated, green, siliceous metargillites weathering greenish grey and rusty brown, and buff coloured sandstones. Mud cracks are abundant at all horizons. The Elk River canyon is carved in the horizontal strata of the Roosville formation. Cryptozoan forms occur at several horizons near the top of the Roosville.

Burton Formation. The Burton formation, called after Burton creek near Elko, rests with no discordance of dip on the Roosville siliceous metargillites, and consists in great part of greenish black, calcareous shales with interbedded siliceous limestone bands. A detailed section of the Burton formation at Elko is as follows.

Elko formation.	Greenish black shales with limestone interbands	60± feet
Burton formation.	Sandy limestone	10 "
	Greenish black shale	4 "
	Calcareous grit	3 "
	Hematite conglomerate	8 — 10 inches.

Unconformity.

Roosville formation.

The hematite conglomerate, the base of the Burton, is composed of rounded to subangular pebbles of siliceous hematite, embedded in a cement consisting of quartz and hematite. This conglomerate passes gradually into the overlying grit which is made up of angular and subangular grains of the

Roosville siliceous metargillite and a great number of milky white to glassy quartz grains in a calcareous cement. This grit contains the oldest fossils found in the Galton series. Succeeding this grit is about 4 feet of calcareous, greenish black shale which readily weathers to soft earth. It is brittle and breaks up into small rectangular shaped pieces. Above this shale comes 10 feet of sandy limestone, in beds from 1 to 2 feet in thickness, broken by vertical joints. The weathering colour of this limestone is brown. Above the limestone comes about 60 feet of greenish black, calcareous shale containing numerous bands of siliceous limestone. These interbands are especially rich in trilobite remains.

Elko Formation. The Elko formation, called after the town of Elko on the Crowsnest branch of the Canadian Pacific railway, rests upon the Burton formation. The exact contact between these two formations was not exposed in the sections studied and no structural evidence of an unconformity was present, exposures on each side of the contact being very good.

The lower 30 feet of the Elko formation is composed of massive, grey, siliceous limestone, weathering grey, containing indistinct coral-like forms. The limestone by gradual transition, passes into a massive cream coloured siliceous dolomite in massive beds averaging about 6 feet in thickness.

The Jefferson Limestone. In the Rocky Mountain system, the Devonian limestone rests conformably upon the underlying lower Palæozoic Elko formation, while in the Purcell range to the west, an apparent unconformity exists between the Devonian limestone and the Gateway formation. The staple rocks of the Devonian are a massive, dark grey limestone and dolomites weathering a whitish-grey colour. The following fossils were found in the Jefferson limestone and were identified by Dr. Kindle.

Atrypa reticularis.
Atrypa cf. missouriensis.
Spirifer englemanni.
Strophostylus sp.
Stropheodonta demissa.
Schizophoria n. sp. near s. striatula.

Unconformity at the Base of the Burton.

Although no structural features emphasize the presence of an unconformity at the base of the Burton, yet from other evidence such an unconformity is believed to exist.

(1). In harmony with the other sections throughout the Rocky Mountain geosynclinal, a marine Cambrian transgression is represented in the deposition of the Burton formation.

(2). The conglomerate at the base of the Burton is composed chiefly of hematite pebbles with minor quantities of pebbles of quartzite and quartz in a hematitic quartz cement. The hematite pebbles, although some have a concentric structure, probably represent the results of erosion and subsequent concentration of hematite layers which occur abundantly in the underlying Pre-Cambrian series. The quartzite (metamorphosed sandstone) pebbles are identical with the quartzite of the underlying Phillips formation. The occurrence of these pebbles already metamorphosed before the deposition of the Burton, indicates that a time interval existed between the deposition of the Roosville and Burton formations.

(3). The grit which overlies the conglomerate is characterized by an abundance of milky white quartz particles evidently derived from the erosion of quartz veins such as are known to be present in the underlying Roosville formation and other members of the Pre-Cambrian series. Green particles of the Roosville siliceous metargillites are also present and their presence supports the idea that the Roosville formation was metamorphosed before the Burton was laid down, hence the idea of a time interval between the deposition of the Roosville and Burton formations is strengthened.

(4). The difference in degree of metamorphism of the Roosville and the Burton is very striking in the field. The laminæ of the Roosville siliceous metargillites are so thoroughly cemented together that the rocks always form steep cliffs, in fact the perpendicular walls of the Elk River canyon are carved in the Roosville formation. In contrast to this the Burton formation weathers to a soft earth and is characterized by gentle slopes.

(5). Since cryptozoan forms have not been described, as far as the writer knows,from formations later than the Pre-Cambrian, the classification of the Roosville and the underlying formations as Pre-Cambrian is still more firmly established.

THE PURCELL SERIES.

The Purcell series of East Kootenay was first described by Daly in 1904,[1] and subsequently in unchanged form in 1913,[2] and is as follows:—

Erosion surface.

		feet.	
Middle Cambrian...	Moyie.....	3400+	
	Purcell lava.....	465	
	Kitchener, upper part.....	6000±	7400
Lower Cambrian....	Kitchener, lower part.....	1400±	
	Creston, upper part.....	3000±	9500
Beltian.....	Creston, lower part.....	6500±	

Base unexposed.

In 1911, Daly identified for the writer, the Kitchener and Creston formations, in the neighbourhood of Kingsgate, B.C., (see map) where the south-flowing Moyie river crosses the International Boundary line. Subsequent work by the writer in 1912, definitely proved that the so-called Kitchener rocks near Kingsgate were older and not younger than the Creston, and the name Aldridge formation was proposed for this group of rocks. Further work on the section in the neighbourhood of the Moyie lakes (see map) showed that a group of rocks lithologically similar to those described by Daly as Kitchener, overlies the Creston and underlies the Siyeh. The name Kitchener has hence been retained for those rocks which overlie the Creston and underlie the Siyeh.

The Moyie formation was examined over a wide area. The area of Moyie rocks outlined by Daly west of Kingsgate was found to rest conformably upon the same rocks which Daly

[1]Daly, R. A., Geol. Surv. Can., Ann. Rept., 1904, p. 91A.
[2]Daly, R. A., Geol. Surv. Can., Memoir 38, 1913, p. 119.

identified as Kitchener, near Kingsgate, and which were subsequently proved to belong to the Aldridge formation. Hence, they cannot be Moyie as originally defined by Daly as lying conformably on the Kitchener. Lithologically, these so-called Moyie rocks are identical with the Aldridge and hence are classed as Aldridge. The Moyie in the vicinity of the Yahk river rests conformably on the Kitchener formation as defined by the writer, and in this region is lithologically similar to the lower part of the Siyeh formation and occupies the same stratigraphic position as the Siyeh south of Cranbrook, where it overlies the Kitchener and underlies the Purcell Lava.

The Purcell Lava is absent in the Boundary section but is present in the section south of Cranbrook (see map). Daly states that the Purcell Lava is absent between the Kitchener and Moyie on the International Boundary line, since the flow did not extend as far west as the Yahk river. The writer concludes that the lava occupied a position above the Moyie and has been removed by erosion, and that the Moyie is equivalent to the lower part of the Siyeh. Hence, the name Moyie has been dropped from the stratigraphic series of East Kootenay.

The Purcell series as defined by the writer, is as follows:—

Erosion surface.

Pre-Cambrian.....	Gateway	2000+
	Purcell Lava	300
	Siyeh	4000
	Kitchener	4500
	Creston	5000
	Aldridge	8000±
	Base unexposed.	

Aldridge Formation. The Aldridge formation is the oldest known sedimentary member of the Purcell series in the Purcell range. It consists of argillaceous quartzites and purer quartzites with a subsidiary amount of argillite. The beds vary in thickness from a few inches in the argillitic members to 8 feet in the pure quartzites, but the average thickness of the strata is 6 inches.

The argillaceous quartzites are grey to almost black in colour on fresh fracture. They weather to a rusty brown, and since the argillaceous quartzites are in greater abundance, they give the characteristic reddish-brown colour to the formation as a whole. The thick-bedded purer quartzites weather to a light grey colour. Shallow water features, except some conglomerates on Goat river, were not noticed in the Aldridge formation. In places, cubes of pyrite were abundant. A fact, worthy of emphasis, is that in this region the Aldridge formation is characterized by the presence of a relatively large number of thick gabbro sills called the Purcell Sills. The succeeding younger formations contain only a few gabbro sills, and these are relatively thin and unimportant.

Creston Formation. The Creston formation rests conformably upon the Aldridge formation. A transition zone 500 feet in thickness separates the Aldridge and the Creston formations. The latter consists of a well-bedded series of grey argillaceous, quartzites, purer quartzites, and sandstones with thin intercalations of argillite. The beds, averaging one foot in thickness, are often cemented together so that they form steep cliffs. In the western part of the range, in the vicinity of Goat river, the quartzites are coarser in texture, and resemble coarse sandstones in appearance, while in the eastern part they are finer-grained and more argillaceous. In general, the quartzites are grey on fresh fracture and weather to a grey colour, which is in distinct contrast to the weathering colour of the Aldridge formation. When the grey quartzites are impregnated with cubes of pyrite, they weather reddish-brown.

Ripple marks were noted at several horizons throughout the Creston formation. Intruded into the formation are a few gabbro sills reaching a thickness of 100 feet.

Kitchener Formation. Lying conformably upon the Creston formation and passing into it by gradual transition is the Kitchener formation, which is composed of calcareous argillites, calcareous quartzites, argillaceous quartzites, and limestones, in beds whose average thickness is 6 inches. The weathering colour is reddish-brown.

Siyeh Formation. Lying conformably on the Kitchener formation and passing into it by gradual transition occurs the Siyeh formation, which consists of purple and green siliceous argillites in beds from 1 inch to 2 inches in thickness. Dolomites and limestones are present in the middle part of the formation. The argillites are characterized by the presence of abundant mud-cracks and ripple marks.

Purcell Lava. The Siyeh epoch was brought to a close by the outpouring of basalt called the Purcell Lava. This lava consists almost entirely of amygdaloidal basalt with small amounts of rhyolite and breccia and is the extrusive phase of Purcell Sills.

Gateway Formation. The lower part of the formation consists of alternating bands of massive concretionary siliceous dolomite and limestone weathering buff, and massive light grey quartzites. These are succeeded by thin-bedded sandy argillites and greenish grey siliceous argillites. The sandy argillites weather a light buff and are characterized by the presence of abundant casts of salt crystals.

RELATION OF GALTON SERIES TO THE PURCELL SERIES.

The Purcell series of the Purcell range is the western or near-shore equivalent of the Galton series and the relations of these two series is expressed in the following table.

Galton series of the Galton range of Rocky Mountain system.	Purcell series of the Purcell range.
Roosville	
Phillips	
Gateway	Gateway
Purcell Lava	Purcell Lava
Siyeh	Siyeh
	Kitchener
	Creston
	Aldridge

Pre-Cambrian Sections of Northwestern Montana and Northern Idaho, by C. D. Walcott.

Belt mountains, Montana (Walcott).	Dearborn area, Montana (Walcott).	Lewis and Clark area, Montana (Walcott).	Lewis and Livingstone ranges, Montana (Willis).	Camp Creek, Mission Range section, Montana. (Walcott).	North and Northeast of Coeur d'Alene, Idaho. (Calkins).	Boundary section east from Kootenay river (Daly).
				Cambrian. Unconformity.		
			No superjacent strata.	Camp Creek series Arenaceous-grey 1,762 feet.		
Cambrian. —Unconformity—	Cambrian.	Cambrian. —Unconformity.—	*Kintla.* *Sheppard* Quartzites. 1,200 feet.	Calcareous and arenaceous 1,500 feet.		
Marsh. 800 feet.						
Helena. Calcareous 2,400 feet.	Unconformity.	Arenaceous 1,015 feet.	Siyeh limestone.	Arenaceous mostly reddish colour		
	Siliceous and calcareous. 945 feet.	Limestone, 285 feet.				
Empire. 600+ *Spokane.* 1,500+ *Greyson.* 3,000+ Arenaceous strata 5,100 feet.	Greenish and purple, arenaceous and siliceous strata. 5,772 feet.	Arenaceous 1,210 feet. Base concealed. Total section 2,540 feet.	4,000 feet.	4,491 feet.	No superjacent strata.	
			Grinnell. *Appekunny* Siliceous. 3,800 feet.	Arenaceous red and grey colours 198 feet of limestone near 700 feet from summit. 3,887 feet.	Striped peak. 2,000 feet.	
Newland. Calcareous 2,200+ feet.	Base concealed. Total section 6,718 feet.		*Altyn* calcareous and siliceous 700 feet.	*Blackfoot.* Calcareous and siliceous. 4,805 feet.	*Wallace.* Calcareous and siliceous. 5,000+feet.	No superjacent strata.
Chamberlain. Siliceous 1,500 feet.			Base concealed. Total section 9,700 feet.			*Yahk.* 500 feet.
Neihart sandstone 700 feet.				*Ravalli.* Siliceous and arenaceous. Purple and greenish and grey beds. 8,255 feet.	*Burke.* *Saint Regis.* Siliceous and arenaceous. Purple, greenish, and grey beds. 8,000 feet.	*Moyie.* Argillite. 3,200 feet.
—Unconformity— *Archæan.* Total section 12,000 feet.						*Kitchener.* Quartzite. 7,400 feet.
				Base concealed. Total section 24,760 feet.	*Prichard.* Banded, dark blue grey, blue black and grey. Siliceous series. 10,000 feet.	*Creston.* Quartzite. 9,500+feet.
					Base concealed. Total section 25,000 feet.	Base concealed. Total section 20,600 feet.

Total thickness of section of Pre-Cambrian rocks in northwestern Montana and Northern Idaho, as now known, 37,000 feet.

Probable Correlation of Principal Sections of Pre-Cambrian Sediments in Montana and Idaho, by F. C. Calkins.

Belt mountains (Walcott).a	Lewis and Livingston ranges (Willis).b	Philipsburg district (Calkins).c	Mission range (Walcott).d	Coeur d'Alene district (Calkins).e	Cabinet range, western and central parts (Calkins).	Forty-ninth parallel, between crossings of Kootenay river (Daly).f
Cambrian. ——Unconformity—— *Marsh.* Shale, red, 800 feet.	Top not seen. *Kintla.* Shale, maroon red; ripple marks, etc.; some quartzitic and calcareous beds. 800 feet. *Sheppard.* Quartzite yellow, ferruginous 700 feet.	Cambrian. — Unconformity. —	Cambrian. ——Unconformity.—— *Camp Creek.* Sandstone, grey, rather thin bedded. 1,762 feet.	Upper part of section eroded.	Shales and sandstones, medium to thin bedded; colour prevailingly greenish grey, but in part red and purple. Shales partly calcareous and weathering buff. A little white crystalline limestone, weathering yellow, at several horizons Base not seen. 10,000± feet.	Upper part of section eroded.
Helena. Limestone, with some shale. 2,400 feet.	*Siyeh.* Limestone, dark blue or grey, weathering buff, with shale interbedded. 4,000 feet	*Camp Creek.* Shale and sandstone, the latter prevailing in upper portion. Colour chiefly red. 5,000+feet to 0 feet.	Shales, sandstones, and limestones. 1,560 feet.			
Empire. Shales, greenish grey. 600 feet.	*Grinnell.* Shale, partly arenaceous; dark red; ripple-marked and sun cracked. 1,800 feet.		Sandstones, mostly reddish. 4,491 feet			
Spokane. Shales, with thin beds of sandstone; deep red 1,500 feet.			Sandstones, largely shaly, colours red and grey, with 198 feet of limestone 700 feet below top. 3,887 feet.	*Striped Peak.* Shales and sandstone, red and green 1,000+ feet.	*Striped Peak.* Shales and shaly sandstones, prevailingly dark red; ripple marks, etc. 2,000+ feet.	*Yahk.* Quartzite. 500 feet.
Greyson. Shales, mostly dark grey. 3,000 feet.	*Appekunny.* Shale, grey black, and greenish, interbedded with white quartzite. 2,000± feet.					
Newland Limestone, impure, weathering buff, with interbedded shale. 2,200 feet. *Beltina danai.*	*Altyn.* Limestone, upper part thin-bedded and ferruginous; lower part greyish blue, massive, siliceous. 1,400 feet. *Beltina danai.*	*Newland.* Limestone thin bedded, more or less siliceous and ferruginous, passing into shale generally buff on weathered surface 4,000 feet.	*Blackfoot.* Limestone thin bedded, more or less siliceous; siliceous layers, weathering buff, interbedded with calcareo-arenaceous shales. 4,805 feet. *Beltina danai.*	*Wallace.* Shales, more or less calcareous, interbedded with thin layers of siliceous and ferruginous limestone and calcareous sandstone. Limestones and calcareous shales weather buff. 4,000 feet.	*Newland.* Limestones, thin bedded, siliceous and ferruginous, interbedded with more or less calcareous shales. 5,000± feet.	*Moyie.* Argillite. 3,400 feet.
	Base not exposed.					
			Ravalli. Sandstones, quartzitic, fine grained, greyish purple and grey. 2,550 feet.	*St. Regis.* Shales and sandstones, purple and green. 1,000 feet.	*Ravalli.* Quartzites, siliceous shales, and shaly sandstones; upper part green and purple; lower part grey mostly greenish, locally with faint purple tinge; middle part thickest bedded, and most quartzitic, consisting locally of fairly pure white quartzite. 8,000 ± feet.	
Chamberlain. Shale, mostly black, with some sandstone, 1,500 feet.		*Ravalli.* Quartzite, grey, with some dark bluish and greenish shale. 2,000 feet.	Sandstones, compact grey. 1,060 feet.	*Revett.* White quartzite, partly sericitic. 1,200 feet.		*Kitchener.* Ferruginous quartzite. 7,400 feet.
			Sandstones, greenish grey, fine grained, in layers 4 inches to 2 feet thick. 4,645 feet. Base not seen. Total Ravalli, 8,255 feet.	*Burke.* Indurated siliceous shales, with sandstones and quartzites, prevailingly grey-green. 2,000 feet.		
		Prichard. Shales, dark bluish, interbedded with sandstone; rusty brown on weathered surface. 5,000± feet.		*Prichard.* Argillite, blue-grey to black, with distinct and regular banding, interbedded with a subordinate amount of grey sandstone. Uppermost part arenaceous and marked with shallow-water features. Base not exposed. 8,000+feet.	*Prichard formation.* Argillite, dark bluish, banded. 2,000 feet.	*Creston.* Quartzitic sandstones, thick-platy, grey, interbedded with a subordinate amount of bluish argillaceous material. Base not exposed. 9,500+ feet.
Neihart. Quartzite, with some shale in upper part. 700 feet		Quartzite, light coloured. Base not exposed. 1,000± feet			Sandstones, grey, thick bedded to shaly, interbedded with more or less sandy bluish shales. The rocks become more argillaceous toward the southeast. 10,000± feet. Base not exposed.	
Archæan.						

a Walcott, C. D. Pre-Cambrian fossiliferous formations: Bull. Geol. Soc. America, vol. 10, 1899, pp. 199–244.
b Willis, Bailey, Stratigraphy and structure, Lewis and Livingston ranges, Montana: Bull. Geol. Soc. America, Vol. 13, 1902, pp. 305-352.
c Report in preparation.
d Walcott, C. D. Algonkian formations of northwestern Montana: Bull. Geol. Soc. America, vol. 17, 1906, pp. 1–28.
e Ransome, F. L., and Calkins, F. C., Geology and ore deposits of the Cœur d'Alene district, Idaho: Prof. Paper U. S. Geol. Survey No. 62, 1908.
f Daly, R. A., Summary Rept. Geol. Survey, Canada, for 1904, 1905, pp. 91–100.

56815—E—p. 10b.

Daly in his correlation of the Galton and Purcell series emphasizes the importance of the Purcell Lava in the correlation of not only these two series, but for all the equivalent series of the Rocky Mountain geosynclinal.[1] In addition, the Siyeh and Gateway formations are identical lithologically in the Galton and Purcell series.

General Correlation of Pre-Cambrian (Beltian) by Walcott.

Walcott made the first general correlation table of the Beltian of Montana, Idaho, and British Columbia, in a paper entitled the "Algonkian Formation of Northwestern Montana,[2]" and for convenience this table is here reproduced.

General Correlation of Pre-Cambrian (Beltian) by Calkins.

In 1908, Calkins[3] formulated a correlation ta ble of the Beltian as a result of a rapid reconnaissance in Idaho and Montana and along the International Boundary line across the Purcell range. His correlation table based upon Walcott's of 1906, is identical with Walcott's except as to the position of the Purcell series. Both Walcott and Calkins place the whole of the Beltian in the Pre-Cambrian. Calkins' table of formation is here appended.

[1]Daly, R. A., Geol. Surv. Can., Memoir 38, p. 162.
[2]Walcott, C. D., Bull. G. S. A., vol. 17, 1906, p. 17.
[3]Calkins, F. C., U. S. G. S., Bulletin 384, 1908, p. 40.

General Correlation of Pre-Cambrian (Beltian) by Daly.

Daly, in 1913, from his field work along the International Boundary line, puts forward the accompanying correlation table.[1]

Correlation of Pre-Cambrian (Beltian) by Schofield.

(*1*) *Correlation of Purcell Series with Coeur d'Alene Series.* The correlation of the individual members of the Coeur d'Alene series with the Purcell series by Walcott and Calkins was based upon Daly's subdivision of the Purcell series which was found to be erroneous. The writer, in 1911, carefully examined the formations in the Coeur d'Alene district and was able to identify in that region with some degree of certainty, the formations exposed in East Kootenay. The following table shows the writer's conception of this correlation.

Coeur d'Alene Series.		*Purcell Series.*	
Striped Peak	1000+	....Siyeh (lower part)	2000+
Wallace	4000	....Kitchener	4500
St. Regis	1000		
Revett	1200	..Creston	5000
Burke	2000		
Prichard	8000+	....Aldridge	8000±

(*2*) *General Correlation of Pre-Cambrian by Schofield.* The following general correlation table is based on Walcott's original table presented on the foregoing page of this article, with additions by the writer on the results of field work in the Pre-Cambrian of Idaho and British Columbia. It will be noticed that the controversy centres around the age of the Siyeh limestone which is one of the most important horizon markers in the Beltian.

The evidence for the determination of the Siyeh limestone as Middle Cambrian by Daly on stratigraphical and lithologic bases, is given in part by these words.

[1]Daly, R. A., Geol. Surv., Can., Memoir 38, p. 178.

Correlation Table Prepared by R. A. Daly.

1 Summit series, Selkirk, range, 49° N. Lat.	2 Purcell series, Purcell range, 49° N. Lat.	3 Coeur D'Alene series (1).	4 Series in Cabinet range (1).	5 Series in Philipsburg district (2).	6 Series in Mission range (3).	7 Galton series, Galton range, 49° N. Lat.	8 Lewis series, Clarke and Lewis ranges, 49° N. Lat.	9 Series in Belt mountains (4)	10 Castle Mountain Bow River series (5)	11 Series at Blacksmith Fork, Utah (5).	12 System.
Conformity with upper Palæozoic?	Erosion surface.	Erosion surface.	?	Conformity with upper Palæozoic.	?	Erosion surface.	Erosion surface.	Conformity with upper Palæozoic.	Conformity with upper Palæozoic.	Conformity with upper Palæozoic.	
									Sherbrooke, 1,375 feet. Paget, 360+feet. Bosworth, 1,855+ feet.	St. Charles, 1,227 feet.	Upper Cambrian.
Lone Star, 2,000+feet.	Moyie 3,400+feet.	Striped Peak, 1,000 +feet.	Striped Peak, 2,000 + feet.	Meagher, 400 feet. Wolsey, 100–300 feet. Flathead, 50–300 feet.	Flathead. Thickness. ? Camp Creek, 11,700 (?) feet.	Roosville, 600+feet. Phillips, 550 feet. Gateway, 1,850 feet.	Kintla, 820 feet. Sheppard, 500 feet.	Gallatin. Flathead.	Eldon, 2,728 feet.	Nouman, 1,041 feet. Bloomington, 1,320 feet. Blacksmith, 570 feet.	Chiefly Middle Cambrian.
Beehive, 7,000 feet.	Kitchener, upper part, 6,000±feet.	Wallace, 4,000 feet. St. Regis, 1,000 feet.	Blackfoot (called Newland by Calkins) 5,000±feet.	Camp Creek, 0–5,000 feet Blackfoot, 4,000 feet.	Blackfoot, 4,805 feet	Gateway, lower part, 125 feet. Siyeh, 4,000 feet.	Sheppard, lower part 100 feet. Siyeh, 4,100 feet.	Marsh, 800 feet. Helena, 2,400 feet. Empire, 600 feet.	Stephen, 640 feet. Cathedral, 1,595 feet.	Ute, 729 feet. Spence, 30 feet. Langston, 498 feet. Brigham, upper part.	Middle. Cambrian.
Ripple, 1,650 feet. Dewdney, 2,000 feet. Wolf, upper part, 1,000±feet.	Kitchener, lower part, 1,400±feet. Creston, upper part, 3,000+feet.	Revett, 1,200 feet. Burke, 2,000 feet. Prichard, upper part, 1,500±feet.	Ravalli, upper part, 5,000±feet. Ravalli, lower part, 3,000±feet.	Ravalli, 2,000 feet. Prichard, upper part, 2,000±feet.	Ravalli, upper part, 4,550 feet.	Wigwam, 1,200 feet. MacDonald, 2,350 feet. Hefty, 775 feet.	Grinnell, 1,600 feet. Appekunny, 2,600 feet.	Spokane, 1,500 feet. Greyson, 2,000±feet	Mount Whyte, 390 feet. St. Piran, 2,705 feet. Lake Louise, 165 feet. Fairview, 600+feet.	Brigham+1,232 feet.	Lower Cambrian.
Wolf, lower part, 1,900± feet. Monk, 5,500 feet. Irene Volcanic formation, 6,000±feet. Irene conglomerate 5,000+ feet. Total, 32,050+feet.	Creston, lower part, 6,500±feet. Base concealed. Total, 20,300+feet.	Prichard, lower part 6,500+feet. Base concealed. Total, 17,200+feet.	Prichard, 10,000± feet. Base concealed. Total, 27,000+feet.	Prichard, lower part, 3,000±feet. Neihart, 1,000±feet. Base concealed. Total, 12,550–18,000 feet.	Ravalli, lower part, 4,000+feet. Base concealed. Total, 25,055 feet.	Altyn, 650 feet. Base concealed. Total, 12,100 feet.	Altyn, 3,500± feet. Waterton, 200+ feet. Base concealed. Total, 13,420 feet.	Greyson, 1,000±feet Newland, 2,200 feet. Chamberlain, 1,500 feet. Neihart, 700 feet. Total, 14,000± feet.	Continuation of Bow River argillites. Base concealed. Total, 12,353+ feet.	Base concealed. Total, 6,647+feet.	Beltian.
Unconformity.								Unconformity.			
Priest River terrane.								Cherry Creek beds			
								Unconformity.			
								"Archæan."			

(1) F. C. Calkins, Bull. 384, U. S. Geol. Survey, 1909, p. 40.
(2) F. C. Calkins, Bulls. 384 and 315, U. S. Geol. Survey, 1909 (p. 40) and 1907 (p. 33).
(3) C. D. Walcott, Bull. Geol. Soc. America, Vol. 17, 1906, p. 2.
(4) C. D. Walcott, Bull. Geol. Soc. America, Vol. 10, 1899, p. 201, and references therein, to Peale and Weed.
(5) C. D. Walcott,, Smithsonian Misc. Collections, Vol. 53, No. 1812, 1908.

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GENERAL CORRELATION TABLE.

Clark and Lewis range 49th Parallel.	Rocky Mountains, B.C.	Purcell range, B.C.	Coeur d'Alene district, Idaho.	Cabinet range, Montana.	
R. A. Daly, G.S.C. Mem. 38, 1913, p. 97.	The correlation of these two series by the author is based on sections described by Daly (G.S.C., Memoir 38, 1913) and subsequently modified by the author.		F. C. Calkins, U. S. G. S., Prof. Paper 62, 1908, p. 25.	F. C. Calkins, U. S. G. S., Bull. 384, 1909, p. 40.	
	Lowest Middle Cambrian.				Cambrian.
	Unconformity.				
Erosion surface.	Roosville, 1,000 feet.				
	Phillips, 500 feet.	Erosion surface.		Erosion surface.	
Kintla, 800 feet. Sheppard, 600 feet.	Gateway, 2,025 feet.	Gateway, 1,000 feet.			
Purcell Lava.	Purcell Lava.	Purcell Lava.			Pre-Cambrian
			Erosion surface.	Shales and sandstones 10,000 feet.	(Beltian).
Siyeh, 4,100 feet.	Siyeh, 4,000 feet.	Siyeh, 4,000 feet.	Striped Peak, 1,000 feet.	Striped Peak, 2,000 feet.	
Grinnell, 1,600 feet. Appekunny, 2,600 feet.	Wigwam, 1,200 feet. MacDonald, 2,350 feet. Hefty, 775 feet.	Kitchener, 4,500 feet.	Wallace, 4,000 feet.	Blackfoot, 5,000 feet.	
Altyn, 3,500 feet.	Altyn, 650 feet.				
		Creston, 5,000 feet.	St. Regis, 1,000 feet. Revett, 1,200 feet. Burke, 2,000 feet.	Ravalli, 8,000 feet.	
		Aldridge, 8,000± feet.	Prichard, 8,000 feet.	Prichard, 10,000 feet.	

"Walcott recognizes the Cambrian-Ordovician equivalent of McConnell's Castle Mountain group as occurring near Belton, Montana, and Nyack creek, Montana. At these localities, massive bluish and greenish limestones bearing a species of Raphistoma and Stromatoporoid form, were found in great development. As shown by Plate 6 of Walcott's paper, the field habit of these limestones is extremely similar to that of the Siyeh limestone at Mt. Siyeh, which is less than 15 miles distant from the Nyack Creek locality. It is difficult to avoid the suspicion that these Castle Mountain limestones are, in truth, identical with the Siyeh limestone in which, therefore, Middle Cambrian fossils may at some future time be discovered."[1]

The discovery of lowest Middle Cambrian fossils in the Burton formation, 3535 feet above the Siyeh formation, points out that the Siyeh limestone cannot be Middle Cambrian, and since the Siyeh formation occurs below the unconformity which exists between the Pre-Cambrian and the Cambrian in the Rocky Mountain geosynclinal, it is concluded that the Siyeh is Pre-Cambrian in age.

This conclusion is supported by Walcott in the following words.

"The series of limestones at the head of Nyack creek illustrated by Plate 6, are of Cambrian or Ordovician age, as indicated by fragments of fossils that I found in them. I do not think the Siyeh limestone is to be correlated with them nor with the Castle Mountain limestones of McConnell."[2]

[1]Daly, R. A., Geol. Surv., Can., Memoir 38, 1913, p. 183.
[2]Walcott, C. D., Geol. Surv. Amer., Bull., vol. 17, 1906, p. 19.

The first number of the Museum Bulletin was entitled, *Victoria Memorial Museum Bulletin Number 1.*

The following articles of the Geological Series of Museum Bulletins have been issued.

Geological Series.

1. The Trenton crinoid, Ottawacrinus, W. R. Billings; by F. A. Bather.
2. Note on Merocrinus, Walcott; by F. A. Bather.
3. The occurrence of Helodont teeth at Roche Miette and vicinity, Alberta; by L. M. Lambe.
4. Notes on Cyclocystoides; by P. E. Raymond.
5. Notes on some new and old Trilobites in the Victoria Memorial Museum; by P. E. Raymond.
6. Description of some new Asaphidæ; by P. E. Raymond.
7. Two new species of Tetradium; by P. E. Raymond.
8. Revision of the species which have been referred to the genus Bathyurus (preliminary paper); by P. E. Raymond.
9. A new Brachiopod from the base of the Utica; by A. E. Wilson.
10. A new genus of dicotyledonous plant from the Tertiary of Kettle river, British Columbia; by W. J. Wilson.
11. A new species of Lepidostrobus; by W. J. Wilson.
12. Prehnite from Adams sound, Admiralty inlet, Baffin island, Franklin; by R. A. A. Johnston.
13. The origin of granite (micropegmatite) in the Purcell sills; by S. J. Schofield.
14. Columnar structure in limestone; by E. M. Kindle.
15. Supposed evidences of subsidence of the coast of New Brunswick within modern time; by J. W. Goldthwait.