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TRIASSIC STRATIGRAPHY OF THE
ROCKY MOUNTAINS AND FOOTHILLS,
PEACE RIVER DISTRICT, BRITISH COLUMBIA

(Report, index map, appendix)

B. R. Pelletier



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By

B.R. Pelletier

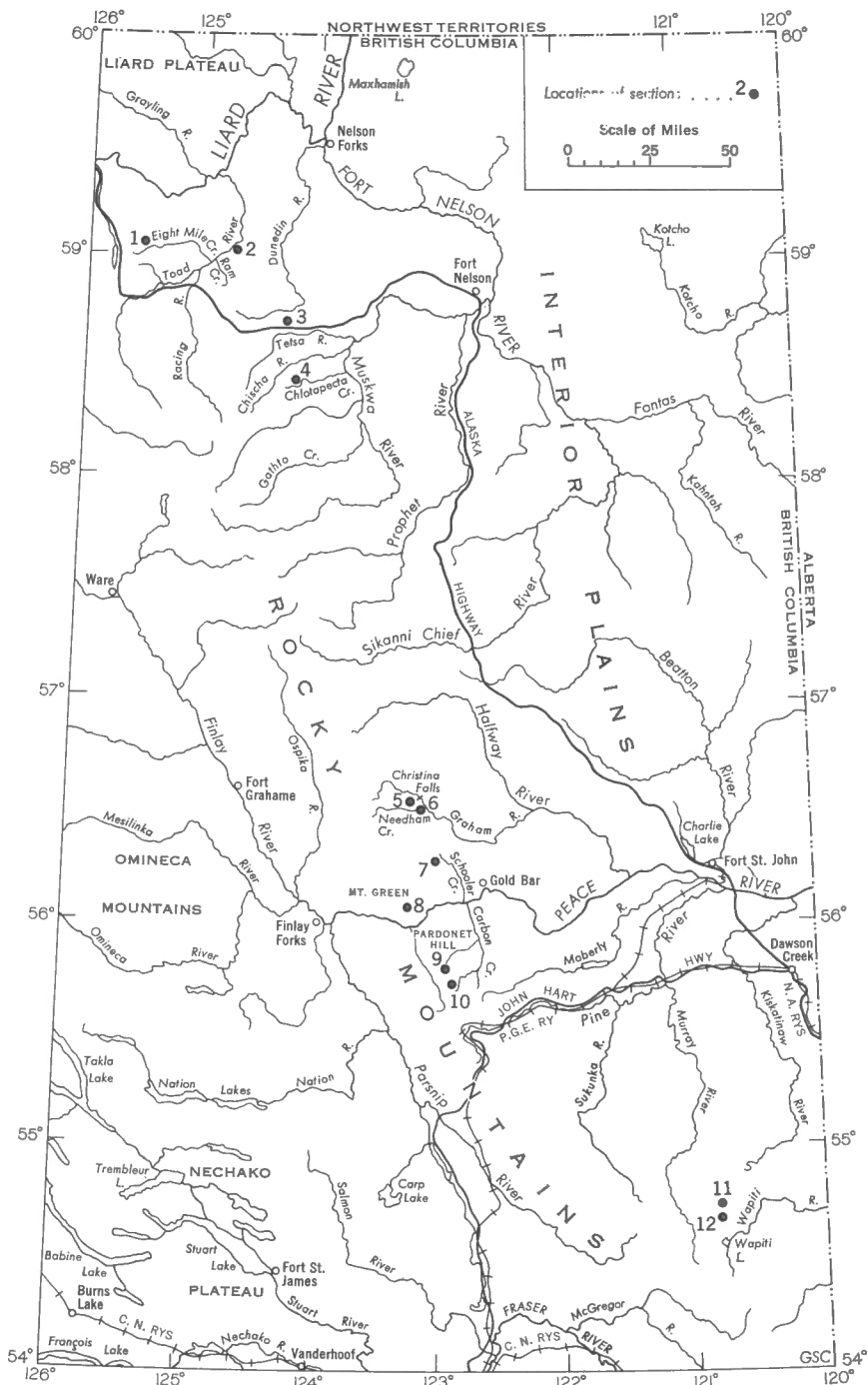
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Figure 1. Map of northeastern British Columbia showing location of stratigraphic sections	facing p. 1
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Index map of northeastern British Columbia showing locations of stratigraphic sections described in appendix

TRIASSIC STRATIGRAPHY OF THE
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INTRODUCTION

This study began in the summer of 1959 (Pelletier, 1960)¹, and continued in the summer of 1960 (Pelletier, 1961). During the 1961 field season (Figure 1), sections were measured as follows: in the extreme westerly Foothills 10 miles east of Muncho Lake; in the eastern Foothills about 25 miles farther east, on the south bank of Toad River; along the Alaska Highway, 1 mile north of mile-post 380; on the north bank of Chlotapecta Creek, about 7 miles south of Chischa River and about 10 miles east of the Rocky Mountains; on ridges and along rivers up to 30 miles north and 20 miles south of Peace River, between Goldbar on the east and the Rocky Mountains on the west; and on high ridges in the vicinity of Murray River about 20 miles southwest of Stony Lake.

The stratigraphy, lithology, outcrop distribution, and physiography of the Triassic formations in the area between Gatho Creek and Liard River have been described in the 1960 and 1961 reports. Triassic rocks in the Pine Pass area have been described by Muller (1961), and those in the Halfway River area by Irish (1962). Earlier studies of the Triassic rocks occurring in the vicinities of Liard, Toad, Tetsa, and Peace Rivers are summarized by McLearn and Kindle (1950). Triassic rocks in the subsurface of central Alberta and northeastern British Columbia east of the Foothills are described by Hunt and Ratcliffe (1959), Colquhoun (1960), and Armitage (1962). An interpretation of the effects of the Peace River Arch upon the deposition of Mesozoic strata in the area of the Foothills and Rocky Mountains west of Fort St. John is given by Williams (1958). Ammonoid faunas of the Pardonet Formation, Peace River area, have been described by McLearn (1960); Tozer (1961) gave a general account of the sequence of Triassic faunas of Western Canada.

This report presents additional sections and sedimentary studies, with further conclusions on source area and sedimentation. The writer collaborated with a joint National Museum of Canada - American Museum of Natural History party under G. Stucker of New York, in an effort to locate Triassic fossil fish in the Wapiti Lake area and determine their stratigraphic position. The age of these fish and similar specimens collected from a section in Needham Creek (Appendix, section 6), 2 miles west of Graham River and 35 miles north of Peace River, is discussed here.

¹Names and/or dates refer to publications listed in the References.

Several collections of invertebrate fossils were made at sections described in the appendix; these faunas were identified by E.T. Tozer, T.L. Sadler-Brown served as field assistant, and I. Seversen of Valhalla Centre, Alberta, worked in base camp.

GENERAL STATEMENT

The sections measured in 1959 and 1960, and several of those measured in 1961, serve as a control in establishing formational boundaries to the Triassic formations in northeastern British Columbia north of Gatho Creek. Other sections were measured in 1961 to establish similar control in the Peace River area, with a view to correlating the Triassic formations in the two areas. The Triassic beds in both areas rest disconformably upon chert of probable Permian age. In the northern area the Triassic beds are overlain disconformably by shales of Lower Cretaceous age and, in the southern area around Peace River, are overlain by shales of Jurassic age. Within the Triassic system, formational contacts are gradational.

The Triassic formations—the Grayling, Toad, and Liard (the only named formations in this report)—occurring in the northern areas, can be recognized lithologically in the Foothills from the mouth of Toad River west across strike to the mouth of Racing River. The younger unnamed post-Liard beds which occur in the upper part of the section at Racing River extend westerly to the Sentinel Range but are absent to the east. These beds include equivalents of the Pardonet Formation (see Hunt and Ratcliffe, 1959, p. 571; and McLearn, 1921). In the Peace River area the Grayling Formation is thin or absent in the eastern sections, and is recognizable only in the westerly ridges near the Rocky Mountain front. However the Toad and Liard Formations can be traced westerly for several miles across the Foothills belt from the vicinity of Goldbar, and are recognizable along the entire eastern Foothills between Liard River and sections up to 90 miles south of Peace River. The post-Liard beds of the Peace River area are similar in lithology, faunal content and stratigraphic position to beds of the same, but tentative, designation in the Liard - Toad River area. They have been previously named the "Grey Beds" (upper part only of this unit—see McLearn, 1940; and McLearn and Kindle, 1950, p. 46), and are overlain by the Pardonet Formation (McLearn, 1940). In all areas investigated between Liard and Peace Rivers, changes in facies occur within a few miles across strike, although along strike a given facies may persist at the same stratigraphic position in the section for scores of miles.

Along the eastern Foothills in the area between Gatho Creek and Liard River, Triassic rocks occur in their entirety between the disconformable boundaries of the underlying Permian chert (Fantasque Formation?) and the overlying Cretaceous shales, and are less than 4,000 feet thick. To the west the Triassic rocks become thicker and may exceed 5,000 feet in the Racing River area. Farther west the Triassic appears to be thinner but neither the overlying Cretaceous nor the underlying Permian contacts were observed, so that it was not possible to establish an overall thickness in this area. In sections along the central ranges of the Foothills extending north and south of Peace River and about 10 miles west of Goldbar, the thickness of the Triassic rocks, obtained by measuring partial sections, is about

Table of Formations

Era	Period or Epoch	Formation and Thickness (feet)		Lithology	Faunal Zones
		Liard River	Peace River		
Mesozoic	Lower Cretaceous	Garbutt or Buckingham	Bullhead Group	Shale, sandstone and conglomerate	
		(2, 300)			
	Jurassic	Absent	Fernie Group (400)	Black shales, dark grey siltstones and sandstones	
		Unnamed post-Liard beds (600 - 1, 200)	Pardonet (2, 000+)	Limestone, dolomite, coarse sandstones and dark grey calcareous siltstones	<u>Monotis</u> <u>Halobia</u>
Palaeozoic	Upper Triassic	Liard (0 - 600)	Liard (600 - 1, 300)	Massive, grey, calcareous sandstones, minor grey limestones, and dark grey siltstones	<u>Nathorstites</u>
		Toad (600 - 3, 000)	Toad (650 - 1, 000)	Massive, grey, calcareous siltstones and mudstones, minor sandstone and limestone, platy shales and siltstones	<u>Gymnotoceras</u> - <u>Beyrichites</u> <u>Wasatchites</u>
	Lower Triassic	Grayling (850 - 1, 400)	Grayling (15 - 350)	Chiefly dark grey, non-calcareous shales and minor siltstones and limestones; interbedded thin sandstone in lower part	<u>Claraia</u> <u>stachei</u>
		Fantasque (?) (165)	Fantasque	Thick-bedded, blocky, dark bluish grey to black chert	

3,500 to 3,800 feet. Data from subsurface sections (Hunt and Ratcliffe, 1959) indicate a decrease in thickness to the east. In the vicinity of Murray River and Wapiti Lake about 20 to 30 miles southwest of Stony Lake, the thickness of the Triassic rocks is somewhat less than 3,000 feet. The axis of greatest thickness of the Triassic rocks in the Foothills appears to extend southeasterly from Racing River to several miles north of Murray River. A decrease in thickness of these rocks is known to occur to the northeast, east and southeast. The decrease in thickness toward the east is due partly to pre-Cretaceous erosion, and partly, for the Toad Formation at least, to eastward convergence of the formations. There are insufficient data to conclude that a decrease in thickness of the Triassic takes place to the southwest and west in the Peace River area, although it is indicated in the Toad - Liard River area.

GRAYLING FORMATION

The Grayling Formation consists of non-calcareous flaky shales with minor thin interbedded sandstones in the lower part. Although the shales weather dark grey to black, certain thin sandstones and kettle concretions, which may contain fossils, weather a bright rusty-orange. The shales of the Grayling are soft and generally occur as deeply recessive units on ridge-tops and hillsides, or as concealed units in anticlinal valleys. Small-scale crossbedding, ripple-marks, and sole markings such as fluting, grooves, and flow casts, occur throughout the sandstone. These primary sedimentary structures indicate that sedimentary transport took place in a southwesterly direction. The presence of ammonites and the pelecypod Claraia stachei indicates a marine environment of deposition for the Grayling Formation during the early part of the Scythian epoch (McLearn, 1945). The Grayling Formation occurs in river sections between Liard and Chischa Rivers, and on a mountain section at Mount Green (Appendix, section 8). A covered interval of 15 feet may be underlain by typical Grayling Formation in Needham Creek (Appendix, section 6) and, although some of the overlying platy siltstones may be equivalent in age to the Grayling, the lithology is typical of the lower Toad Formation.

Large fossil fish, up to 3 feet long, poorly preserved pelecypods, and an ammonite identified by Tozer as Paranorites sp. of lower Scythian age, occur in the platy siltstones near the base of the section at Needham Creek. This further indicates the occurrence of rocks that are different in lithology from the typical Grayling Formation, but are of the same age. This was again observed in the Murray River - Wapiti Lake area. There, rocks of lower Scythian age consist of platy, dark brownish grey, calcareous siltstones, weathering medium- and orange-brown. Large fossil fish (at Wapiti Lake only), ammonites, and the pelecypod Claraia stachei Bittner are present in this unit (Appendix, section 11). However, rocks of typical Grayling lithology are absent.

The Grayling Formation has an estimated thickness of more than 1,300 feet on Liard River, about 3 miles above Grayling River; it decreases in thickness to about 800 feet in the upper Dunedin River, 40 miles south of Liard River; and decreases again to 350 feet or less at Mount Green, 6 miles north of Peace River. No observations on thicknesses east or west of the above sections were made, but Hunt

and Ratcliffe (1959, p. 570) showed a progressive decrease in the combined thickness of the Grayling and Toad Formations in the subsurface to the east. The gradual decrease in thickness of the Grayling Formation, from its greatest recorded thickness in the vicinity of Toad and Liard Rivers to its absence south of Peace River, suggests that a basin receiving sediments in which the Grayling-type lithology was formed extended from north of Liard River an unknown distance, and southerly to an area a few tens of miles south of Peace River. The eastern boundary, or shoreline, passed along the Foothills belt in a general northwest-southeast trend and, based on a thickness of 15 feet for the Grayling Formation at Needham Creek and Graham River, this boundary did not extend more than a few miles farther east of this section of Grayling. The western limit to the basin of deposition of the Grayling Formation has not been determined.

TOAD FORMATION

The Toad Formation consists of calcareous, dark grey, platy siltstones and shales, which alternate with sequences of calcareous, dark grey, massive siltstones up to several hundred feet thick. Some fine-grained sandstones are present in the upper part and contain crossbedding and ripple-marks that both indicate a northwesterly trending shoreline and sedimentary transport to the southwest. In the area of Peace and Murray Rivers, the upper Toad Formation consists of thin-bedded and flaggy, fine-grained sandstones in place of the thick-bedded, more coarsely grained sandstones that occupy the same stratigraphic interval in the Gatho Creek - Liard River area. Two ammonite faunas occur in the northern area: the Wasatchites fauna of early upper Scythian age, and another Gymnotoceras fauna of Middle Triassic (Anisian) age. A pelecypod fauna of late upper Scythian age is also present (Tozer, 1961, p. 5). Fossils are rare in the western sections except in the lower part of the formation. According to fossil evidence, the Toad is upper Scythian and Anisian in age in the eastern Foothills. For example, from a locality near mile-post 380, Alaska Highway, the following were identified by Tozer: Gymnotoceras sp., Leiophyllites kindli McLearn, Hungarotid indet., Longobardites, and Parapopanoceras tetsa McLearn. From outcrops of the Toad Formation in Needham Creek fossils were collected about 125 feet above the Permian chert, and were identified by Tozer as Posidonia mimer Oeberg, Arctoceras sp., and Juvenites sp. They indicate a Lower Triassic, upper Scythian age. Poorly preserved pelecypods, Daonella sp., and crushed ammonites, possibly Gymnotoceras and Ptychites, occurring in the upper beds of the Toad in Needham Creek, indicate a Middle Triassic age, and probably Anisian. Farther south in the vicinity of Murray River and Wapiti Lake, only the Anisian fauna has been collected. At approximately 850 feet above the base of the Triassic section from two different localities in this area, the following were identified by Tozer: Daonella sp., and Gymnotoceras sp. indicating a Middle Triassic, Anisian age (Appendix, section 11); and Gymnotoceras sp., Gymnotoceras cf. meeki (Mojsisovics), Ptychites sp., Protrachyceras sp., and Daonella sp., all of which also indicate a Middle Triassic, Anisian age (Appendix, section 12). In section 11 these fossils are overlain by beds containing Parapopanoceras cf. tetsa McLearn, Gymnotoceras sp., and Ceratites hayesi McLearn (?) which indicate a Middle Triassic, Anisian age. However, at the base of this section

the fossil Claraia stachei occurs in rocks similar in lithology to the overlying beds, and as beds are conformable throughout this formation it is presumed that the Toad Formation here is not only Anisian in age but may be as old as lower Scythian. The rocks in this lower Scythian interval are indistinguishable from rocks that occur in a stratigraphic position equivalent to the Toad Formation farther north in the Liard River area. Because of similar lithology of the Toad and Grayling Formations in the lowest part of the section here, and in view of the absence of typical Grayling lithology but the presence, here in the lower Toad Formation, of fossils similar to those of the Grayling Formation, some of the Lower Triassic rocks have been called by the double name "Toad-Grayling Formation" (Hunt and Ratcliffe, 1959).

The thickness of the Toad Formation increases from 1,200 feet near the mouth of Toad River, to more than 2,000 feet about 9 miles to the west; it reaches an estimated maximum of 3,000 feet in the Racing River area (Pelletier, 1961, p. 4, 15). Farther west the formation becomes thinner. At mile-post 427.5, Alaska Highway, it is about 1,560 feet thick, and this may include some Liard Formation. In the Peace River area the Toad Formation at Needham Creek is about 1,000 feet thick and, as mentioned previously, it becomes thinner to the east. At Green Mountain 30 miles southwest of Needham Creek, the Toad Formation is about 650 feet thick and consists chiefly of platy siltstones. As the upper boundary here is arbitrarily chosen, the westward decrease in thickness of the Toad may not have been established. The Toad Formation, similar to the Grayling, appears to have had its maximum development in the Racing River - Liard River area. Deposition of beds consisting of material derived from the east and northeast appears to have overlapped the eastern limit of the Grayling Formation.

The sedimentary and stratigraphic relationships of the Toad and Grayling Formations to each other west of the Foothills are not known, but their typical lithologies are distinguishable in sections in the western Foothills, and the contact between these formations in the latter area can be mapped. This contact is not distinguishable in the subsurface to the east, nor in outcrops to the south in the vicinity of Murray River. The Toad Formation south of Peace River does not have the predominant black to dark grey character, typical of the Toad north of Peace River. Generally it is a more reddish brown and less massive in appearance. For this reason it may be inadvisable to use the name Toad farther south.

LIARD FORMATION

The Liard Formation in the eastern Foothills consists of fine- to coarse-grained, grey massive sandstones with minor interbeds of thick grey limestone, and thick sequences of dark grey, massive siltstones. However, the intervals of heavy sandstones grade westerly over a distance of a few miles into less well defined ledges of finer sandstones and platy beds, and the massive, light grey limestone becomes somewhat more important in that it occupies more of the section. The Liard Formation has many shallow-water characteristics and shows festoon bedding, crossbedding, ripple-marks, scour features and coquinoid layers. Sedimentary structures again indicate a south-westerly transport of sediments. A Ladinian age is assigned to the

Liard Formation based on the occurrence of Nathorstites at one or more stratigraphic levels. The fauna of the Liard Formation has been discussed by McLearn (1947b) and Tozer (1961).

The maximum development of the Liard Formation in the Gatho Creek - Liard River area is in the vicinity of Racing River, where it is 400 to 600 feet thick. A few miles to the west the Liard Formation, due to a lateral change in facies across strike, is absent, although that interval is occupied by dark grey platy siltstones typical of the Toad Formation. Toward the east the Liard Formation decreases in thickness and is absent at the mouth of Toad River, as well as on Tetsa River near mile-post 372, Alaska Highway. Part of this eastward thinning is due to pre-Cretaceous erosion, and probably to a lesser extent to eastward convergence of the units. At Goldbar on the north bank of Peace River, about 85 miles west of Fort St. John, the Liard Formation consists of the "Dark Siltstones" and lower "Grey Beds" of McLearn (see McLearn and Kindle, 1950, pp. 45-53), and about 450 feet is exposed. This figure does not include McLearn's Nathorstites-bearing "Flagstones", which would increase the thickness of the Liard Formation by about 250 feet. A few miles west of Goldbar in ranges extending north of Peace River, the Liard Formation is as much as 1,300 feet thick. This variation in thickness suggests that the main area receiving sediments during Ladinian time was presumably in the vicinity of Peace River rather than in the area of the type section to the north on Liard River. The evidence of coarse sandstone, coarse crossbedding, current-ripple marks, and beds of bioclastic shelly material suggests that this area of sedimentation occurred over a shallow marine platform.

UNNAMED POST-LIARD BEDS

These beds in the Toad River - Liard River area comprise undivided Upper Triassic units which are equivalent in age to the Pardonet Formation and Grey Beds in the area of Peace and Halfway Rivers; usage follows previous report (Pelletier, 1961, p. 5). The post-Liard beds are generally thick-bedded and massive, and consist of medium to light grey limestone, dolomite and sandstone in the lower part (most probably the Grey Beds), with thinner darker siltstones and limestones in the upper beds (most probably the Pardonet Formation). Several bioclastic units occur throughout the limestones but these are generally thin. Several crossbeds and ripple-marks suggest southwesterly transport of sediments. In the area north of Toad River the post-Liard beds occur in the upper part of the Racing River syncline, and are characterized by the fossils Sirenites and Halobia. To the west are younger beds, which contain the pelecypod Monotis subcircularis as typified in sections immediately east of Sentinel Range. In the Peace River area the Pardonet Formation contains Karnian and Norian faunas described by McLearn (1947a, 1960).

In the area north of Toad River the entire thickness of the post-Liard beds is not known as no section is complete. They appear to be the youngest Mesozoic rocks known, or preserved, in the area. In the Racing River syncline these beds appear to be about 950 feet thick; about 6 miles to the west they are about 1,150 feet thick; at mile-post 428 they are between 300 and 600 feet thick, and presumably

are thinner to the west. There are no occurrences of these younger beds east of the Racing River syncline in the vicinity of Liard River and Gatho Creek. There the Lower Cretaceous shales lie unconformably upon the Liard Formation, so that absence of post-Liard beds in this area may be due primarily to pre-Cretaceous erosion. Toward the south, post-Liard beds are overlain unconformably by Jurassic shales. They reach a maximum development of more than 1,600 feet in ranges a few miles west of Goldbar, and a thickness of 2,565 feet is recorded by McLearn (1960, p. 8) from the section at Pardonet Hill, Peace River. As in the case of the Liard Formation, these post-Liard beds appear to have been deposited in their greatest thickness in the Foothills west and northwest of Fort St. John. Also, the evidence of coarse sandstones and grits, numerous crossbedded units and beds of bioclastic shelly material, together with the development of several units of sandstone containing well-washed quartz, indicates considerable current action in shallow waters. It is thought that such features would develop on a subaqueous platform, or shelf, near shore, where normal sedimentary accumulation by means of bottom currents take place.

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— APPENDIX —

Section 1. High hill 8 miles north of Nonda Creek and 2 miles north of Eight-Mile Creek, and about 14 miles north of Toad River from mile-post 428, Alaska Highway.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
Section begins in trough of tight syncline near top of hill. No Cretaceous is present.			
<u>Unnamed Post-Liard Beds</u>			
12	Sandstone and siltstone, dark grey and weathering brownish yellow; fine-grained; calcareous; unit consists of 1-inch plates of interbedded sandstone and siltstone, with minor medium-bedded sandstone throughout; small-scale crossbedding and current-ripple marks present; beds somewhat resistant. Age is not known but is included in Triassic because of conformability and lithologic similarity.	220	1,950
11	Siltstone and minor sandstone and limestone, dark grey and weathering medium brownish yellow; calcareous; numerous beds of pelecypods at 4 feet from base; unit is somewhat recessive. Presence of <i>Halobia</i> sp. indicates Upper Triassic; probably late Karnian age.	185	1,730
10	Siltstone, dark grey and weathering medium brownish grey; calcareous; minor, medium-bedded and thin dark grey limestone; beds massive but some soft platy beds occur in upper part; irregular, narrow black calcareous beds occur parallel to bedding; unit is somewhat resistant. At 190-foot mark, some poorly preserved ammonites and pelecypods occur; <i>Halobia</i> sp. <i>Juvavites</i> sp., and <i>Discotropites</i> sp. of Karnian age are present.	270	1,545

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
9	Siltstone, dark grey and weathering brown; calcareous, somewhat arenaceous; beds are platy and generally less than 1/2 inch thick; current-ripple marks present; unit is partly recessive. Large ammonite impressions and pelecypods 15 feet from base; <u>Halobia</u> sp.	370	1, 275
8	Siltstone and sandstone, dark grey and weathering brownish grey; sand is fine grained; all beds are calcareous; thick-bedded siltstones are interbedded with thick intervals of soft, platy siltstone; thick beds are internally divided by laminations but do not weather out as plates; all beds are sandier and coarser than those in lower units of this section.	210	905
<u>Toad Formation</u>			
7	Siltstone, dark grey and weathering orange-brown; calcareous; in places, 2 to 3 feet of platy beds aggregate to form small ledges; all beds are platy; unit is recessive.	200	695
6	Siltstone, dark grey and weathering brown; calcareous; massive; forms ledge.	30	495
5	Siltstone, dark grey and weathering brown; calcareous platy; recessive in upper 10 feet, otherwise forms ledge.	40	465
4	Covered interval; soft, black, platy siltstone in talus; recessive.	20	425
3	Siltstone, dark grey and weathering dark grey and brown; calcareous; laminations 1/4 to 1/2 inch; several feet may be interbedded with minor thick-bedded siltstones; unit forms ledge.	25	405
2	Covered interval, black platy siltstone in talus containing poorly preserved ammonite impressions; recessive.	300	380

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
1	Siltstone, dark grey and weathering brown; calcareous; platy; minor thick-bedded siltstone is interbedded; black calcareous elliptical-shaped nodules present; unit forms ledge. Base of section covered by overburden at bottom of hill.	80	80

Section 2. Upper part of section on south bank of Toad River about 8 miles below Ram Creek; lower part on high hill 1 mile along strike to the south.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
Section begins in trough of syncline at top of bank. Contact not seen between Cretaceous and Triassic units.			
<u>Liard Formation</u>			
15	Sandstone and minor siltstone, dark grey and weathering yellowish brown; fine-grained; calcareous; thick-bedded; recessive.	55	1,579
14	Sandstone, dark grey, weathering brown; fine-grained; calcareous; massive; forms ledge; spirifers and terabratulids occur in small lenses of coquinoid limestone.	32	1,524
13	Sandstone, dark grey and weathering brown to grey; fine-grained; calcareous; wispy crossbedding and small ripple-marks present; recessive.	12	1,492
12	Sandstone, dark grey and weathering greyish brown; calcareous; massive; forms ledge.	75	1,480
11	Sandstone, dark grey and weathering dark brownish grey; calcareous; minor festoon bedding present; medium-bedded; recessive.	10	1,405
10	Sandstone, dark grey and weathering dark brownish grey and yellowish grey; calcareous; massive; minor limestone present; terabratulids, spirifers and <u>Gryphaea</u> occur near base; forms ledge. Stratigraphic offset has been made along strike 1 mile to south to include remainder of section.	65	1,395

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<u>Toad Formation</u>			
9	Siltstone, dark brownish black and weathering brown with considerable white coating; calcareous; thin-bedded; recessive, and partly covered.	60	1,330
8	Sandstone, medium to dark grey and weathering medium brownish grey; fine-grained; calcareous; forms ledge.	40	1,270
7	Covered interval, recessive; presumably soft, dark grey calcareous siltstone.	231	1,230
6	Siltstone, dark grey to black and weathering medium grey and orange-brown; calcareous; medium- to thin-bedded; minor ledge.	18	999
5	Covered interval, recessive; presumably soft, dark grey calcareous siltstone.	252	981
4	Siltstone, dark grey to black and weathering medium brownish grey; calcareous; thick-bedded; forms ledge.	28	729
3	Covered interval, recessive.	77	701
2	Siltstone, medium to dark grey and weathering medium grey and orange-brown; calcareous; massive. Top 45 feet is a massive ledge; next 445 feet is soft, highly cleaved siltstone and is recessive; lower 40 feet is massive siltstone ledge.	530	624
1	Siltstone, medium grey to dark grey and weathering medium grey; calcareous; medium- to thick-bedded but internally divided sandy laminations; forms ledge. This unit is base of section and occurs in core of anticline.	94	94

Section 3. West flank of hill 1 mile north of mile-post 380,
Alaska Highway.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<p>Section begins in covered interval at top of ridge. Cretaceous is absent on hilltop but occurs in syncline immediately to the east with exposures along the Alaska Highway 1 mile along strike to the south.</p>			
<p><u>Liard Formation</u></p>			
10	Sandstone, medium grey and weathering yellowish brown and red; medium-grained; calcareous; medium-bedded; forms ledge.	10	970
9	Sandstone, dark grey and weathering dark brownish grey; fine- to medium-grained; calcareous; medium-bedded, generally, but a few thick-bedded, medium-grained sandstones and platy, black siltstones are interbedded; considerable scouring occurs, as well as festoon bedding and ripple-marks; recessive.	115	960
8	Sandstone, medium grey and weathering yellowish brown and orange; medium-grained, calcareous; thick-bedded to massive; festoon bedding present; dominant ledge former.	85	845
7	Sandstone, dark grey and weathering yellowish brown and orange; thin- to medium-bedded; medium-grained; calcareous; wisps of fine-scale crossbedding and ripple-marks, minor scouring; recessive, but ledge occurs in lower few feet.	25	760
<p><u>Toad Formation</u></p>			
6	Siltstone, dark grey to black and weathering dark grey and yellowish grey and white; calcareous; finely laminated sandstones are interbedded but minor; beds are soft, sooty, and	110	735

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	occur as thick or massive aggregates of finely laminated siltstones; recessive.		
5	Covered interval; soft black siltstone occurs in talus and probably occupies this interval; recessive.	70	625
4	Siltstone and minor fine-grained sandstone, dark grey and weathering dark brownish grey; calcareous; massive; forms ledge.	85	555
3	Siltstone, dark grey and weathering dark brownish grey; massively bedded, but breaking into platy units; ledge continues from above unit. Small black nodules occur in 1-inch layers in a few beds at base of unit.	145	470
2	Siltstone, dark grey to black and weathering dark grey; calcareous; unit consists of platy aggregates a few feet thick interbedded with massive beds to give ribbed look to rocks; recessive. Fossils occur at 5 feet from base: <u>Gymnotoceras</u> sp., <u>Leiophyllites kindli</u> McLearn, Hungaritid, <u>Longobardites</u> sp. Fossils also occur at 30 feet from base: <u>Parapopanoceras tetsa</u> McLearn and <u>Gymnotoceras</u> sp.	120	325
1	Siltstone, dark grey to black and weathering dark grey; calcareous; laminated to platy; a few hard beds of massive siltstone are present; unit is essentially soft and recessive. Base of section concealed at bottom of draw.	205	205

Section 4. North bank of Chlotapecta Creek about 7 miles east of Rocky Mountain front.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
Section begins at presumed Cretaceous-Triassic contact, although Cretaceous is concealed.			
<u>Liard Formation</u>			
15	Sandstone and interbedded pyritic shales; black and weathering brilliant rusty-orange; non-calcareous; medium-bedded; shales are generally interbedded but also occupy a recessive interval between the 40- and 50-foot marks; unit forms ledge. This unit is tentatively referred to here as "upper beds of the Liard Formation".	83	1,615
14	Sandstone and minor thick-bedded limestone; dark grey and weathering dark grey and brown; medium-grained; calcareous; contains brachiopods and <u>Gryphaea</u> sp.; massive; forms ledge.	56	1,532
13	Sandstone, light grey and weathering medium grey and brown; coarse-grained; calcareous, thick-bedded; medium-scale crossbedding present; forms ledge.	65	1,476
12	Sandstone, dark grey and weathering dark grey and brown; calcareous; thin-bedded; contains both small-scale crossbedding and ripple-marks; recessive.	6	1,411
11	Sandstone, dark grey and weathering dark grey; fine- to medium-grained; calcareous; generally thick-bedded with minor medium and thin beds; forms ledge.	88	1,405
10	Covered interval, recessive.	75	1,317

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
9	Sandstone, medium grey and weathering medium grey; fine-grained; calcareous; large, limestone concretions weathering low and referred to as 'cannon-ball' type; thin lenses of coquinoïd material consisting of macerated shells of brachiopods and pelecypods; beds massive; forms ledge.	43	1,242
<u>Toad Formation</u>			
8	Covered interval, recessive.	280	1,199
7	Sandstone, dark grey and weathering dark brown and grey; fine-grained; calcareous; thick-bedded, reptile bones (Ichthyosaurs?) occur at 30-foot mark; unit partly recessive.	81	919
6	Sandstone, medium brownish grey and weathering yellowish brown; medium- to coarse-grained; calcareous; thick-bedded; scouring common, also shale-chip breccias and worm casts in many layers; forms ledge.	12	838
5	Sandstone and siltstone, dark grey and weathering dark grey and brown; sand is fine-grained; calcareous; thick-bedded but numerous thinner beds, generally sandstone, are present; scouring common; partly recessive.	96	826
4	Siltstone, dark grey to black and weathering dark brownish grey; calcareous; massive, recessive.	100	730
3	Siltstone and shale, black, calcareous; minor 6-inch siltstone beds; recessive.	40	630
2	Siltstone, dark grey to black and weathering dark grey; calcareous; 15 feet of fault breccia and calcite veining occurs 20 feet above base; massive; forms ledge.	95	590

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
1	Siltstone, dark grey and weathering dark grey; calcareous; beds break into 1-inch plates but generally thick-bedded. At 35 feet from top, beds grade into soft black platy siltstones and shale; at 360 to 464 feet from top, harder, black siltstones occur, then softer siltstones to base of section. Section ends near core of anticline. No Grayling Formation is exposed.	495	495

Section 5. High hill 4 miles west of Graham River and 3 miles north of Needham Creek.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<p>Section begins in Upper Triassic beds on dip slope on west flank of hill. The contact with Jurassic beds is not exposed.</p>			
<p><u>Post-Liard Beds</u></p>			
19	<p>Limestone and sandstone, interbedded. Limestone is medium grey and weathers light grey; fine-grained to coarsely crystalline and contains several bioclastic layers; minor chert pods present; thick-bedded and in intervals up to 10 feet. Sandstone is brown and weathering light brownish grey to light grey; fine- to medium-grained; slightly calcareous; thick-bedded but breaking into 2-inch slabs; fine-scale crossbedding present, also current-ripple marks; unit is somewhat recessive.</p> <p style="padding-left: 40px;">These beds are similar to some of the unnamed post-Liard beds in the Toad River - Liard River area.</p>	115	1,990
18	<p>Sandstone, medium to dark brownish grey and weathering medium brownish grey; fine-grained; calcareous; flaggy to medium-bedded; finely laminated; hard; forms massive</p>	25	1,875
17	<p>Sandstone, medium grey and weathering light yellowish grey; medium-grained; calcareous; medium- to thick-bedded; some crossbedding; forms ledge.</p>	25	1,850
16	<p>Shaly siltstone and sandstone, dark brownish grey and weathering medium brownish grey; sandstone is fine grained; all beds are calcareous, and break into irregular plates and rubble; interval is deeply recessive.</p>	158	1,825

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
15	Sandstone, medium to dark grey and weathering medium brownish grey; fine-grained; calcareous; massive. <u>Spiriferina</u> sp. present; upper 20 feet forms ledge, lower part is recessive and beds tend to be platy.	80	1,667
14	Sandstone, medium grey and weathering light yellowish to brownish grey; medium-grained; calcareous; beds flaggy and thin; forms ledge.	67	1,587
13	Sandstone and siltstone, dark grey and weathering medium to dark grey; fine-grained; calcareous; minor chert content occurs as black nodules a few inches in diameter; beds are thin and platy; unit is recessive.	150	1,520
12	Sandstone, medium brown and weathering yellowish grey; fine-grained; calcareous; 6 feet of dark grey limestone near top; some spirifers present; beds are massive; unit forms ledge.	23	1,370
11	Sandstone, dark grey and weathering dark grey; fine-grained; calcareous; beds are platy; unit is recessive.	97	1,347
10	Sandstone and limestone, medium grey and weathering grey; sand is fine to medium grained and calcareous; limestone is interbedded; all beds are massive and form ledge. Unit occurs at top of hill. All units below are on east-facing scarp.	181	1,250
9	Sandstone, medium brown and weathering yellowish brown; fine-grained; calcareous; thin-bedded and flaggy; unit is recessive.	140	
8	Limestone, light grey and weathering light grey; fine-grained; massive; partly bioclastic; contains <u>Spiriferina</u> sp. and <u>Orbiculoidea</u> sp.; forms ledge.	18	929

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
7	<p>Sandstone, medium brown and weathering yellowish grey; fine-grained; calcareous; massive; forms ledge.</p> <p>This unit is taken as the base of post-Liard beds on the basis of the distinctive grey colour, massive structure of beds, and predominance of limestone, bioclastic units and cleaner sandstones which are similar to post-Liard beds in the area of the Toad and Liard Rivers to the north.</p>	195	911
<u>Liard Formation</u>			
6	<p>Sandstone, brown and weathering yellowish and brownish grey; fine-grained; calcareous; massive but breaking into flaggy and thin beds; minor dark limestone and sandstone, and interbedded in middle of unit; unit forms ledge in middle.</p> <p>The fossils <u>Daonella</u> sp., and <u>Protrachyceras</u> ? sp. indet. indicate a Middle Triassic age.</p>	135	716
5	<p>Sandstone, dark grey and weathering medium grey and yellowish grey; fine- to medium-grained; calcareous; beds are platy except for a few feet of thick beds at base; upper part forms ledge.</p>	145	581
4	<p>Sandstone, dark brown, and weathering light yellowish to brownish grey; fine-grained; calcareous; thick-bedded but breaking into flaggy shales; upper 60 feet forms a ledge.</p>	165	436
3	<p>Sandstone, brownish grey and weathering light yellowish and brownish grey; fine-grained; calcareous; massive; low-weathering 'cannon-ball' concretions up to 1 1/2 feet in diameter are present; fossils</p>	178	271

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	<p>occur in calcareous pods and concretions in upper 35 feet; unit forms ledge.</p> <p>The fossils—<u>Daonella</u> sp., <u>Spiriferina</u> cf. <u>borealis</u> <u>Whiteaves</u>, <u>Terebratula</u> sp., <u>Lobites</u> cf. <u>pacianus</u> <u>McLearn</u>, <u>Nathorstites</u> <u>mcconnelli</u> (<u>Whiteaves</u>)—indicate a Middle Triassic, Ladinian age; <u>Nathorstites</u> zone.</p>		
2	<p>Sandstone, medium brownish grey and weathering light yellowish grey and light brownish grey; fine-grained; massive; fossils occur in calcareous pods; basal 10 feet is recessive and upper part forms ledge.</p> <p>The fossils, <u>Daonella</u> sp. and <u>Ostrea</u> sp., indicate a Middle Triassic age.</p>	45	93
1	<p>Sandstone, medium brownish grey and weathering yellowish grey; fine-grained; calcareous; minor interbedding of arenaceous, platy shale and siltstone, and thin dark grey limestone; some poorly preserved <u>Daonella</u> present; unit is generally medium bedded; forms ledge.</p> <p>Base of section concealed by talus, and lower down by vegetation. Presumably this interval occurs in small gorge on Needham Creek 4 miles south.</p>	48	48

Section 6. Small gorge along Needham Creek 2 miles west of junction with Graham River.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<p>Section begins in a series of closely folded beds. Above this is a covered interval which is on strike with a similar covered interval at the base of Section 5, about 4 miles to the north, but may not be correlative.</p>			
<p><u>Liard Formation</u></p>			
11	Siltstone and shale, dark grey and weathering brownish grey; calcareous; platy; lower 20 feet partly covered. This unit occurs in a succession of folds and beds are not traceable.	35	1,812
10	Siltstone and shale, dark grey and weathering brownish grey; calcareous; platy; minor limestone lenses up to 6 inches wide are present but do not extend more than 6 feet along strike; unit forms ledge.	55	1,777
9	Covered interval mainly, shale and siltstone in talus; recessive.	140	1,722
8	Sandstone and siltstones, dark grey and weathering light brownish grey and yellowish grey; calcareous; hard; platy and flaggy but generally thin-bedded with some medium-bedded layers; medium-scale crossbedding present as well as slump structures; forms ledge.	435	1,582
7	Siltstone, black and weathering dark grey; calcareous; soft; platy and shaly; deeply recessive.	35	1,147
6	Siltstone, dark grey to black and weathering light brownish grey; calcareous; hard; platy and thin-bedded; forms ledge.	27	1,112

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
5	<p>Siltstone and shale; black and weathering dark grey; calcareous; generally platy with minor thin interbeds of hard sandstone and siltstone; poorly preserved fossils present throughout unit.</p> <p>The fossils <u>Daonella</u> sp. and <u>Paratrachyceras</u> ? sp. indicate a <u>Middle Triassic</u> age. Possibly <u>Nathorstites</u> zone.</p>	70	1,085
<u>Toad-Grayling Formation</u>			
4	<p>Siltstone, dark grey and weathering light brownish grey to yellowish grey; calcareous; massive aggregates of soft recessively weathering platy beds alternate with massive, resistant units also consisting of platy beds; unit is somewhat resistant.</p> <p>The fossil <u>Daonella</u> sp. indicates age as <u>Middle Triassic</u>. These fossils along with poorly preserved ammonites and fragments of ichthyosaur bone occur chiefly in the ledge in the upper 100 feet so that the upper part of this unit may be <u>Liard Formation</u>; contact is gradational here.</p>	445	1,015
3	<p>Siltstone, dark grey to black and weathering dark grey; calcareous; thin dark grey limestone occurs throughout; small, black calcareous nodules up to 1/2 inch wide and a few inches long occur in most beds and parallel to bedding; ammonites and ganoid fish remains occur in upper 55 feet; beds generally medium to thick but are massive in upper part; forms resistant unit.</p> <p>The fossils <u>Daonella</u> sp., crushed ammonites, possibly <u>Gymnotoceras</u> and <u>Ptychites</u>, indicate a <u>Middle Triassic</u> age and probably <u>Anisian</u>.</p>	230	570

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
2	<p>Siltstone and fine sandstone, dark grey and weathering medium brownish grey and yellowish grey; calcareous; platy; soft, black, platy beds alternate with harder beds, and the differential weathering gives the unit a ribbed appearance; kettle concretions up to 5 feet in diameter are hard, calcareous, and contain fragments of ganoid fish nearly 3 feet long, as well as ammonites; generally recessive but lower part forms ledge.</p> <p>At the 200-foot mark from top, the fossils <u>Posidonia mimer</u> Oeberg, <u>Arctoceras sp.</u>, and <u>Juvenites sp.</u> indicate a Lower Triassic, early upper Scythian age. At the 285-foot mark from the top, the fossils <u>Paranorites sp.</u> indicates a Lower Triassic, lower Scythian age. Undoubtedly part of this unit and the whole of the underlying unit are equivalent in age to the Grayling Formation but the lithology is typical of the lower Toad Formation in the Tetsa, Toad and Liard Rivers to the north.</p>	325	340
1	<p>Covered interval</p> <p>This unit is occupied by non-calcareous black shales 2 miles east on Graham River. These shales are in disconformable contact with so-called "Permian chert" which is the unit immediately underlying the Triassic here. This chert also occurs at the base of present unit in Needham Creek.</p>	15	15

Section 7. High hill and ridge extending easterly on west side of headwaters of Schooler Creek about 14 miles north of Peace River.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<p>Section begins in Upper Triassic beds on dip slope west of survey cairn on west flank of hill. The contact with Jurassic beds is not exposed.</p>			
<p><u>Post-Liard Beds</u></p>			
36	<p>Siltstone, limestone and minor sandstone; siltstone is dark grey, weathers dark grey, and is calcareous; limestone is dark grey, weathers dark brownish grey, and is fine grained to dense; unit is medium to thin bedded; poorly preserved ammonites, reptile bones (ichthyosaurus), and pelecypods; generally a resistant unit.</p> <p>The fossil <u>Monotis subcircularis</u> Gabb, indicates a Norian age. These beds are equivalent to the Pardonet Formation and probably are Pardonet beds.</p>	265+	2,658
35	<p>Sandstone, medium grey and weathering medium grey; fine- to medium-grained, calcareous; thick-bedded; minor fine-grained, siliceous limestone occurs as interbeds, and is dark grey, weathers a medium grey and contains indeterminate silicified fossils; resistant unit.</p>	105	2,393
34	<p>Limestone, light grey to cream and weathering light grey; dense, with coarse-grained bioclastic material; resistant and forms major ledge.</p>	67	2,288
33	<p>Sandstone and interbedded limestone, dark grey and weathering light grey; thick-bedded and resistant.</p>	65	2,221

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
32	Limestone, dark grey but weathering light grey and dark grey alternately in thick-bedded intervals; unit is somewhat recessive.	25	2,156
31	Sandstone, medium grey and weathering light grey; medium-grained; calcareous; thick-bedded; two massive limestone beds, 10 and 6 feet thick, occur in upper 60 feet; unit forms ledge on cliff wall.	164	2,131
30	Sandstone, yellow and weathering yellowish orange; medium- to coarse-grained; thin-bedded; recessive.	23	1,967
29	Sandstone, dark grey and weathering light grey; coarse-grained; slightly calcareous; medium- and thick-bedded; forms ledge.	118	1,944
28	Sandstone, dark grey and weathering dark yellowish grey; coarse-grained; calcareous; thin- and medium-bedded; slightly recessive.	27	1,826
27	Sandstone, light grey and weathering light grey; coarse-grained; non-calcareous; massive; forms ledge.	48	1,799
26	Dolomite, light yellowish grey and weathering yellowish and yellowish grey; brecciated with fragments ranging from 1/2 inch to 5 inches wide; vugs, stylolites and coarse calcite pods and beds are present, as well as moulds of fossils; rock occurs as massive ledge but is disintegrating in most places into large blocks. This unit is an intraformational dolomite breccia, and is of the collapse or solution type.	42	1,751
25	Sandstone, yellowish grey and light grey and weathering yellow and light grey; fine- to medium-grained; calcareous; massive; soft and recessive.	48	1,709

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
24	Limestone, light grey and weathering light grey; fine-grained; arenaceous; massive but broken down to rubble.	12	1,661
23	Sandstone, light grey and weathering light yellowish grey; fine- to medium-grained; non-calcareous; medium-bedded and laminated; forms ledge.	20	1,649
22	Sandstone, medium grey and weathering grey and yellow; fine- to medium-grained; partly calcareous; massive; forms ledge.	234	1,629
21	Limestone, light grey and weathering light grey; fine-grained; somewhat arenaceous; massive; unit is soft and breaks easily into rubble; recessive.	15	1,395
20	Sandstone, light yellowish brown and weathering yellow; fine-grained; non-calcareous; well-laminated and platy to thin-bedded; fairly resistant.	6	1,380
19	Sandstone, light grey and weathering light grey; fine-grained; non-calcareous; massive; unit forms a broken ledge and is recessive in part.	80	1,374
18	Sandstone, light yellowish grey and weathering light yellow; fine-grained; calcareous; massive; forms broken ledges along crest of ridge.	158	1,294
17	Sandstone, dark grey and dark red, and weathering red and yellowish brown; fine-grained; non-calcareous; red sandstone is interbedded with grey; thin-bedded and platy; scouring, ripple-marks, fine crossbedding, worm burrows and casts are present; lower 15 feet is recessive but upper part forms ledge.	47	1,136
16	Sandstone, light grey and weathering light yellowish grey; fine- to medium-grained; slightly calcareous;	32	1,089

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	massive; poorly preserved ammonite impressions present; unit is hard and forms ledge.		
15	Sandstone, light brownish grey and weathering light yellowish brown; very fine grained; non-calcareous; massive, soft and recessive.	15	1,057
14	Sandstone, light brownish grey and weathering whitish grey; fine-grained; non-calcareous; massive but breaking into medium and thin beds; medium-scale crossbedding; unit forms ledge. This unit is arbitrarily taken as the base of the post-Liard beds. It is the first unit of a sequence of predominantly grey sandstones and limestones which form the scarp face and dip slope of the mountain.	42	1,042
<u>Liard Formation</u>			
13	Sandstone, medium brownish grey and weathering yellowish brown; fine-grained; calcareous; thin-bedded, with interbedded platy, sandy shales; forms ledge.	100	1,000
12	Dolomite, light yellowish brown and weathering light greyish brown; minor, thin, brown-weathering sandstone occurs in middle; unit forms small ridge. Faults are present and the beds are highly contorted.	7	900
11	Sandstone, light grey and weathering light grey to white; medium-grained; slightly calcareous; massive; does not form outcrop on ridge; recessive.	60	893
10	Sandstone, medium brownish grey and weathering light yellowish brown; fine-grained; calcareous; beds flaggy; forms ledge in upper 20 feet.	40	833

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
9	Sandstone, dark brownish grey and weathering yellowish grey; fine-grained; calcareous; massive; recessive.	10	793
8	Limestone, medium grey and weathering light grey; fine-grained to coarsely crystalline; bioclastic in part; massive; forms ledge.	40	783
7	Sandstone, medium brownish grey and weathering light yellowish brown; fine-grained; calcareous; beds platy; recessive.	55	743
6	Limestone, medium grey and weathering light grey; fine-grained to coarsely crystalline; minor breccia; massive; forms ledge.	13	688
5	Sandstone and shale, partly covered; dark grey and weathering brown; thin; some chert pebbles up to 1/2 inch in diameter; terabratulids and gryphaeids present but poorly preserved, and generally form a coquinoïd layer; unit is recessive. This unit is similar to eastern exposures of Liard Formation in the Tetsa River area to the north.	160	675
4	Sandstones, medium brownish grey and weathering yellowish brown; calcareous; beds occur in massive aggregates of platy and thin- to medium-bedded units; medium-scale crossbedding; unit forms ledge.	205	515
3	Sandstone, light grey and weathering light grey; medium- to coarse-grained with some grit present; beds are massive but contain medium-scale crossbedding; unit forms ledge.	25	310
2	Sandstone, dark grey and weathering light yellowish brownish grey; fine- to medium-grained; generally massive but breaking into thin- and medium-bedded units; scouring,	225	285

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	ripple-marks and crossbedding are present; unit is resistant.		
1	Sandstone, dark grey and weathering yellowish to orange-brown; fine- grained; calcareous; generally flaggy and thin-bedded; forms ledge.	60	60
	This unit is at base of exposed section and is partly covered. Remainder of section is completely concealed. This unit is part of the Liard Formation but may not be the base of it.		

Section 8. West flank of Mount Green about 6 miles north of Peace River.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
Section begins in syncline but intense folding and faulting has distorted the Upper Triassic beds, most of which are not described.			
<u>Liard Formation</u>			
6	Sandstone and siltstone, dark grey to brown and weathering yellowish grey and light brown; fine-grained; calcareous; beds platy to medium-bedded but generally thin; several 30- to 40-foot ledges present. These beds are younger than some known Middle Triassic. They are presumed to be a fine-grained equivalent of the Liard Formation to the east, based on sand content, and occurrence of ledges overlying a thick sequence of platy black siltstones.	350	1,332
<u>Toad Formation</u>			
5	Siltstone, dark grey and weathering yellowish grey and dark grey; calcareous; somewhat arenaceous; generally platy and recessive. These beds are gradational with overlying thin sandstones and underlying black platy siltstones. On the basis of lithology and stratigraphic position they are presumed to be uppermost beds of Toad Formation.	428	981
4	Siltstone and shale, black and weathering dark grey; calcareous; platy, minor flags of siltstone present; prolific occurrence of pelecypods 48 feet from top; unit forms ledge. The fossil <u>Daonella</u> sp. indicates a Middle Triassic age.	202	553

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<u>Grayling Formation</u>			
3	<p>Covered interval, non-calcareous black shale and platy siltstone in talus; deeply recessive</p> <p>Because the shale is typical of the shale in areas in which known Grayling Formation occurs, and because of the stratigraphic position of this unit, it is presumed that this unit is uppermost Grayling.</p>	87	341
2	<p>Shale, black and weathering rusty-orange, non-calcareous; thin, light grey, orange-weathering limestone and sandstone is interbedded with the shale but occupies less than 5 per cent of unit; forms ledge.</p> <p>This unit is typical Grayling.</p>	146	254
1	<p>Covered interval, talus of above unit, namely shale and limestone; some minor shale and limestone occur as scattered beds in unit; calcareous concretions are present but are unfossiliferous. Fragments of fish scales present; unit is deeply recessive.</p> <p>Grayling is structurally conformable with the underlying Permian chert, but is presumed to be stratigraphically disconformable. Contact is concealed.</p>	108	108

Section 9. High hill at headwaters of Eleven Mile Creek, east of Clearwater Creek and 20 miles south of Peace River.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<p>Section begins on east side of small saddle which is underlain by the soft, recessive shales of Jurassic age. These beds are overlain to the west by Cretaceous sandstones and shales, and underlain to the east by Triassic limestones and siltstones.</p>			
<p><u>Post-Liard Beds</u></p>			
9	<p>Limestone, medium grey, light grey and weathering light grey; fine-grained; massive; forms ledge.</p> <p>Upper contact with Jurassic beds is concealed but appears to be structurally conformable. Above Jurassic interval of approximately 100 feet, sandstones occur containing pelecypod impressions. This limestone may not be Triassic but is included with post-Liard beds as its lithology is similar to some limestone in the Upper Triassic.</p>	185	1,565
8	<p>Siltstone, dark grey and weathering dark brownish grey; calcareous; platy; thin sandstone and limestone beds interbedded; several layers of pelecypod coquinas; unit is recessive.</p> <p>The fossil <u>Monotis subcircularis</u> Gabb found in upper 10 feet indicates age as Upper Triassic, late Norian. The fossil <u>Monotis</u> sp. found in lower 20 feet indicates age as Upper Triassic, Norian.</p>	160	1,380
7	<p>Limestone, dark grey and weathering medium grey; fine-grained; massive but tends to break into thin beds; forms ledge.</p>	40	1,220
6	<p>Siltstone, dark grey and weathering dark brownish grey; calcareous; platy; but occasionally in massive aggregates; recessive.</p>	115	1,180

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
5	Limestone, dark grey and weathering medium grey; silicified coquina in basal 30 feet. Ammonites, pelecypods and reptile bones occur in large kettle-concretions and limestone lenses; thick-bedded and generally forms ledge. The fossils <u>Halobia</u> sp. and <u>Juvavites</u> sp. indicate the age as Upper Triassic, Karnian or Norian.	150	1,065
4	Siltstones, dark grey and weathering dark brownish grey; calcareous; platy; recessive.	250	915
3	Sandstone, medium grey and weathering grey; medium-grained; calcareous; generally thick-bedded with thick interbeds of dark grey limestone weathering dark grey; forms ledge.	110	665
2	Dolomite, light to medium grey and weathering medium grey to greyish white; medium-bedded to massive; brecciated; upper 200 feet forms ledge, but lower part is recessive.	355	555
1	Sandstone, medium grey and weathering light yellowish grey; medium- to coarse-grained; crossbedding present; thick-bedded; unit forms ledge. This unit continues into core of anticline and forms base of section. Units 1 and 2 of this section are similar to units 7 and 8 respectively, of section 10.	200+	200

Section 10. Long high ridge at head of Peck Creek and east of Clearwater River, and about 24 miles south of Peace River.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<p>Section begins in tight syncline near survey cairn on top of ridge. Norian beds, and presumably some Karnian beds, are absent.</p>			
<p><u>Post-Liard Beds</u></p>			
8	<p>Dolomite, light grey and weathering medium grey to greyish white; some of unit is brecciated and other parts are massive, or thick-bedded; the breccia crumbles and disintegrates readily.</p> <p>This unit is similar to unit 2 of section 9.</p>	300	2,850
7	<p>Sandstone, medium grey and weathering orange and brownish grey and somewhat lighter grey; medium- to coarse-grained; calcareous; thick-bedded; minor thick-bedded limestone in upper 30 feet, with some chert; forms ledge.</p> <p>This unit is similar to unit 1 of section 9 and is considered to be the base of post-Liard beds on the basis of lithology.</p>	205	2,550
<p><u>Liard Formation</u></p>			
6	<p>Sandstone and siltstone, dark grey and weathering light yellowish grey; calcareous; beds are platy to flaggy and occur in medium- to thick-bedded aggregates; upper part is somewhat shaly and silty, and in upper 350 feet numerous thin- to medium-bedded bioclastic limestones are present; squashed ammonites are recrystallized brachiopods occur throughout. Unit forms ledge except for minor recessive intervals occupied by shale.</p>	1,015	2,345

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	At 400 to 600 feet from base, crushed trachyceratids indicate the age as Middle or Upper Triassic. At 900 feet from base, Ostreid (?) and trachyceratid fragments, and at 965 feet from base, terebratulids indet. and rhynchonellids indet., all indicate age as Middle or Upper Triassic.		
5	Siltstone and shale, dark grey and weathering light yellowish and brownish grey; calcareous; beds flaky and platy; unit is recessive.	220	1,330
4	Siltstone, dark grey and weathering light yellowish and brownish grey; calcareous; beds occur as massive aggregates of platy units containing poorly preserved ammonite impressions, also minor shale and medium-bedded limestone; unit forms ledge. Both this unit and the overlying unit are gradational with the underlying Toad Formation. However, because of their lithologic similarity to the basal Liard Formation in the vicinity of Needham Creek (sections 5 and 6) they are arbitrarily placed here in the lowest Liard Formation.	90	1,110
<u>Toad-Grayling Formation</u>			
3	Covered interval; dark grey platy calcareous siltstone in talus.	70	1,020
2	Siltstone, dark grey to black and weathering dark grey; calcareous; platy; forms ledge.	110	950
1	Covered interval, dark grey to black shale and platy siltstone in talus; some talus of fine sandstone and limestone weathering orange occurs in lower part and is similar to lithology of presumed Grayling at base of section on Mount Green (section 8).	840	840

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	<p>The Grayling Formation is indivisible from the Toad Formation here. Base of section is at the presumably disconformable contact with Permian chert. This section, together with section 9 about 4 miles north, gives a complete thickness of the Triassic rocks in this area.</p>		

Section 11. High hill 12 miles north of Wapiti Lake and about 95 miles south of Peace River.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<p>Section begins in syncline. Along strike to north and south a few miles, Jurassic shales (Fernie Formation) overlie the Triassic units in this area, but were not observed in this section.</p>			
<p><u>Liard Formation</u></p>			
5	<p>Dolomite and limestone, light grey and weathering light yellowish grey; fine-grained; brecciated in part; slightly arenaceous, contains interbedded sandstone in minor amounts, and occurs as plates and flags; medium- to thick-bedded; forms ledge.</p> <p>This unit is thought to belong to the Liard Formation but is not considered to be the uppermost Liard in this area.</p>	102	1,397
4	<p>Sandstone, dark grey and weathering light orange-brown; medium-grained; calcareous; crossbedding and ripple-marks present, as well as low-weathering 'cannon-ball' concretions; upper beds contain minor calcite veining and solution breccias; some pelecypod impressions present; beds are thick but may break into plates; several ledges occur in this unit.</p> <p>The fossil <i>Daonella</i> sp. indicates a Middle Triassic age, and in most parts the lithology is typical of the Liard Formation in the area of Toad and Liard Rivers.</p>	330	1,295
<p><u>Toad Formation</u></p>			
3	<p>Siltstone and minor sandstone, dark grey and weathering medium brownish grey; calcareous; beds are thin and platy; fossils are abundant in calcareous kettle-concretions up</p>	435	965

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	<p>to 1 foot or so in diameter; unit is generally recessive but ledges several feet thick occur every 30 to 40 feet, except for upper 130 feet which is covered and recessive.</p> <p>Fossils are at 305 feet from base of unit. They are: <u>Gymnotoceras</u> sp., <u>Gymnotoceras</u> cf. <u>meeki</u> (Mojsisovics), <u>Ptychites</u> sp., <u>Protrachyceras</u> sp., <u>Daonella</u> sp., and indicate a Middle Triassic, Anisian age.</p>		
2	Sandstone, dark grey and weathering medium orange-brown; fine-grained; calcareous; beds occur as flags; unit forms ledge.	30	530
1	<p>Covered interval, with several small mounds underlain by siltstone and sandstone, dark grey and weathering dark brownish grey; calcareous and platy. There is some platy siltstone, dark grey and weathering orange-brown, in the talus.</p> <p>There are no fossils to indicate the age of this interval although part of it may be equivalent to lower Scythian, but no typical Grayling lithology is present. This unit is presumably in disconformable contact with Palaeozoic limestone but contact is concealed.</p>	500	500

Section 12. High hill 10 miles north of Wapiti Lake and about 95 miles south of Peace River.

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
<p>Section begins in covered interval near the trough of an overturned syncline. Because of faulting and overburden, some of the Upper and Middle Triassic beds are indistinct and are not recorded.</p>			
<p><u>Toad Formation</u></p>			
11	<p>Covered interval, considerable dark grey calcareous siltstone in talus containing numerous ammonites, pelecypods and marine reptile bones; unit is recessive.</p> <p>Section continues above this interval but was not measured. The fossils <u>Parapopanoceras</u> cf. <u>tetsa</u> McLearn, <u>Gymnotoceras</u> sp., and <u>Ceratites hayesi</u> McLearn? all indicate age as Middle Triassic, Anisian.</p>	65+	1,020
10	<p>Sandstone, dark brownish grey and weathering light orange-brown; fine-grained; calcareous; generally thick-bedded but flaggy beds and plates are common; forms ledge.</p>	50	955
9	<p>Siltstone, dark grey and weathering dark grey; calcareous; platy; minor interbeds of thin limestone; poorly preserved ammonites present; unit is somewhat recessive.</p> <p>The fossils <u>Daonella</u> sp. and <u>Gymnotoceras</u> sp. indicate a Middle Triassic, Anisian age.</p>	45	905
8	<p>Covered interval, platy siltstones in talus; recessive.</p>	115	860
7	<p>Siltstone and fine-grained sandstone; dark grey and weathering light orange-brown and grey; calcareous; generally thick-bedded but breaking into flaggy beds, with some interbedding of flags and thicker units;</p>	95	745

Unit	Lithology	Thickness (feet)	Height Above Base (feet)
	poorly preserved ammonite impressions present; dark calcareous narrow nodules up to 3 inches long lie in plane of bedding; forms ledge.		
6	Siltstone, dark grey and weathering medium orange-brown; calcareous; finely laminated and platy; ammonite impressions poorly preserved; unit forms ledge except for lower 30 feet.	325	650
5	Siltstone and fine sandstone, dark grey and weathering medium orange-brown; calcareous; beds occur as plates less than 1/2 inch thick, and as thicker flags; some unidentified pelecypods present; unit is recessive.	12	325
4	Sandstone, dark grey and weathering medium orange-brown; fine-grained; calcareous; thick-bedded; forms ledge.	38	313
3	Siltstone and fine sandstone, dark grey and weathering medium orange-brown; calcareous; beds occur as thin plates and interbedded flags; recessive.	110	275
2	Sandstone, dark grey and weathering medium orange-brown; fine- to medium-grained; beds thick but tend to fracture in irregular plates 1 inch to 6 inches thick; forms ridge; resistant unit.	65	165
1	Siltstone, dark brownish grey and weathering medium brown; calcareous; beds are finely laminated to platy and contain minor, thin sandstone; fossil fish, ammonite and pelecypod impressions present.	100	100
	The fossil <u>Claraia stachei</u> Bittner indicates the age as Lower Triassic, lower Scythian. Stratigraphically, this interval is Grayling equivalent, but lithologically it is indistinct from the platy siltstones of the Toad Formation here. Contact with underlying Palaeozoic limestone is disconformable. This unit is the lowest Triassic in the area of this section.		