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STRATIGRAPHY OF THE MIDDLE CAMBRIAN PLATFORMAL SUCCESSION, SOUTHERN ROCKY MOUNTAINS

J.D. Aitken

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Cover Illustration
Castle Mountain and Helena Ridge, viewed from Highway #1. The lower vertical limestone on Castle Mountain (left of photo) is the Cathedral Formation. A distinct ledge of Stephen Formation separates the Cathedral from the Eldon Formation, above. The Eldon is surmounted by a few metres of recessive-weathering Pika at the summit. Pale ribs of outcrop in the timber are Gog quartzites, separated from the Cathedral by talus slopes on the Mount Whyte.
On Helena Ridge, at right, successive skyline peaks from right to left are the tops of Gog, Cathedral, Eldon and, in the distance, Arctomys. Photograph by Ben Gadd.

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PREFACE

The Cambrian succession of the southern Rocky Mountains of Canada is renowned for its completeness and great thickness, and for its strong influence on the style of Mesozoic and Tertiary deformation in the region. Cambrian strata host the majority of the exploitable metallic mineral deposits of the Canadian Rocky Mountains.

This bulletin is a benchmark contribution, the culmination of three decades of detailed field studies, and provides a comprehensive current analysis of the Middle Cambrian strata of the region. The report includes abundant basic data that have formed the basis of numerous earlier papers and several significant advances, including: the classification and understanding of algal/microbial limestones, the recognition and interpretation of large-scale depositional cycles, and the mechanism and history of subsidence of the western continental margin.

The report clarifies the existing lithostratigraphic nomenclature. Several new reference sections are designated and nine new members are defined. Recognition of these members is essential to an understanding of depositional patterns. A network of sections of the platformal facies of the Middle Cambrian is presented, extending from south of the Bow River to north of the Athabasca River, and from the mountain front westward to the change to basinal facies. The data are interpreted in terms of modern sedimentological concepts and depositional models. Both the database and the interpretations will facilitate future analysis of Middle Cambrian strata, not only in the Rocky Mountains but also to the east, where these strata are penetrated by deep wells in the Western Canada Basin.

M.D. Everell
Assistant Deputy Minister
Earth Sciences Sector

PRÉFACE

La succession cambrienne du sud des Rocheuses canadiennes jouit d'une grande renommée en raison de son caractère complet et de sa grande épaisseur, ainsi que de la forte influence qu'elle a exercé sur le style de la déformation au Mésozoïque et au Tertiaire dans la région. La succession du Cambrien renferme la plupart des gisements exploitables de minéraux métalliques des Rocheuses canadiennes.

Le présent bulletin se veut un ouvrage de référence fournissant une analyse exhaustive et à jour de la succession du Cambrien moyen de la région, qui représente l'aboutissement de trois décennies d'études détaillées sur le terrain. Ce rapport comprend d'abondantes données de base sur lesquelles se sont appuyées de nombreuses études publiées jusqu'à ce jour et qui ont été à la base de plusieurs progrès importants dont : la classification et la compréhension des calcaires algaires/microbiens, la reconnaissance et l'interprétation des cycles sédimentaires à grande échelle ainsi que le mécanisme et l'évolution de la subsidence de la marge occidentale du continent nord-américain.

Le rapport clarifie la nomenclature lithostratigraphique existante. Plusieurs nouvelles coupes de référence sont désignées et neuf nouveaux membres sont définis. La reconnaissance de ces membres est essentielle à la compréhension des configurations sédimentaires. Dans le rapport, est présenté un réseau de coupes du faciès de plate-forme du Cambrien moyen; la région couverte par ce réseau s'étend, dans le sens nord-sud, depuis un point situé au sud de la rivière Bow jusqu'au nord de la rivière Athabasca et, dans l'autre sens, depuis le front montagneux, à l'est, jusqu'à la transition au faciès de bassin. L'interprétation des données s'intègre dans le cadre défini par les concepts de sédimentologie et les modèles sédimentaires récents. La base de données ainsi que les interprétations présentées faciliteront l'analyse future des couches de la succession du Cambrien moyen non seulement dans les Rocheuses, mais aussi plus loin à l'est où ces couches sont traversées par des puits profonds dans le Bassin sédimentaire de l'Ouest du Canada.

M.D. Everell
Sous-ministre adjoint
Secteur des sciences de la Terre

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STRATIGRAPHY OF THE MIDDLE CAMBRIAN PLATFORMAL SUCCESSION, SOUTHERN ROCKY MOUNTAINS

Abstract

The thick (1.3 km) and virtually complete Middle Cambrian platformal succession of the southern Rocky Mountains consists of four Grand Cycles, each beginning with a formation of the inner-detrital facies belt and ending with a formation of the middle carbonate facies belt. The first three cycles, Mount Whyte/Cathedral, Stephen/Eldon, and Pika, share a common depositional style and are the main subject of this bulletin. The terminal, Arctomys/Waterfowl, cycle is of a distinctly different style and will be presented in a separate paper. Basinal equivalents of the platformal formations, the lower and middle parts of the Chancellor Group, have not been studied in detail and receive only brief mention. The description of a terminal Lower Cambrian carbonate unit known as the Peyto and Hota formations, clarifies some Middle Cambrian problems.

Dominant influences on Middle Cambrian sedimentation in the region were the thermally subsiding Cordilleran Miogeocline; a hinge-line near the present mountain front; a source of fine grained detritus to the north; and the Kicking Horse Rim, a persistent paleogeographic "high".

The Mount Whyte Formation is subdivided into two new members, the Weed and Chephren. The established Ross Lake Member, the new Trinity Lakes Member, and a wedge of deep-water carbonates, the Takakkaw Tongue, are recognized in the Cathedral Formation. The Takakkaw Tongue extends basinward from the platform-margin reef. The Stephen Formation is subdivided into four new members, the Narao and Waputik members on the platform, and the Amiskwi and Wapta members in the basin. A tongue of outer detrital siliciclastic strata that penetrates the platform-margin shallow-water carbonates of the Eldon Formation is formally recognized as the Field Member. One new member, the Tershishner Member, is recognized in the Pika Formation of the Front Ranges.

Formations and members of the Mount Whyte/Cathedral/Stephen succession are recognized only as members where they pass northward into the more shaly Snake Indian Formation. Outer-detrital (slope facies) equivalents of the Mount Whyte Formation are recognized as the Naiset Formation.

Résumé

L'épaisse (1,3 km), et pour ainsi dire complète, succession de plate-forme du Cambrien moyen dans le sud des Rocheuses se compose de quatre grands cycles; chacun d'eux débute par une formation attribuée à la zone de faciès détritique interne et se termine par une autre rapportée à la zone de faciès carbonaté intermédiaire. Les trois premiers cycles, Mount Whyte/Cathedral, Stephen/Eldon et Pika, présentent le même style sédimentaire et constituent le sujet principal du présent bulletin. Le cycle terminal, Arctomys/Waterfowl, présente un style nettement différent et fera l'objet d'une étude distincte. Les équivalents de bassin des formations de la plate-forme, à savoir les parties inférieure et intermédiaire du Groupe de Chancellor, n'ont pas été étudiés de manière approfondie et ne sont que brièvement mentionnés. La description d'une unité de roches carbonatées marquant la fin de la succession du Cambrien inférieur, que l'on attribue aux formations de Peyto et de Hota, clarifie certains problèmes posés par le Cambrien moyen.

Les éléments qui ont exercé une influence dominante sur la sédimentation du Cambrien moyen dans la région ont été les suivants : la subsidence thermique du miogéoclinal de la Cordillère; la présence d'une charnière près de l'actuel front montagneux; l'existence d'une source de débris à grain fin au nord; et la présence de la bordure de Kicking Horse, une hauteur paléogéographique de longue durée.

La Formation de Mount Whyte est subdivisée en deux nouveaux membres, les membres de Weed et de Chephren. Le Membre de Ross Lake, une unité déjà établie, le Membre de Trinity Lakes, une nouvelle unité, et un prisme de roches carbonatées d'eau profonde, la Langue de Takkakaw, ont été reconnus dans la Formation de Cathedral. La Langue de Takkakaw se prolonge vers l'intérieur du bassin depuis la zone récifale formée à la marge de la plate-forme. La Formation de Stephen est subdivisée en quatre nouveaux membres, ceux de Narao et de Waputik sur la plate-forme et ceux d'Amiskwi et de Wapta dans le bassin. Une langue de couches silicoclastiques de la zone de faciès détritique externe qui pénètre dans le faciès de roches carbonatées formées en eau peu profonde à la marge de la plate-forme, que l'on attribue à la Formation d'Eldon, est reconnue de façon formelle comme le Membre de Field. Un nouveau membre, le Membre de Tershishner, est reconnu dans la Formation de Pika des Front Ranges.

Les formations et les membres de la succession Mount Whyte/Cathedral/Stephen ne s'élèvent qu'au statut de membre lorsqu'ils pénètrent vers le nord dans la Formation de Snake Indian de caractère davantage argileux (shale). Les équivalents de la zone de faciès détritique externe (faciès de talus) de la Formation de Mount Whyte sont reconnus sous le nom de Formation de Naiset.

Summary

The southern Rocky Mountains of Canada contain one of the thickest (1.3 km) and most complete Middle Cambrian successions in the world. This study represents the first thorough documentation of the Middle Cambrian platformal facies (characterized by a well developed middle carbonate facies belt) of the region. The principal objectives of the study are to stabilize existing formational nomenclature and to erect new members where appropriate. Brief reference is made to the off-platform, or basinal, facies (outer detrital belt) to the west, comprising the lower and middle parts of the Chancellor Group, as knowledge of this part of the sequence is still fragmentary. Reference also is made to the subsurface Middle Cambrian formations of the undeformed Western Canada Basin to the east, which are dominated by inner detrital belt facies.

The dominant influences on Middle Cambrian sedimentation were 1) the young Cordilleran Miogeocline, undergoing thermal subsidence; 2) the hinge-line near the present mountain front; 3) a source of fine grained detritus to the north; and 4) the Kicking Horse Rim. The rim formed a persistent, linear, paleogeographic "high" that was initiated in the early Middle Cambrian and persisted into the Ordovician.

A carbonate unit at the top of the Lower Cambrian succession, assigned to the Peyto and Hota formations, is described here because it has frequently been confused with overlying Middle Cambrian units. Its eastward and southward disappearance is due to a facies change to sandstones of the Gog Group, and to erosional truncation beneath Middle Cambrian strata.

The Middle Cambrian succession is treated as a sequence of kilometre-scale, shallowing-upward, depositional Grand Cycles. Each of these cycles is bounded by abruptly gradational, quasi-synchronous contacts, and consists of a lower, shaly half-cycle (inner-detrital facies), and an upper, westward thickening, carbonate half-cycle (middle carbonate facies). Each half-cycle is normally recognized as a formation.

The Mount Whyte (shaly)/Cathedral (carbonate) Grand Cycle begins in the *Plagiura–Poliella* Zone, and ends in the *Glossopleura* Zone. Two new members are established in the Mount Whyte Formation: the Weed Member, a basal unit of green, burrowed siltstone; and the Chephren Member, a unit of shale, limestone, and siltstone. The dominant carbonates of the Cathedral are interrupted by two westward-pinching tongues of inner-detrital, shaly facies: the established Ross Lake Member in the *Albertella* Zone, and a new member, the Trinity Lakes Member, in the *Glossopleura* Zone. The lower Cathedral platform terminates westward in a prograding reef, flanked by a wedge of carbonates of slope origin, the Takakkaw Tongue (new). The upper

Cathedral platform terminates in a nearly vertical reef, the Cathedral Escarpment, abutted by deep-water mudrocks of the basinal facies of the Stephen Formation.

The Naiset Formation is reinterpreted as a slope deposit (outer-detrital facies), approximately coeval with the Mount Whyte Formation (inner-detrital facies).

The Stephen (shaly)/Eldon (carbonate) Grand Cycle begins in the *Glossopleura* Zone and ends at or near the top of the *Bathyuriscus–Elrathina* Zone. On the depositional platform, two new members – a lower, limestone-rich unit, the Narao Member, and an upper, shale-rich unit, the Waputik Member – are established in the Stephen Formation. The Narao Member passes westward into shallow-water carbonates of the uppermost Cathedral Formation at the Kicking Horse Rim, whereas the Waputik Member, although it thins over the rim, continues westward into basinal deposits. West of the rim, the Stephen Formation thickens greatly and two new members are recognized. The lower member consists of deep-water mudrocks and is named the Amiskwi Member. The upper member is transitional to shallower facies and is named the Wapta Member.

Like the Cathedral Formation, the Eldon Formation comprises peritidal facies at the Kicking Horse Rim and subtidal facies to the east. An eastward-pinching tongue of outer detrital facies is formally recognized as the Field Member (new) of the Eldon Formation. Its rich fauna, including agnostid trilobites, provides a basis for correlation with the Middle Cambrian of Europe.

The Mount Whyte/Cathedral/Stephen succession of the Bow River transect, dominated by the thick carbonate strata of the Cathedral Formation, passes northward into a succession of subequal shaly and carbonate units of the Snake Indian Formation, in which the Weed, Ross Lake, Trinity Lakes, and Stephen members are still recognizable.

The last Grand Cycle described is assigned entirely to the Pika Formation, and lies within the *Bolaspidella* Zone. It resembles the Stephen/Eldon cycle, but the lower, westward thinning, shaly half-cycle is not so clearly demarcated. With the westward pinchout of the lower Pika Formation shales, the Pika and Eldon formations together form a single, thick, carbonate unit over the Kicking Horse Rim. In the Front Ranges, a unit characterized by dolomitized oolite and flat-pebble conglomerate is recognized as the Tershishner Member (new) of the Pika Formation.

Another Grand Cycle, overlying the Pika Formation and comprising the Arctomys and Waterfowl formations, is also largely Middle Cambrian (*Bolaspidella* Zone). This cycle apparently overlies an unconformity and is of a depositional style markedly different from the other cycles. It will be described in a later report.

Sommaire

La partie sud des Rocheuses canadiennes renferme l'une des successions du Cambrien moyen parmi les plus épaisses (1,3 km) et les plus complètes au monde. Cette étude constitue le premier examen approfondi du faciès de plate-forme du Cambrien moyen (caractérisé par une zone de faciès carbonaté intermédiaire bien développée) de la région. Les principaux objectifs de l'étude sont la consolidation de la nomenclature existante des formations et l'établissement de nouveaux membres le cas échéant. Le faciès de bassin (zone de faciès détritique externe), qui est situé au large de la plate-forme, à l'ouest, et se compose des parties inférieure et intermédiaire du Groupe de Chancellor est brièvement traité puisque cette partie de la succession est encore mal connue. Des références sont également faites aux formations de subsurface du Cambrien moyen du Bassin sédimentaire de l'Ouest du Canada, à l'est, qui sont non déformées et se rapportent principalement à la zone de faciès détritique interne.

Les éléments qui ont exercé une influence dominante sur la sédimentation du Cambrien moyen dans la région ont été les suivants : 1) la subsidence thermique du miogéoclinal de la Cordillère, encore à un stade peu avancé de son évolution; 2) la présence d'une charnière près de l'actuel front

montagneux; 3) l'existence d'une source de débris à grain fin au nord; et 4) la présence de la bordure de Kicking Horse. La bordure constituait une hauteur paléogéographique linéaire de longue durée qui est apparue au début du Cambrien moyen et dont l'existence s'est maintenue pendant l'Ordovicien.

Une unité de roches carbonatées au sommet de la succession du Cambrien inférieur, attribuée aux formations de Peyto et de Hota, est décrite ici parce qu'elle a été fréquemment confondue avec les unités sus-jacentes du Cambrien moyen. Sa disparition en direction de l'est et du sud est attribuable à un changement de faciès marqué par un passage aux grès du Groupe de Gog et à son élimination par érosion sous les couches du Cambrien moyen.

La succession du Cambrien moyen est traitée comme une séquence de grands cycles sédimentaires de dimension kilométrique qui témoigne d'une diminution de la profondeur du milieu de dépôt vers le haut. Les cycles sont limités par des contacts quasisynchrones qui révèlent une transition rapide. Chacun d'eux consiste en un demi-cycle inférieur formé de shale (zone de faciès détritique interne) et un demi-cycle supérieur composé de roches carbonatées (zone de faciès carbonaté intermédiaire) qui s'épaissit en direction de l'ouest. Chaque demi-cycle est normalement élevé au rang de formation.

Le début du grand cycle de Mount Whyte (shale)/Cathedral (roches carbonatées) se situe dans la Zone à *Plagiura-Poliella* et il se termine dans la Zone à *Glossopleura*. Deux nouveaux membres sont établis dans la Formation de Mount Whyte : le Membre de Weed, une unité basale de siltstone vert criblé de terriers, et le Membre de Chephren, une unité de shale, de calcaire et de siltstone. Dans les roches carbonatées constituant la lithologie dominante de la Formation de Cathedral, sont intercalées deux langues de shale de la zone de faciès détritique interne qui se terminent en biseau en direction de l'ouest : le Membre de Ross Lake, unité antérieurement établie, qui se situe dans la Zone à *Albertella* et un nouveau membre, le Membre de Trinity Lakes, qui se trouve dans la Zone à *Glossopleura*. Le faciès de plate-forme de la partie inférieure de la Formation de Cathedral se termine en direction de l'ouest sous la forme d'un faciès récifal de progradation qui se trouve flanqué d'un prisme de roches carbonatées déposé en milieu de talus, la Langue de Takkakaw (nouvelle unité). Le faciès de plate-forme de la partie supérieure de la Formation de Cathedral se termine par un faciès récifal presque vertical, l'escarpement de Cathedral, sur lequel viennent s'appuyer les mudstones d'eau profonde du faciès de bassin de la Formation de Stephen.

La Formation de Naiset est réinterprétée comme un dépôt de talus (zone de faciès détritique externe) et est approximativement contemporaine de la Formation de Mount Whyte (zone de faciès détritique interne).

Le début du grand cycle de Stephen (shale)/Eldon (roches carbonatées) se situe dans la Zone à *Glossopleura* et il se termine au sommet de la zone à *Bathyuriscus-Elrathina* ou près de ce niveau. Sur la plate-forme sédimentaire, deux nouveaux membres - une unité inférieure riche en calcaire, le Membre de Narao, et une unité supérieure riche en shale, le Membre de Waputik - sont définis dans la Formation de Stephen. Le Membre de Narao passe en direction de l'ouest aux roches carbonatées d'eau peu profonde du sommet de la Formation de Cathedral à la bordure de Kicking Horse, alors que le Membre de Waputik, bien qu'il s'amincisse sur la crête de la bordure, se prolonge vers l'ouest dans les dépôts de bassin. À l'ouest de la bordure, la Formation de Stephen s'épaissit considérablement et on y reconnaît deux nouveaux membres. Le membre inférieur consiste en mudstones d'eau profonde et on lui a donné le nom de Membre d'Amiskwi. Le membre supérieur assure le passage vers les faciès d'eau moins profonde et a été nommé Membre de Wapta.

Comme la Formation de Cathedral, la Formation d'Eldon se compose de faciès péritidaux à la bordure de Kicking Horse et de faciès subtidaux à l'est. Une langue de la zone de faciès détritique externe se terminant en biseau vers l'est est reconnue de manière formelle sous le nom de Membre de Field (nouvelle unité) de la Formation d'Eldon. Sa riche faune comprenant des agnostidés (trilobites) permet l'établissement de corrélations avec le Cambrien moyen d'Europe.

La succession Mount Whyte/Cathedral/Stephen du transect de la rivière Bow, dans laquelle dominent les épaisses couches de roches carbonatées de la Formation de Cathedral, passe en direction du nord à une succession formée d'unités de shale et de roches carbonatées en quantités à peu près égales; cette succession est attribuée à la Formation de Snake Indian dans laquelle peuvent être reconnus les membres de Weed, de Ross Lake, de Trinity Lakes et de Stephen.

Le dernier grand cycle décrit est entièrement attribué à la Formation de Pika et est contenu dans la Zone à *Bolaspidella*. Il ressemble au cycle de Stephen/Eldon, mais le demi-cycle inférieur de shale s'amincissant vers l'ouest n'y est pas aussi bien délimité. En raison de la terminaison en biseau en direction de l'ouest des shales de la partie inférieure de la Formation de Pika, les formations de Pika et d'Eldon forment ensemble une unique et épaisse unité de roches carbonatées sur la crête de la bordure de Kicking Horse. Dans les Front Ranges, une unité caractérisée par la présence d'oolites dolomitisées et d'un conglomérat à cailloux aplatis est reconnue comme le Membre de Tershishner (nouvelle unité) de la Formation de Pika.

Un autre grand cycle, situé au-dessus de la Formation de Pika et constitué des formations d'Arctomys et de Waterfowl, appartient également en grande partie au Cambrien moyen (Zone à *Bolaspidella*). Ce cycle est apparemment limité à sa base par une discordance et présente un style sédimentaire nettement différent des autres cycles. Il sera décrit dans un rapport ultérieur.

INTRODUCTION

The southern Rocky Mountains of Canada have been well known as the locus of some of the world's finest Cambrian sections since attention was drawn to them by Charles D. Walcott, in a series of publications spanning three decades (1908-1928). The rocks are well exposed in structurally simple panels, in each of which the Cambrian is represented by 1000 m and more of strata. Fossils are well preserved, although unfavourable lithofacies leave some large gaps in the fossil record. Field study is made especially enjoyable by a four-month-long season of pleasant, though changeable, weather during the summer, alpine scenery with a biota of great beauty, and the absence of nearly all the animal and vegetable hazards that complicate field studies in many less blessed parts of the Earth.

Regional structure

Geological structure is clearly expressed in the topography of the region. Low relief in the vicinity of Calgary and the Plains region to the east reflects the essentially undeformed character of the 3658 m (12 000 ft) of Phanerozoic sedimentary rocks that overlie Precambrian crystalline basement. The easternmost Foothills mark the eastern limit of folding and thrust faulting. Foothills structures, although they produce structural relief of thousands of metres, are modest compared with structures in the mountains proper, and Paleozoic rocks appear only locally at the surface, as at Moose Mountain. The mountain front is marked by a regional topographic scarp that follows the traces of a series of en echelon, eastward-directed thrust faults of great displacement. These faults bring resistant Paleozoic carbonates and (in southern Alberta) resistant Proterozoic strata over less resistant Cretaceous shales and sandstones. It is the resistance to weathering of the Paleozoic rocks, as well as their elevated structural position, that accounts for the elevations of the Rocky Mountain summits, culminating in Mount Robson at 3954 m (12 972 ft).

The first-time visitor will be struck immediately by the pronounced asymmetry of structure in the Main and Front Ranges of the Rocky Mountains; that is, in the near universality of southwestward dips. This prevailing dip reflects the fact that the southern Rockies consist of a stack of imbricated thrust sheets. The sheets or plates of strata overlying each of the southwest-dipping "master" thrusts (from east to west along Highway 1, the McConnell, Sulphur Mountain, Bourgeau, Pipestone Pass, and Simpson Pass thrusts) are themselves sliced by southwest-dipping, imbricate thrust faults that root in the master thrusts.

Although, at the level of exposure, flat thrusts are rare, and dips on fault planes average about thirty degrees, it has long been realized that the master thrusts must flatten at depth. Regional reflection seismic studies (Bally et al., 1966) suggested that westward, at least to the Rocky Mountain Trench, the crystalline basement is not involved in the deformation. Recent studies, however, are leading to renewed suggestions of basement involvement.

Folds are subordinate structural features, except in the western Main and Western ranges. There, a major anticlinal fan-fold, the Porcupine Creek Anticlinorium, occurs. This fold has an overturned west limb and is succeeded to the west by a series of eastward dipping thrust faults and westward overturned synclines that form the east wall of the Rocky Mountain Trench in the Brisco and Stanford ranges. In the west wall of the Trench, eastward-directed thrusting reappears with the great Purcell Fault. Normal faults in the Main Ranges are subordinate to the prevailing contractional structures, and postdate them.

Strata now forming the west wall of the Rocky Mountain Trench have been thrust at least 200 km (125 miles) northeastward, and crustal thickening exceeding 8 km (5 miles) has accompanied this movement (Price and Mountjoy, 1970).

Geological maps at scales of 1:50 000 to 1:250 000 are available for about half of the region covered by this report; they are listed in Appendix "D".

Previous work

The first reference to Cambrian rocks within the study area was by H.H. Winwood (1885), who announced the discovery of Cambrian fossils in Kicking Horse Pass. R.G. McConnell (1887), undoubtedly alerted by Winwood's report, recognized strata in the Sawback Range as Cambrian, and assigned them to the "Castle Mountain group", which embraced the entire succession of carbonate rocks and shales beneath the Devonian and above his "Bow River group". The latter comprised the predominantly clastic succession of Early Cambrian and Precambrian age. McEvoy (1900), studying the geology along the Yellowhead Route through Jasper, tentatively and somewhat speculatively recognized McConnell's "Bow River" and "Castle Mountain" groups from Jasper westward.

The great Charles Doolittle Walcott, already a world authority on the Cambrian System, first set foot in the Canadian Rockies in 1907 and, despite the

demands of a distinguished public career, carried out fieldwork in the region almost every summer until 1925. With only minor exceptions, the Cambrian stratigraphic nomenclature of the region today is that of Walcott. His publications are far too numerous to be summarized here; a complete list is appended to Yochelson's (1967) excellent biography. Among Walcott's notable accomplishments that stand little amended today was his early recognition of the great sub-Cambrian unconformity. Walcott also discovered and thoroughly exploited the remarkably fossiliferous Burgess Shale, now formally identified as a World Heritage Site by UNESCO. Walcott's stratigraphy and biostratigraphy were those of an era in which biostratigraphers tended to give only superficial attention to the rocks, and in which "the fossils make the formation." This accounts for his numerous synonyms for lithostratigraphic units, which have confused those attempting to comprehend the Cambrian stratigraphy of the region from the literature alone. Modern stratigraphers and geological mappers do their work with a nomenclature of far fewer terms than did Walcott. Notwithstanding this, Walcott's contributions were monumental, and his name will be associated with the Cambrian of the region for as long as the science of geology is practised.

J.A. Allan (1912, 1914a, b, 1916) confronted the Cambrian problems of the region when assigned the task of preparing a geological map of the Field map area. He defined the Chancellor Formation, and thus set the stage for the later recognition that much of the carbonate-dominated Cambrian succession east of Field (the "platform region" of this report) changes westward to a thin bedded, argillaceous, and very poorly fossiliferous facies. He also named the Ottertail Formation, the key unit for geological mapping in the Western Ranges, and the Cambro-Ordovician Goodsir Formation (now the McKay Group). He drew attention to specific localities at which the sub-Cambrian unconformity could be demonstrated, and reported the presence of Cambrian formations at Ghost River.

L.D. Burling (1914, 1915, 1916a, b) made major contributions. He reviewed Early Cambrian stratigraphy of the North American Cordillera, and established the stratigraphic position of the *Albertella* fauna. He noted evidence of shallow-water sedimentation in the Cambrian strata of the region, and confirmed the Cambrian age of McConnell's "Castle Mountain group". More sensitive than Walcott to the nuances of rock character, he early recognized the lithostratigraphic tie between the Cambrian redbeds, now known as Arctomys Formation, at Mount Bosworth, and the basal strata of the Lynx Formation of the Mount Robson region. He placed the Middle Cambrian/Upper Cambrian boundary at the base of these redbeds – a position near that presently recognized. He also recorded evidence of a "diastrophic break of considerable magnitude" at the base of the Middle Cambrian – an observation ahead of its time. Still an enthusiast for the Cambrian, the ageing Burling prepared, in 1955, an annotated index to the Cambro-Ordovician of Jasper Park and the Mount Robson region – a document still useful today.

P.E. Raymond (1930a, b) studied the Cambrian and younger rocks of Jasper National Park. Strangely, not one of his proposed formation names for Cambrian strata has survived. All have been supplanted, either by senior terms of Walcott's authorship or by more rigorously defined terms. On the other hand, Raymond's Devonian Flume and Perdrix formations have been extended widely, and remain valid.

Charles Deiss (1939, 1940) re-studied the Cambrian formations in the Lake Louise and Mount Assiniboine areas. He defined the Pika Formation, previously a part of Walcott's Eldon Formation, and also the Naiset Formation. It is interesting that Deiss' reasons for erecting the Naiset Formation, for Mount Whyte equivalents near Mount Assiniboine, were mainly paleontological and mainly invalid. Nevertheless, the rocks so designated are usefully distinguished from the Mount Whyte, being distinct in lithology and origin. On the other hand, Deiss' placements of the Lower/Middle Cambrian and Middle/Upper Cambrian boundaries were farther from the positions now accepted than were Burling's much earlier placements.

J.R. McGehee (1949) made the first published references to Cambrian strata in the subsurface of Alberta.

Franco Rasetti (1951, 1956) was the first to carry out biostratigraphic studies of the Cambrian rocks of the region to thoroughly modern standards. An atomic physicist and skilled amateur coleopterist, with no formal training in geology, he not only published biostratigraphy that has stood up well under the scrutiny of his successors, but his observations on the rocks were some of the most useful that had been made up to that time. Among other things, he resolved a long-standing muddle by removing the Lower Cambrian Peyto unit (Member, limestone, or Formation) from the Mount Whyte Formation, and confirmed the sub-Middle Cambrian unconformity postulated earlier by Burling.

C.S. Ney (1954) was the first to recognize and report the existence of the Cathedral Escarpment, near the

town of Field. Of all the features of the Cambrian of the region, the escarpment is one of the most important, in terms of its significance to Cambrian lithostratigraphy and carbonate-depositing processes elsewhere in the world. The escarpment has been intensively studied since Ney's time.

G.O. Raasch and D.E. Campau (1957) reported on the Cambrian section penetrated by the California Standard Parkland 4-12 well in southern Alberta, thus providing a new measure of biostratigraphic control for the study of the Cambrian of the Plains. R.D. Hutchinson (1960) further extended biostratigraphic control by reporting occurrences of Middle Cambrian fossils (the *Glossopleura* fauna) in three wells in eastern Alberta. H. van Hees (1959, 1964) produced the first regional studies of Cambrian rocks in the subsurface.

R.D. Hughes (1955) reported on the Cambrian formations of the Sunwapta Pass area. He erected three new formations but, because subsequent work has shown that previously established formational nomenclature can be applied in this region, none of his formations is currently accepted.

E.W. Mountjoy (1962) described and mapped the Cambrian formations in a large area north of Jasper. He drew formational nomenclature (largely of Walcott's authorship) in part from the Mount Robson area and in part from the upper Bow Valley and Glacier Lake areas. Later, Mountjoy and Aitken (1978) established the Snake Indian Formation, and elucidated its facies relationship to other Middle Cambrian formations.

D.K. Norris and R.A. Price (1966) published an account of the Cambrian formations of the Rocky Mountains south of latitude 49°30′N, established correlations with some of the strata in the upper Bow Valley, and solved some long-standing problems of Cambrian correlation in the region. O.L. Slind and G.D. Perkins (1966) traced the Cambrian succession from Mount Robson northward to Pine Pass.

D.C. Pugh (1971, 1973), taking as a starting point my (1968) correlation of the surface and subsurface Cambrian strata of Alberta, carried out regional studies of the subsurface of the Plains that, because of a greatly increased number of Cambrian well penetrations, went well beyond the earlier work of van Hees.

G.D. Hockley (1973) examined the sedimentology and relationships of the Peyto and Mount Whyte formations in the region. P.A. Palonen (1976) studied the sedimentology of the Gog Group and divided it into widely recognizable units. D.G. Cook (1975) provided the first concrete ties between the Cambrian of the platform region and that of the basinal facies to the west. I.A. McIlreath (1977a, b) undertook a detailed study of the Cathedral Escarpment and the Cambrian facies change that takes place along a line trending northwest through Field, modifying in part the platform-to-basin correlations of Cook.

H.B. Whittington and a team of co-workers undertook a complete redescription and re-evaluation of the Burgess Shale fauna, based in part on Walcott's enormous collections and in part on material quarried in 1966 and 1967 (Whittington, 1971, 1980, 1985; Conway Morris and Whittington, 1985, and numerous other papers). In 1977, a team from the Royal Ontario Museum, led by Desmond Collins, renewed fieldwork on the Burgess Shale and were successful in discovering new sites and new taxa of soft-bodied animals (Collins and Rudkin, 1981, and other papers; Collins et al., 1983; Briggs and Collins, 1988). This work continues.

Since he commenced work in the Canadian Cordillera in 1965, W.H. Fritz has made numerous contributions to the Middle Cambrian biostratigraphy of the southern Rocky Mountains in addition to his many papers on Lower and Upper Cambrian stratigraphy, and on Cambrian stratigraphy in other parts of the Cordillera. Fritz and Norris (1965) published biostratigraphic correlations and recognized important changes in lithostratigraphy between the present study area and Montana. In 1971, Fritz refined Rasetti's earlier biostratigraphic zonation of the "basinal" Stephen, and demonstrated the depositional relief across the Cathedral Escarpment by establishing the relative positions of contemporaneous faunas on the platform and in the basin. He contributed to two guidebooks for international field excursions (Aitken et al., 1972; Fritz, 1981), established broad correlations of some Lower and Middle Cambrian strata from Mexico to Yukon (1975), and, with E.W. Mountjoy (1975), clarified some aspects of the Cambrian stratigraphy of the Mount Robson area. All of this work was in addition to the production of dozens of unpublished reports on collections of fossils made by himself and others, including the author. Fritz's work provides almost all the biostratigraphic framework for this report.

The present report deals with only a part of my work on the lower Paleozoic of the southern Rocky Mountains, begun in 1961. The original assignment was to study and report on the pre-Devonian formations of the region and, for logistical reasons, the entire column from Precambrian to Ordovician was

studied concurrently in the field. Previous publications resulting from the project include a resolution of stratigraphic relationships at the sub-Devonian unconformity (the "Ghost River Problem") in the Front Ranges (1966a); two papers on the striking cyclicity that characterizes the Lower Ordovician and older stratigraphy of the region (1966b, 1978); revision of the Lower Ordovician (1967, with B.S. Norford); revision of the Upper Cambrian (1967, with R.G. Greggs); establishment of refined correlations between the surface and subsurface Cambrian (1968), rediscovery of the Cathedral Escarpment, first recognized by Ney, and further demonstration that it was in fact a submarine cliff (1968, with W.H. Fritz); documentation of the sub-Cambrian unconformity (1969); recognition and documentation of the Kicking Horse Rim (1971); a guidebook to the Cambrian and Ordovician of the Southern Rockies, prepared for the 24th International Geological Congress (1972, with W.H. Fritz and B.S. Norford); and a later contribution to a guidebook prepared for the Second International Symposium on the Cambrian System (1981).

Objectives and scope

My assignment in 1961 was to investigate the pre-Devonian stratigraphy of the southern Rocky Mountains. So vast a subject had to be broken into manageable pieces for publication. This report, therefore, deals broadly with the Middle Cambrian of the region. The Lower Cambrian Peyto Formation is included in the study, however, because it is persistently confused with the Mount Whyte Formation. Conversely, although the Arctomys Formation and much of the Waterfowl Formation are Middle Cambrian (Fig. 2) the marked change in rock character, from a "Middle Cambrian theme" to an "Upper Cambrian theme", that takes place at the base of the Arctomys, allows a unified sedimentological treatment of the Pika and older Middle Cambrian formations that would be complicated by inclusion of the Arctomys/Waterfowl cycle.

In this bulletin I attempt to deal in detail only with the platform stratigraphy of the Middle Cambrian of the region. Some aspects of the rocks deposited on the slope and basin west of the middle carbonate facies belt are described, but the stratigraphy and sedimentology of the outer-detrital deposits are understood at a primitive and incomplete level only, and await further study.

My objective, therefore, is to describe the lithology, thickness, age relationships, and variation of the succession from the Peyto Formation through the Pika Formation, within a region bounded by the mountain front to the east, the change to basinal facies on the west, and the latitudes of Mount Assiniboine on the south and Jasper on the north (Fig. 1), and to interpret the paleogeography and depositional processes that this succession records. Reference to Cambrian rocks outside this quadrilateral is made where appropriate.

Fieldwork

The main fieldwork was carried out during the summers of 1961 through 1967. Five of these field seasons were of three month's duration each, while those of 1964 and 1967 were short and limited to specific objectives. During the field seasons of 1965 and 1966, I was attached to "Operation Bow-Athabasca", under the direction of R.A. Price, and enjoyed the advantage of access by helicopter to some of the less accessible sections reported on here.

All sections were measured with a Jacob's staff. Several checks on the precision of the method proved that reproducibility was within 5 per cent for outcops with unfavourable geometry, and much better for ideal exposures. Most of the sections were measured before the introduction of metric units; accordingly, stratigraphic thickness was measured in feet (determined to the nearest six inches) throughout the field project. Grain size and bedding thickness classifications were based on metric units from the beginning of the project. In this report, the original measurements in feet retain primacy over the calculated metric equivalents (given to the nearest 0.1 metre) to avoid false implications.

Preparation of the results for publication was seriously delayed by other responsibilities.

Acknowledgments

My interpretations of Cambrian paleogeography and sedimentation have been enhanced by discussions with A.R. Palmer, I.A. McIlreath, H.B. Whittington and many others. In addition to contributing valuable discussions, R.A. Price, E.W. Mountjoy, and D.G. Cook have demonstrated that the formations described here are indeed mappable.

From 1965 on, I enjoyed welcome biostratigraphic support from W.H. Fritz. This support took the form, not only of the identification and zonation of my fossil collections, but also complete access to Fritz's reports on his own described and thoroughly collected sections. These contributions by Fritz pervade

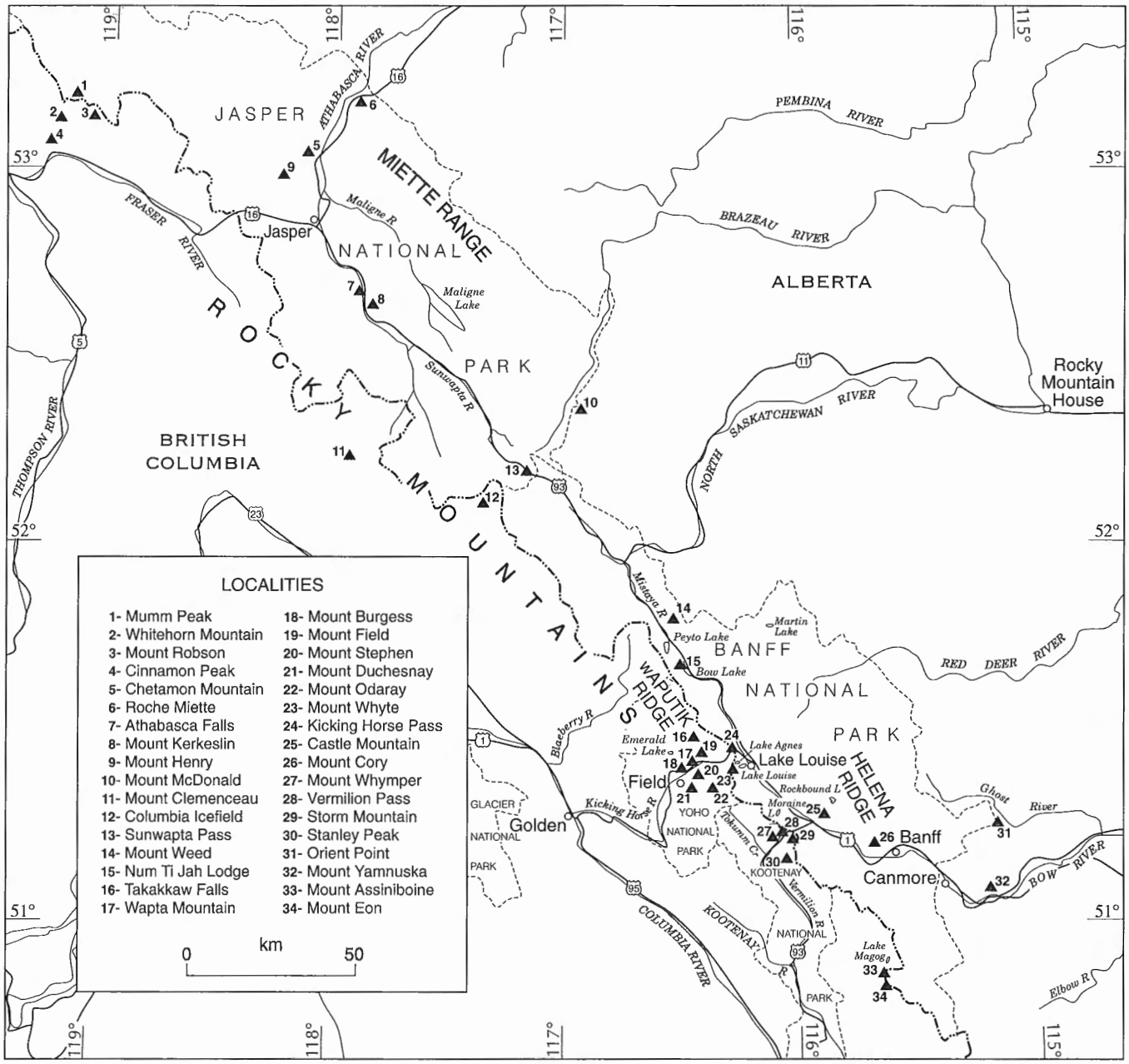


Figure 1. *Index to geographic localities mentioned in the text. (See Fig. 85 for an index map of all stratigraphic sections measured and described for the present study.)*

everything that I have accomplished with regard to the Cambrian of the region, and their importance cannot be exaggerated.

Field assistants involved in the project had to withstand exhausting days, frequently in situations of physical danger, and endure much discomfort. Despite all this, they performed efficiently and cheerfully. My field assistants from 1961 to 1963 were R.D. Ferguson, G. Marlborough, G.E. Benson, A.K. Kuhme, Djalil Nasution, G.W. Holfeld, J.F. Giguere, and P.T.P. McCullough. Assistants attached to Operation Bow–Athabasca were R. Keith, R. Douglas, Yvon Houde, R. Campbell, P. McLaren, B. Corniel, R. Stesky and R. Deptuck. My field assistants in 1964 and 1967 were M. Landers and M. Webb, respectively. Anne, Tenley, Scott and Sally Aitken all made important contributions during the quarrying of the Burgess Shale and later fieldwork. Particular mention must be made of T.W. Green, whose work in various capacities during the two seasons of quarrying (1966, 1967), set a fine example of sustained, cheerful effort to all the others.

Elspeth Snow provided efficient technical assistance at many stages of preparation of the manuscript. Critical readers I.A. McIlreath and B.C. Richards made numerous suggestions for the improvement of the original draft

PALEOGEOGRAPHIC AND SEDIMENTOLOGICAL SYNTHESIS

Geological reports are customarily organized so that interpretation follows the presentation of data. The data presented in this bulletin, however, are more easily comprehended and remembered when placed in a conceptual frame of reference. Accordingly, custom is violated here by commencing with a broad portrayal (based largely on earlier contributions) of Middle Cambrian sedimentation patterns, the paleogeography as deduced from those patterns, and the cyclicity that is fundamental to subdivision of the Cambrian succession in the region (Fig. 2). This synthesis is validated by the data presented subsequently.

The paleogeographic and sedimentological models presented here were partly developed through important insights gained by comparing the cyclicity characteristic of the Middle Cambrian of the region with that more characteristic of the Upper Cambrian, in an earlier report (Aitken, 1978). The Upper Cambrian is beyond the scope of this bulletin, and the reader is referred to the paper cited for a fuller discussion and broader view of Cambrian cyclicity.

Virtually all the rock types discussed occur in two or more formations, and display strong associations with certain other rock types. To avoid repetition, detailed descriptions of the rock-types (grouped as lithofacies) are incorporated in Appendix A.

Facies belts and the Grand Cycle

A concept basic to the understanding of regional lower Paleozoic sedimentation, paleogeography, and cyclicity in North America is that of persistent but temporally shifting facies belts (Palmer, 1960; Robison, 1960; Aitken, 1966b, 1978; Palmer and Halley, 1979). It is now well established that, with minor exceptions, any synchronous surface passing through Cambrian deposits of the craton and the Cordilleran miogeocline cuts across three distinct lithofacies:

1. An *inner detrital facies*, deposited nearest the centre of the craton and characterized by shale and siltstone with subordinate carbonate interbeds. Sandstones become increasingly prominent as the contact with the crystalline Precambrian basement is approached, and may predominate in Lower Cambrian deposits. Glauconite is commonly, but not invariably, present.

2. A *middle carbonate facies*, characterized by a variety of carbonate rocks. Shale is virtually absent, but some of the carbonate rocks contain clay. Beds containing abundant quartz silt and sand occur in some sequences.

3. An *outer detrital facies*, deposited "outboard" from the middle carbonate facies belt and characterized in some instances by mudrocks and in others by thin bedded, argillaceous, and silty carbonate rocks, or by carbonate/shale couplets. In most instances it can be shown that this facies accumulated in water deeper than that in which the other two facies originated; however, the deep-water origin of some units is still in doubt.

Discussion of facies relationships is facilitated by the fact that, historically, to a large extent, formational boundaries were chosen so as to isolate lithosomes consisting entirely of one or other of these facies.

The most obvious cycles observed in Cambrian deposits of the region are the asymmetrical, large-scale cycles, spanning from one to three trilobite assemblage-zones and commonly exceeding 1000 feet (300 m) in thickness. These have been termed *grand cycles* (Aitken, 1966b) and subsequently formalized by some authors as *Grand Cycles*. In the following discussion, it will be shown that the Grand Cycles characteristic of the Middle Cambrian record the abrupt appearance of inner detrital deposits, followed by their gradual replacement by middle carbonate deposits, or, in other words, cyclical shifts (up to hundreds of kilometres in extent) of the boundary between the inner detrital and middle carbonate facies belts. In contrast, except for the unique westward spread of carbonate strata represented by the Upper Cambrian Ottertail (Lyell) Formation, the outer edge of the middle carbonate facies belt remained relatively fixed, varying in position by only a few kilometres. The known incursions of outer detrital facies into the long-term middle carbonate facies belt were limited in reach, compared to the movements of the inner detrital belt, and did not produce cycles analogous to those just described.

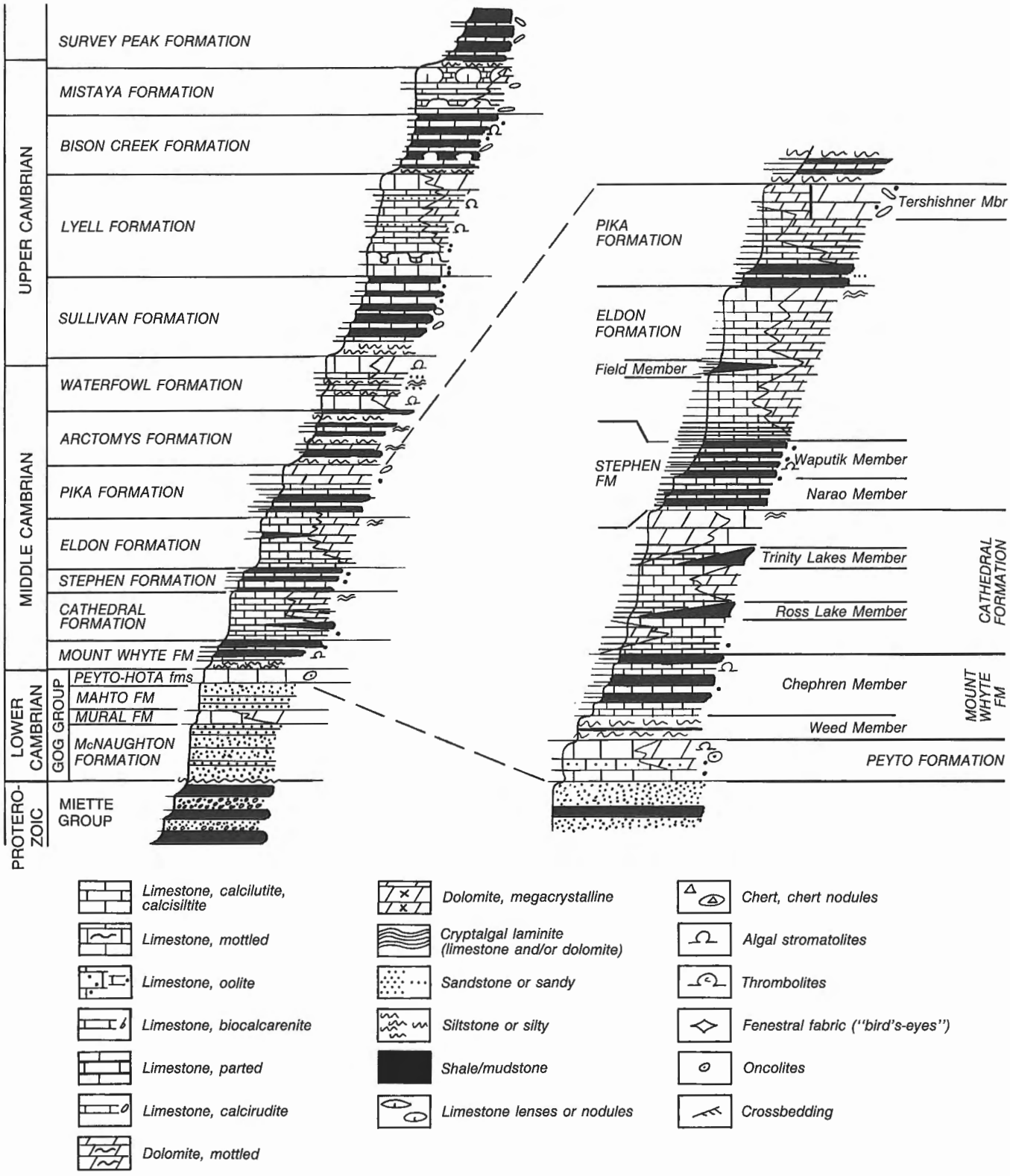


Figure 2. *The Cambrian platformal succession of the southern Rocky Mountains of Canada. Formations discussed in this report are illustrated in expanded form on the right. Diagrammatic lithological symbols as for all columnar displays.*

Major paleogeographic features

Cordilleran miogeocline

The thick Cambrian rocks of the southern Rocky Mountains form a major part of the sedimentary accumulation known as the Cordilleran Miogeocline ("Cordilleran Geosyncline"), that flanks the North American Craton along its western edge. The wedge shaped cross-section of the preserved parts of all chronostratigraphic units, with proximal facies in the thin, eastern part of each wedge, is consistent with the view that Cambrian sedimentation took place on a subsiding, passive continental margin. I have tended to agree with Stewart (1972) that this margin was formed by continental separation, previously dated at 750 to 850 Ma; that is, that the oldest deposits recording the creation of the embryonic lower Paleozoic Pacific margin of the continent are the immature, coarse grained, detrital sediments and volcanic rocks of the Windermere Supergroup. This view is in disagreement with the views expressed by Gabrielse (1972) and others, that it is the chemical sediments and mature, fine grained, detrital sediments and volcanic rocks of the much older Purcell Supergroup that mark the first response to creation of that margin. New evidence from subsidence rates back-calculated from sedimentary thicknesses (Bond and Kominz, 1984), however, suggests that continental separation did not take place until about the beginning of the Cambrian, and that the thick, coarse grained, Windermere sediments relate to a pre-separation episode of rifting. Timing of the rifting event is now more closely constrained by the discovery (Parrish and Armstrong, 1983) of two localities where Windermere rocks rest nonconformably on granitic rocks dated at about 730 Ma.

Shape and extent of the "basin"

Middle Cambrian rocks apparently form a continuous belt or prism along the North American Cordillera. The eastern pinchout of this prism is sinuous, being found within the mountains at some latitudes and far out into the undeformed interior plains at others. All of the rocks discussed in this report were deposited within a markedly thickened part of the prism. The thicker sequence of rocks occupies a gently trough-shaped feature, the axis of which trends northeast, transverse to the structural grain of the Rocky Mountains, and lies near a line through Mount Athabasca/Edmonton. Subsurface data (Pugh, 1971, 1973) reveal both the trough's southern flank, which passes through the Cypress Hills, and its more distinct northern flank, which trends northeastward through Lesser Slave Lake. The thick, complete sections near the axis of the trough provide as good a record of Middle and Late Cambrian history as can be found anywhere in the world.

The isopach maps, as drawn, emphasize northeast-trending features across which depositional units change thickness rapidly. To the extent that the isopachs express reality (see below, "Notes on the Isopach Maps"), these features reflect deep-seated faults, originating at least as early as the inception of Windermere deposition, that were reactivated during the Middle Cambrian.

Kicking Horse Rim

The key to understanding Middle Cambrian facies relationships is an appreciation of the influence of the persistent paleogeographic feature known as the Kicking Horse Rim (Aitken, 1971). The Kicking Horse Rim was a narrow, positive or persistently shallow feature, oriented north-northwest - more or less parallel to the present tectonic strike. Suppressed from time to time, it kept reappearing to dominate sedimentary facies throughout the Middle and Upper Cambrian, and probably into the Ordovician (op. cit.).

The rim is expressed at numerous stratigraphic levels, in each case by a belt of peritidal carbonate strata that lies west of the subtidal facies of the same age. With local exceptions, the peritidal strata are the westernmost platformal deposits; to their west, coeval strata are of slope and basinal origin.

Evidence that led to the initial concept of the rim is discussed in the original paper (Aitken, 1971) and much of it is repeated in this report. Some new observations that postdate publication of the concept of the Kicking Horse Rim, and document its existence conclusively, include the following:

1. Recognition of the westward thinning of the Peyto Formation to a zero edge, at least locally, and its reappearance farther west (see below, under "Peyto Formation"). This records erosional bevelling of the Peyto from the crest of a subtle anticline. The anticline developed prior to pre-Mount Whyte/Naiset deposition, and localized the Kicking Horse Rim - as expressed in Middle and Upper Cambrian strata. A pre-Middle Cambrian precursor to the rim is not excluded, and indeed is suggested by facies changes in the Gog Group.

2. Demonstration of eastward-pinching sandstone tongues in the Peyto Formation, and the westward pinchout of the basal quartz siltstone member of the Mount Whyte Formation (Weed Member of this report), by Hockley (1973).

3. The presence in the Cathedral Formation of scalloped erosion surfaces (this report) and gypsum (McIlreath, 1977b) at various localities along the rim. These features are not present elsewhere in the Cathedral.

4. Demonstration (this report) that the Narao Member of the Stephen Formation (largely subtidal lime mudstone) changes facies westward to cryptalgalaminate dolomites of intertidal to supratidal origin, at the top of the Cathedral Formation.

5. The distribution of quartz sand near the Eldon/Pika contact (Aitken, 1978; and this report), which indicates the existence, at the westernmost platformal sections, of a high-energy littoral zone not recorded in sections to the east, except along the cratonal shoreline.

The Kicking Horse Rim has heretofore been considered a linear feature, but the preparation of isopach maps on a palinspastic base, revealing that Middle Cambrian formations may have been affected by syndepositional faulting, lead one to question the supposed linearity. In particular, the isopach map (Fig. 24) of the Weed Member of the Mount Whyte Formation strongly implies (as drawn) the existence of a large sinistral offset in the rim. The putative offset cannot be verified, and, acccordingly, has not been "pushed" in the contouring of higher units.

Source of detritus

Although contributions of detritus from the cratonal shoreline cannot be ruled out, every major aspect of the distribution of detrital quartz and clay in the Middle (and Upper) Cambrian deposits of the region is consistent with a persistent source north of the study area (Aitken, 1978). On the basis of stratigraphic studies carried out near the location in the northern Rockies (lat. 58°05′N, long. 124°25′W) previously suggested as the source, Fritz (pers. comm., 1978) has expressed doubt that the source is correctly identified. Nevertheless, the sense of sediment transport remains clear.

Orientation

In this report, depositional trends and the postulated movements of sediment are related to present geographic north. The reader should remember, however, that since the Cambrian North Pole was in the western Pacific Ocean (Morel and Irving, 1978), the Cordilleran Miogeocline was a low-latitude feature, oriented roughly east-west and lying to the north of the exposed craton.

Limitations of the bulletin

The scope of this bulletin is limited in several ways. For example, although the Lower Cambrian Peyto Formation is considered at some length, largely to clear up problems that others have encountered in the course of geological mapping, the highest Middle Cambrian formations, the Arctomys and Waterfowl (Aitken and Greggs, 1967), are omitted. The reason for this omission is that the succession from the Peyto through the Pika Formation has a certain unity of depositional "style" – each Grand Cycle is a variation on a persistent theme – whereas, with the appearance of the evaporitic redbeds of the Arctomys Formation, the "style" changed markedly, and the "Middle Cambrian theme" never reappeared. A detailed treatment of the Arctomys/Waterfowl Grand Cycle is, therefore, deferred to another report.

Definitions

In the following discussion, an attempt is made to interpret paleogeography and depositional environments as precisely as the available data permit. For this reason, it is advisable to define some of the terms used (see Fig. 3).

Platform is used in two distinct senses. A tectonic platform is the stable region inboard from the passive-margin hingeline. A constructional (usually carbonate) platform is the high-standing, relatively flat-topped, depositional feature on which relatively shallow conditions are maintained almost continuously by sedimentation. The constructional (carbonate) platform may be built on the tectonic platform, or on the more rapidly subsiding miogeocline outboard from the hingeline.

Ramp (carbonate ramp) (Ahr, 1971; Wilson, 1975) denotes a thick carbonate body whose depositional surface descends gradually from shallow to deep water.

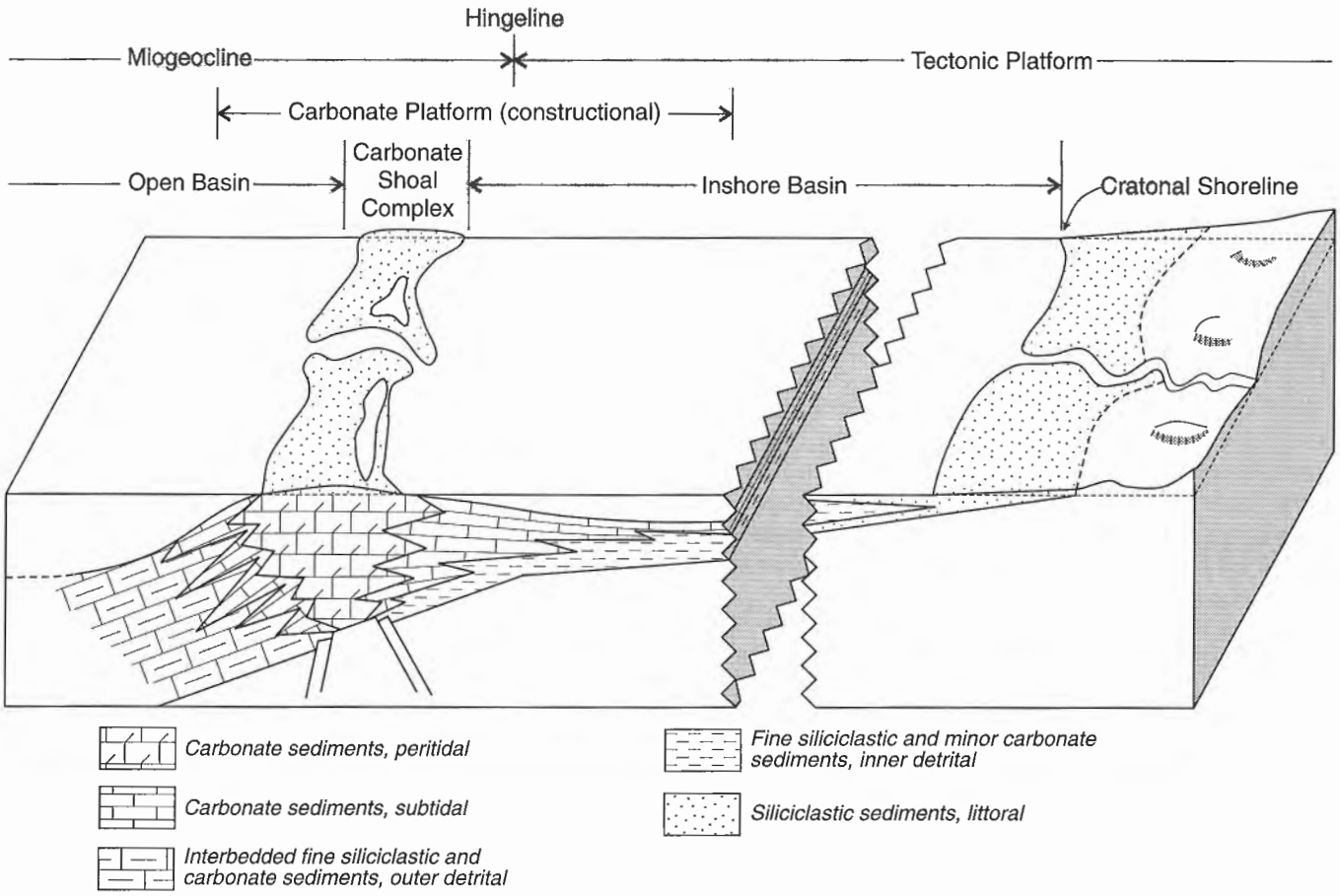


Figure 3. *Definitions of paleogeographic elements.*

A ramp lacks a conspicuous break in slope. Facies belts tend to be wide and irregular, with the facies of highest energy nearest the shore. In this report, it is considered that a carbonate platform may pass basinward into a ramp.

Carbonate shoal complex is used to denote an area of peritidal carbonate deposition that is not part of the cratonal shoreline (see below). It includes the entire spectrum of environments and sediments from supratidal sabkhas and evaporite pans, through tidal channels, to subaqueous carbonate dunes and bars that are spatially and genetically associated with intertidal environments.

Rim is used to denote a special case of the carbonate shoal complex; namely, one in which the complex is narrow and confined to the outer edge of the constructional platform.

Cratonal shoreline is used to specify the shoreline that separates the emergent craton from the marine environment, as distinct from shorelines that might surround carbonate complexes, reefs, and islands.

Inshore basin denotes the marine environment lying between a carbonate shoal complex and the cratonal shoreline. This is the "restricted shelf" of Palmer and Campbell (1976).

Open basin denotes the marine environment outboard from the depositional platform. This is the "deep shelf" of Palmer and Campbell (1976).

"Stephen-type" cycle – outline and interpretation

The cycle comprising the Stephen and Eldon formations (Fig. 4) was one of the two "typical" cycles on which earlier discussions of Cambrian cyclicity in the region were based (Aitken, 1966b, 1978). In this cycle, the Stephen Formation represents the shaly half-cycle, the Eldon Formation the carbonate half-cycle. Middle Cambrian Grand Cycles of the region are fundamentally of Stephen type. A brief interpretive summary follows. For a more complete discussion, and for the contribution of Upper Cambrian cyclicity to the synthesis, the reader is referred to my paper of 1978.

The Stephen/Eldon cycle – as recorded within the inshore basin, remote from both rim and cratonal shoreline – begins at a gradational contact where parted lime mudstone[1] of the Stephen Formation overlies massive, burrow-mottled lime mudstone or locally, cryptalgal laminite[2] (the terminal deposit of the preceding cycle) of the Cathedral Formation (Fig. 5, stage 1). This upward change in rock type records both deepening and an increased supply of detrital mud. A little higher, the first unit of shale appears – this is an eastward-rooted tongue of the inner detrital facies (Fig. 5, stage 2). This and subsequent shale tongues pinch out westward, and do not reach the axis of the Kicking Horse Rim, which persisted during this early stage of the cycle, sheltering the inshore basin from open-sea wave energy. Each shale incursion marks the base of a shallowing-upward subcycle and is succeeded by parted lime mudstone. Shallowing into the intertidal zone occurred only on the rim. Erratic occurrences of ooid, oncoid and skeletal grainstones, rudstones, and hardgrounds, although characteristic of the ends of subcycles, are not limited thereto. These out-of-sequence occurrences may record local current action and microtopography. A sharp increase upward in the shale content of the subcycles records accelerated deepening that drowned the rim. With the rim subdued, open-sea wave-energy reached the inshore basin. Terrigenous mud was then transported across the inshore basin and the former site of the rim, and into the open basin, helping to reduce the former relief between open basin and platform (Fig. 5, stage 3). Small-scale cyclicity (with a subdued limestone component) continued on the platform.

The detrital mud supply then began to decrease because of continued northeastward transgression of the cratonal shoreline and decelerated relative sea-level rise, permitting re-establishment of carbonate deposition along the former line of the rim and, hence, the formation of a new rim (Fig. 5, stage 4). Differential compaction above the old carbonate rim was probably sufficient to localize the new rim above the old. The new rim carbonates were the earliest deposits of the carbonate half-cycle, the Eldon Formation.

Re-establishment of the Kicking Horse Rim initiated positive feedback, both by ponding detrital muds on the inshore side and by diminishing the energy regime of the inshore basin. Terrigenous siliciclastic muds no longer were transported completely across the inshore basin; their place was taken in the outer part of the inshore basin by subtidal lime muds. Thus, deposits of

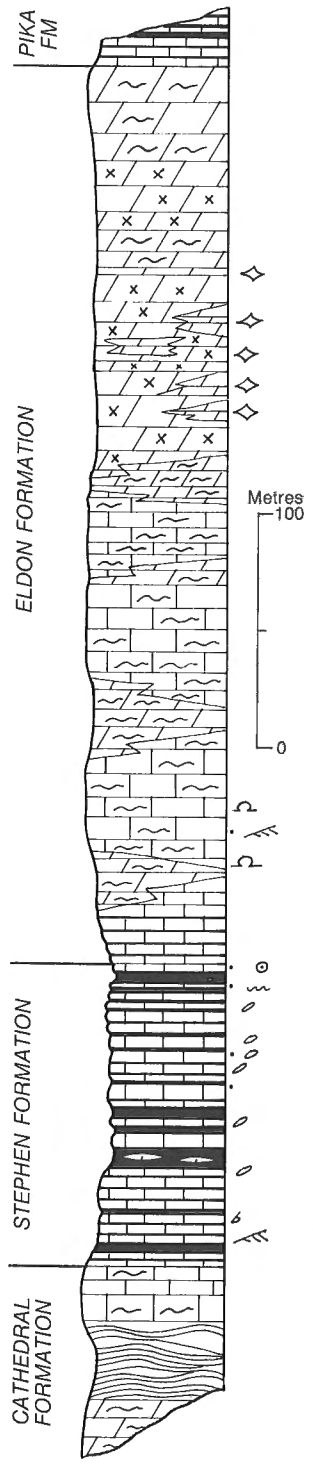


Figure 4. *Characteristics of the Stephen/Eldon Grand Cycle – the "type" Grand Cycle for the Middle Cambrian of the southern Rocky Mountains. For legend see Figure 2. (Modified from Aitken, 1978, fig. 3.)*

[1]All named lithofacies are fully described in Appendix A.

[2]This work was virtually all carried out prior to the reclassification of blue-green algae to cyanobacteria. This reclassification rendered the term cryptalagal (Aitken, 1967) obsolete, to be replaced by microbial (e.g., Kennard and James, 1986). The obsolete term, however, permeates notebooks, specimen descriptions, explanations of columnar sections, and earlier publications by the author. It is retained here, therefore, for the sake of the unity of the work, while the appropriateness of the newer term is freely acknowledged.

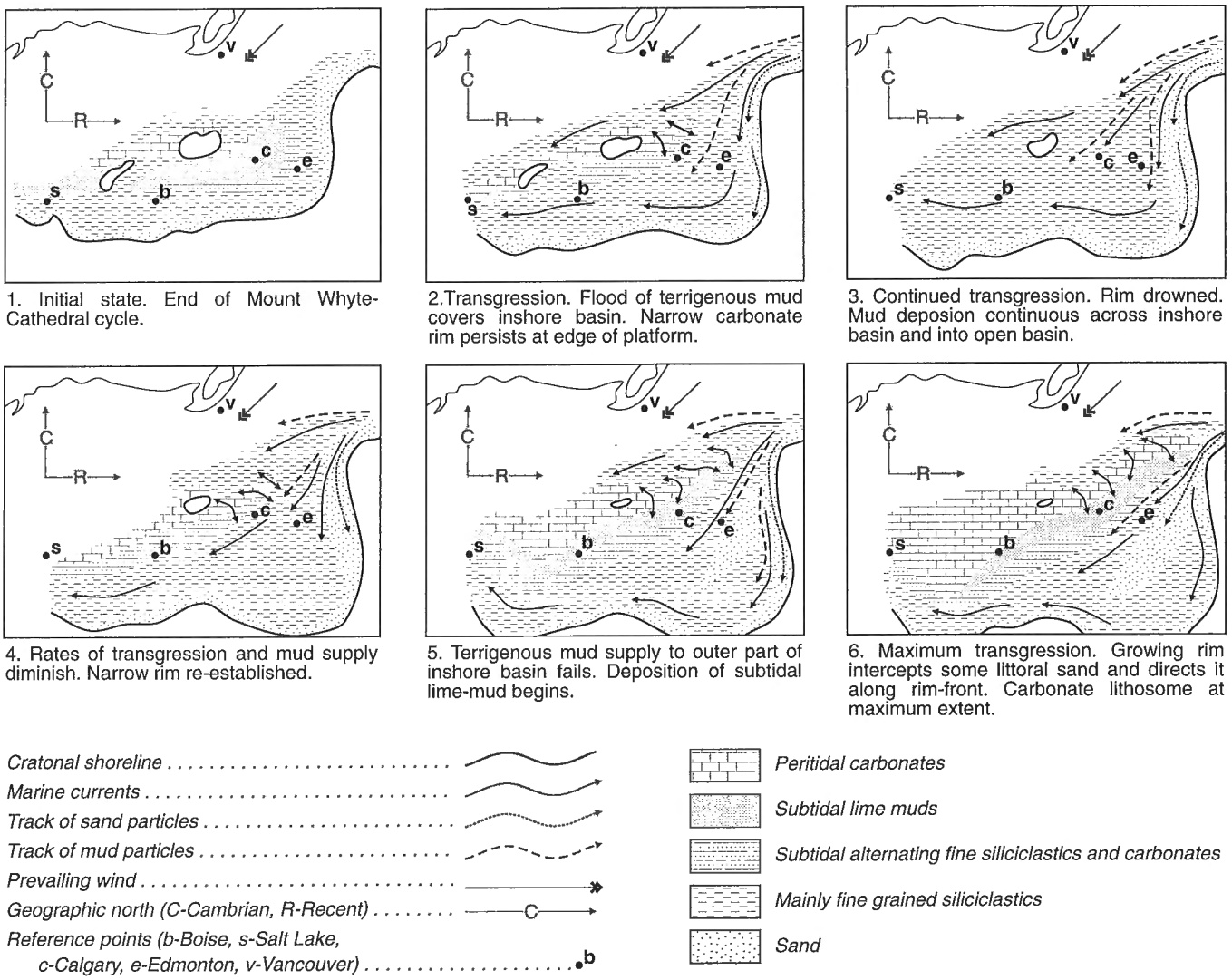


Figure 5. *Evolution of paleogeography during deposition of the Stephen/Eldon Grand Cycle. (From Aitken, 1978, fig. 9.)*

the carbonate half-cycle now were accumulating in the outer part of the inshore basin contemporaneously with deposits of the shaly half-cycle in the inner part (Fig. 5, stage 5). From this stage onward, the southwestward limit of successive shale tongues migrated northeastward, following the transgressive cratonal shoreline. The subtidal lime mud lithosome (with intercalations of dark-pellet and intraclast grainstones) expanded accordingly, generating a diachronous contact between the shaly (Stephen) and carbonate (Eldon) half-cycles, that is younger to the northeast. During this stage, expansion of the peritidal carbonate facies of the rim was relatively modest – rarely more than 20 km (12 miles). This situation persisted until the Grand Cycle was terminated by rapid deepening and the renewed influx of terrigenous mud that initiated the next cycle, represented by the Pika Formation.

The foregoing account deals exclusively with transgression, yet episodes of regression must have separated the transgressive cycles. Were this not so, the successive transgressive cycles would be arranged in a northeastward (cratonward) overlapping progression, rather than in vertical succession. The evidence from the lithofacies is solely that of expansion of the peritidal, "rim", facies into the inshore basin. The concept of regression in this situation is difficult, since the limit of the peritidal complex shifted northeastward (i.e., cratonward) during regression, rather than in the opposite, more familiar, sense.

Independent, physical evidence of regression is known regionally from the bases of only two of the Middle Cambrian cycles:

1. The Mount Whyte/Cathedral cycle (possibly a special case), which begins at the sub-Middle Cambrian unconformity (Hockley, 1973; Palonen, 1976; this report).

2. The Arctomys/Waterfowl cycle, the cratonal shoreline of which was at all times far to the southwest of that of preceding and following cycles (Pugh, 1971; Aitken, 1978).

Higher in the succession, evidence of regression is seen, at least locally, at the bases of two more Grand Cycles:

1. The Sullivan/Lyell cycle (Upper Cambrian). The base of the Sullivan Formation is erosional at Maligne Lake (not previously reported).

2. The Survey Peak cycle (Cambro-Ordovician). The base of the Survey Peak Formation is erosional at Arête Mountain on the Brazeau River (Aitken and Norford, 1967).

Notes on the isopach maps

In order to portray the variation in thickness of selected units in a meaningful way, an attempt was made to prepare a palinspastic base map (Aitken, 1988). Palinspastic reconstruction was based on the restored cross-sections of Price and Fermor (1982) and Campbell et al. (1982) (lines A-B and C-D on Figure 15, respectively). The fact that, in the course of drawing isopachs, no problems were encountered that could be attributed to major errors in palinspastic analysis, suggests that the reconstruction is reasonable.

Data points are so widely and unevenly spaced that isopachs can be drawn (whether mechanically or interpretively) in an almost infinite number of ways, none of which can be devoid of assumptions and many of which would be devoid of geological "sense". An element of subjectivity in contouring the thickness data is, therefore, both inevitable and desirable, so long as subjectivity is kept within reasonable bounds.

Isopach maps were drawn in an upward stratigraphic sequence. At the start, the only subjective elements introduced were:

1. A presumption, based on experience and available geological maps, that the depositional strike is subparallel to the tectonic strike.

2. A presumption, supported by lithofacies distribution, that the Kicking Horse Rim was persistent both in time, throughout the Middle Cambrian, and in space, from Mount Assiniboine to the vicinity of Mount Robson.

3. The knowledge, derived from experience and mapping, that all Middle Cambrian carbonate formations thin rapidly, west of the rim, as they pass into the slope facies.

4. An assumption, applied where not prohibited by data, that structures revealed by isopachs of a given unit will in general be inherited to some degree by younger units.

As contouring of data commenced, it became evident immediately that, in certain areas, isopachs had to be drawn with pronounced northeastward deflections from the expected north-northwest trend. Furthermore, these deflections lie in a limited number of zones that either are constrained to a northeast trend by the data, or can readily be contoured in northeast-trending conformity with the data-defined zones. The northeast-trending zones of deflection are superposed in successive units. These observations call to mind both the northeasterly structural trend of the Precambrian Churchill structural province, which forms the crystalline basement in the region (e.g., Stockwell et al., 1970, Fig. IV-2), and the northeast-trending faults with Precambrian and younger movements that are documented southwest of the study area (e.g., Lis and Price, 1976; Foo, 1979). The assumption was made that the zones of northeastward deflections of isopachs constitute a response to continued or renewed faulting along the ancient northeast trend, and a "blocky" style of contouring has been adopted to reflect this assumption.

BIOSTRATIGRAPHY

Virtually all biostratigraphic work on the Cambrian of the southern Rocky Mountains has been based on trilobite fossils. Data on other fossil groups have been published but no attempt has been made to establish a zonation based on the non-trilobite elements of the biota. With minor exceptions, the trilobite faunas of the region belong to the shallow-water, North American Province. Cosmopolitan trilobites occur mainly in the deposits of slope and deeper water origin, outboard from the carbonate platforms, and in tongues of these facies that locally penetrate the outer edges of the platforms. None of these cosmopolitan forms is known from platformal deposits of the Middle Cambrian, but a few are known from the Lower and

Upper Cambrian platforms in various parts of the Cordillera. The trilobites providing the only direct tie with the Middle Cambrian fauna of Europe occur in a platform-directed tongue of deeper water deposits, the Field Member of the Eldon Formation.

Earlier studies of the Cambrian fossils by Walcott, Burling, Raymond, Deiss, Rasetti, and Greggs (1962) have served to characterize nearly all the lithostratigraphic units faunally, and to set the Cambrian succession of the southern Rocky Mountains in relation to the Cambrian successions in other parts of North America. More recent work, by W.H. Fritz, which commenced in the early 1960s, was carried out contemporaneously with and partly in cooperation with my own. Dr. Fritz reported on all my collections and, combining these data with those from his own more detailed collecting, prepared the range charts for the Canadian Cordillera (Tables 1-3). Some genera

Table 1
Range chart for Lower Cambrian trilobites, Canadian Cordillera (chart by W.H. Fritz)

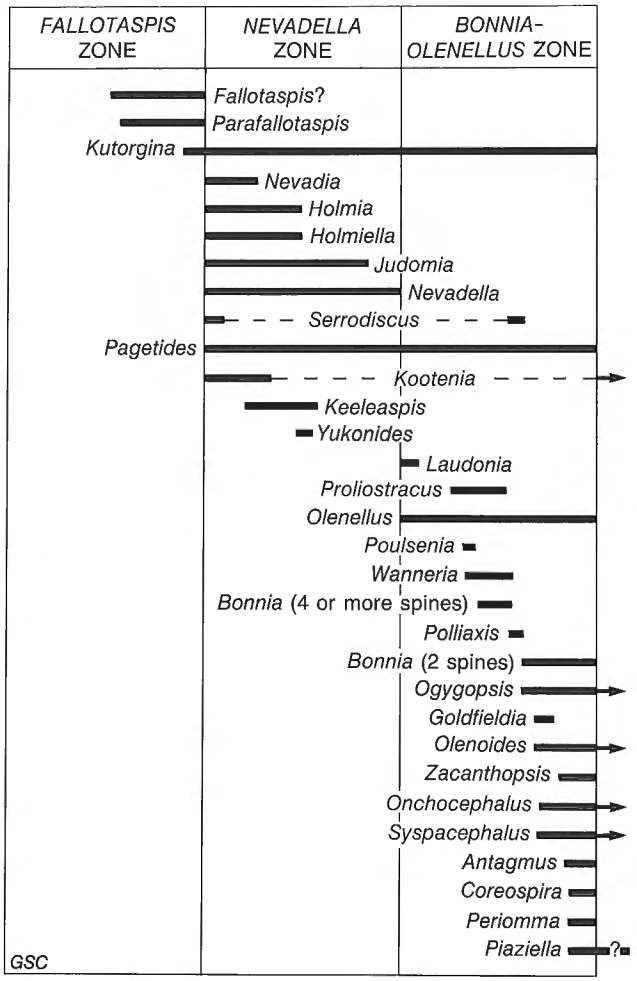


Table 2
Range chart for Middle Cambrian trilobites, Canadian Cordillera (chart by W.H. Fritz)

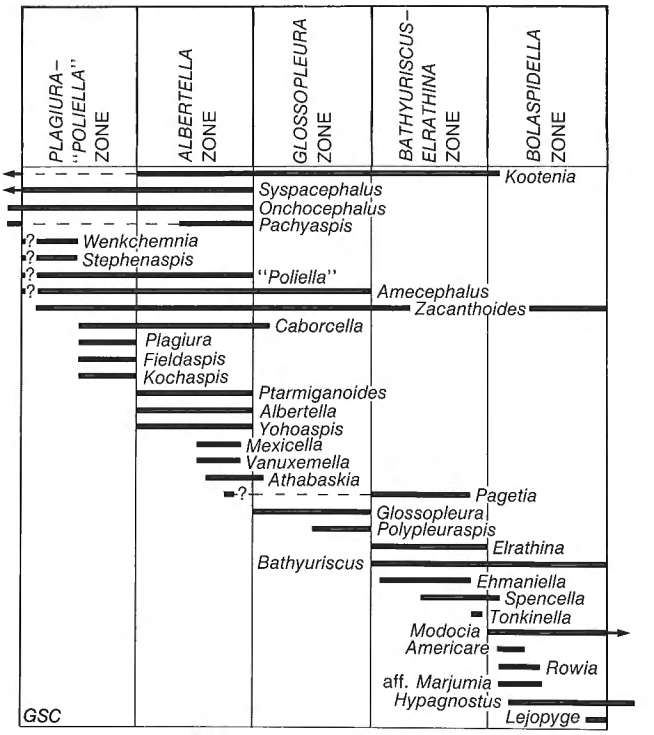
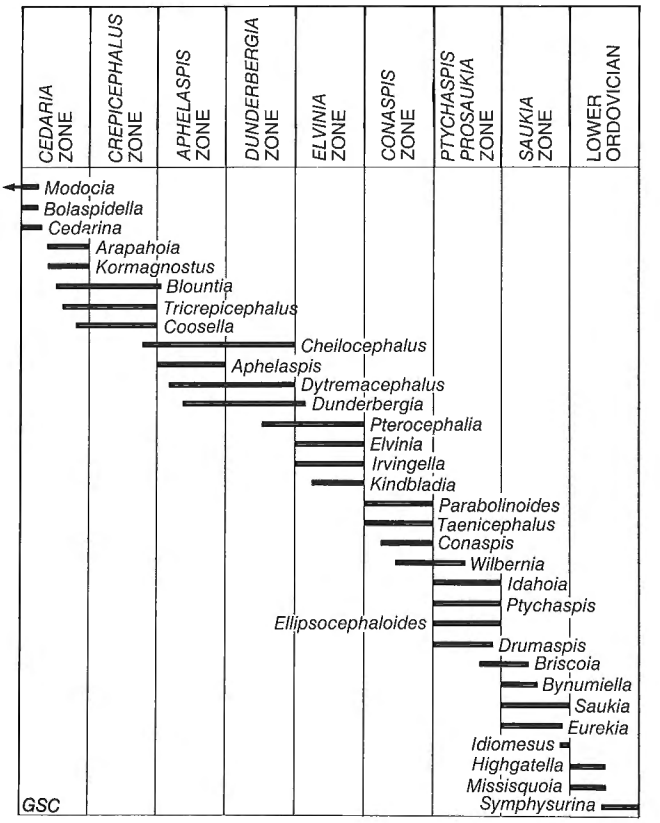


Table 3
Range chart for Upper Cambrian trilobites, Canadian Cordillera (chart by W.H. Fritz)



listed on the range charts have not been found in the southern Canadian Rocky Mountains. The well "punctuated" character of the lithostratigraphic framework of the Cambrian platformal succession generally permits unit recognition and geological mapping with little reference to fossils. Nevertheless, Fritz's work has established the faunal characterization of tongues and members, and documented the quasi-synchronous character of Grand Cycle tops.

DESCRIPTION AND CLASSIFICATION OF LITHOFACIES

The outstanding characteristic of the Middle Cambrian succession is its cyclicity; that is, the seemingly endless recurrence, in a single stratigraphic section, of various rock types. As a result, the comprehensive description of the rocks comprising each formation would be monotonously repetitive and extend an already bulky report. Accordingly, all of the recurring rock types are described and illustrated once only and are assigned to lithofacies in Appendix A. The formations are described in terms of these lithofacies.

DESCRIPTION OF FORMATIONS

Peyto Formation (Gog Group)

Definition

A resistant, mappable unit of varied limestones, locally dolomitized, with minor intercalations of sandstone and shale, Early Cambrian in age, forms the top of the Gog Group (Deiss, 1940; Mountjoy, 1962) throughout much of the region (Figs. 6-8, 32, 61, 63). Originally erected by Rasetti (1951) as the Peyto limestone member of the "St. Piran Sandstone", it has been referred to more recently (with the obsolescence of the term St. Piran) as the Peyto Member of the Gog Group (e.g., Hockley, 1973; Palonen, 1976). The Peyto is here raised to formation status; not merely to satisfy the legalistic niceties of stratigraphic heirarchy, but also to avoid the awkwardness that has haunted discussion of a member of a group that, south of Jasper, has no well established formations.

The Peyto Formation is included in this report on Middle Cambrian stratigraphy for two reasons. Firstly, some of those engaged in geological mapping have had difficulty in separating the Peyto carbonates from the overlying, carbonate dominated Middle Cambrian formations. Secondly, the Gog Group has been, and probably will continue to be, studied mainly by stratigraphers and sedimentologists primarily interested in detrital sedimentary rocks (e.g., Palonen, 1976) and, as a result, the Peyto Formation may not receive further lithostratigraphic study for some time.

Origin of name

The "Peyto Limestone Member" was named by Rasetti (1951) after Peyto Lake, the source of the Mistaya River, near the type section. Rasetti included this member as part of the "St. Piran sandstone", now obsolete.

Type and reference sections

Rasetti (op. cit., p. 55) designated as the type section an interval ". . . in the cliffs formed by the west spur [sic] of Mount Thompson on the west side of the upper Bow Valley, north of Bow Lake and south of Peyto Lake." This is a confusing and incorrect designation of the type section clearly intended by Rasetti, which he described elsewhere (op. cit., p. 11) as being ". . . in the slope and ridge just south of a glacial cirque facing the Bow Valley, 1.0 mile northwest of Num-Ti-Jah Lodge on the north shore of Bow Lake." Any reference to Mount Thompson in this connection is confusing, because the mountain (unnamed on topographic maps) on which Rasetti's section is exposed is two miles northeast of the peak of Mount Thompson, and connected to it only by a narrow ridge and saddle. Nevertheless, the section described by Rasetti can be positively identified from the second quotation given above. Because of thickness anomalies and evidence of faulting at the type section, Hockley (1973) identified a reference section 10 km (6 miles) to the north, at Mount Weed (Section AC–171). The Mount Weed section (Fig. 6) is indeed representative, well exposed, fossiliferous and unfaulted. Following Hockley's recommendation, it is here formally designated the principal reference section for the Peyto Formation.

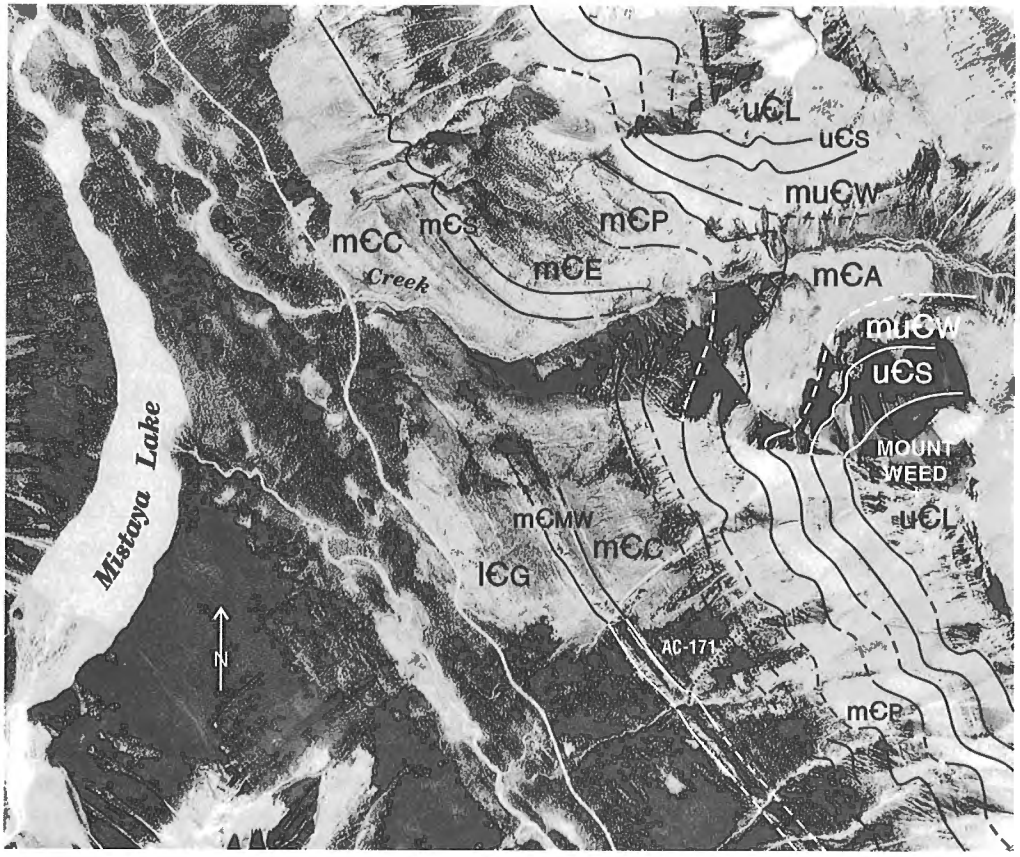


Figure 6. *The southwest flank of Mount Weed. The dotted line marks the route of measurement for Section AC–171, the type section of the Weed and Chephren members of the Mount Whyte Formation and reference section for the Peyto Formation.* lЄG*–Gog Group, including the Peyto Formation at its top;* mЄMW*–Mount Whyte Formation;* mЄC*–Cathedral Formation;* mЄS*–Stephen Formation;* mЄE*–Eldon Formation;* mЄP*–Pika Formation;* mЄA*–Arctomys Formation;* muЄW*–Waterfowl Formation;* uЄS*–Sullivan Formation;* uЄL*–Lyell Formation. National Air Photo Library, part of Air Photo A14970-95.*

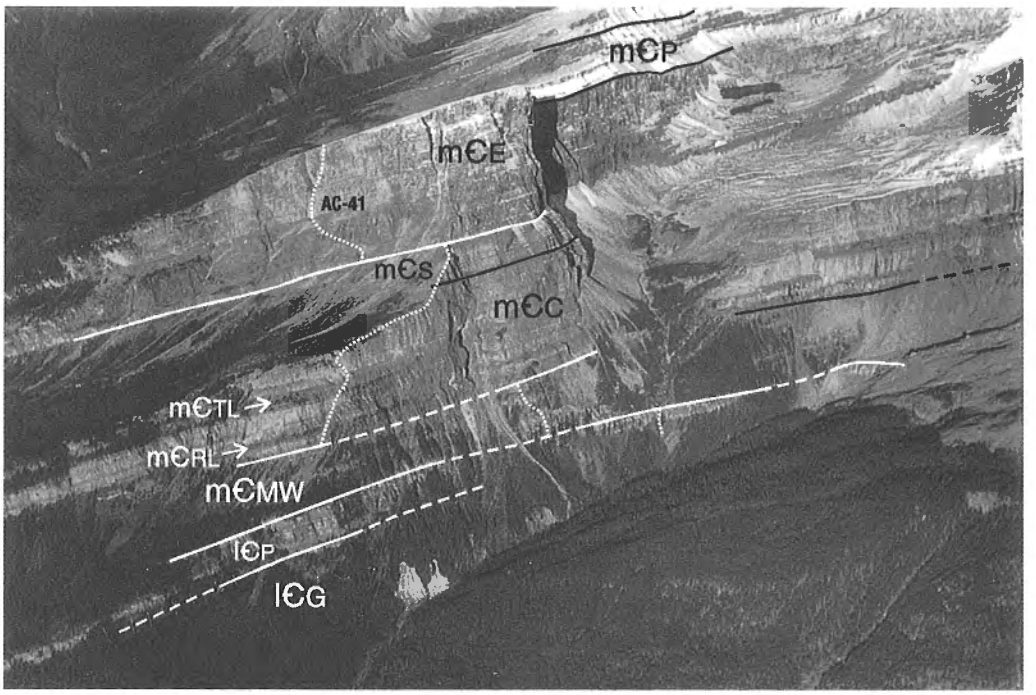


Figure 7. *Section AC–41, at the Banff Park Boundary on the North Saskatchewan River. (Oblique aerial view to the northwest). Dotted line marks the route of measurement.* lЄG*–Gog Group (sub-Peyto strata);* lЄP*–Peyto Formation;* mЄMW*–Mount Whyte Formation;* mЄC*–Cathedral Formation (*mЄRL*–Ross Lake Member;* mЄTL*–Trinity Lakes Member);* mЄS*–Stephen Formation;* mЄE*–Eldon Formation;* mЄP*–Pika Formation. ISPG photo 1518-57.*

Principal Reference Section of the Peyto Formation, on the lower slopes of Mount Weed, above the Banff–Jasper Highway

Section AC–171

(lat. 51°47′06″N, long. 116°32′17″W)
(For access, see Appendix C)

MOUNT WHYTE FORMATION
(415.5 ft/126.6 m)
(Reference Section)

Chephren Member

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
6	Covered: recessive weathering	12 (3.7)	221.5 (67.5)
5	**Limestone**: ooid grainstone, commonly very coarse grained, thin to thick bedded, massive. Minor skeletal grainstone/packstone. Near the top, some very coarse brachiopod grainstone in medium beds	16 (4.9)	209.5 (63.9)
	GSC loc. 87987 (1 ft/30 cm below the top) *Nisusia* sp. *Plagiura*? sp.		
	GSC loc. 87986 (4 ft/1.2 m above the base) cf. *Kochina* sp. *Onchocephalus*? sp. *Wimanella* sp.		
4	**Limestone**: mainly thin bedded calcisiltite with silty dolomitic partings. Minor ooid grainstone at the base	11 (3.4)	193.5 (59)
3	**Limestone**: massive unit of stromatolitic thrombolites	7 (2.1)	182.5 (55.6)
2	**Limestone**: mainly calcisiltite; partly silty, very thin bedded; partings of siltstone common. Minor flat-pebble rudstone	23.5 (7.2)	175.5 (53.5)
	Abrupt but gradational contact.		

Weed Member
(152 ft/46.3 m)
(Reference section)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Siltstone**: greenish grey, calcareous, argillaceous, micaceous; minor sandstone: very fine grained, thin and very thin bedded and laminated; minor partings of shale: greenish grey, laminated, partly calcareous. Feeding burrows and general bioturbation prominent throughout. At 141.5, 143.5, and 154 ft (43.1, 43.7, and 46.9 m) above the base, medium, lenticular beds of limestone, ooid grainstone and rudstone.	152 (46.3)	152 (46.3)
	Erosional contact.		

GOG GROUP

PEYTO FORMATION
(113.5 ft/34.6 m)
(Reference section)

Except for thin shale units near the top, the Peyto Formation is resistant, and forms a marked topographic rib.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Sandstone, shale, and limestone** (intermixed) Sandstone: grey, quartzose, very fine grained Shale: green-grey, calcareous, appearing rotten Limestone: sandy, trilobite grainstone Near the base and in the middle, the sandstone occurs in decimetre-scale pods. This suggests that the sand was introduced into solution-openings in the limestone, and that the unit has been altered by weathering at the sub-Mount Whyte contact	6 (1.8)	113.5 (34.6)
	GSC loc. 87985 *Olenellus* sp. *Onchocephalus* sp.		
	GSC loc. 89440 *Olenellus* sp. *Onchocephalus* sp.		
10	**Shale**: olive, silty, fissile, noncalcareous	17.5 (5.3)	107.5 (32.8)
9	**Limestone**: mainly ooid and skeletal grainstone; irregularly thin bedded	16 (4.9)	90 (27.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 87984 *Olenellus* sp. *Onchocephalus* sp. GSC loc. 87983 *Antagmus* sp. *Bonnia fieldensis* (Walcott), 1916 *Micromitra* sp. *Olenellus* sp. aff. *Syspacephalus ?uncus* (Walcott), 1917 GSC loc. 87982 *Bonnia fieldensis* (Walcott), 1916 *Olenellus* sp. *Paterina* sp. aff. *Syspacephalus ?uncus* (Walcott), 1917		
8	**Shale**: olive, silty, fissile, noncalcareous	4 (1.2)	74 (22.6)
7	**Limestone**: trilobite-hyolithid packstone; dolomitic, irregularly thin bedded	2 (0.6)	70 (21.3)
6	**Sandstone** and **shale** (interlaminated) Sandstone: pink, calcareous, very fine grained, laminated in planar and lenticular style. Shale: green-grey, silty, micaceous	4 (1.2)	68 (20.7)
5	Covered: recessive weathering	21 (6.4)	64 (19.5)
4	**Limestone**: fine skeletal grainstone; oolitic, sandy, with minor thin beds of oolite. Middle third is ooid grainstone: dolomitic, thin and medium bedded, crosslaminated. Locally (near a fault) altered to dolomite: grey, orange-weathering, medium crystalline	24 (7.3)	43 (13.1)
3	**Dolomite**: medium grey, weathering pale orange, medium crystalline; bedding style is inherited from limestone – as Unit 2. Sandy (quartz) in top foot	8.5 (2.6)	19 (5.8)
2	**Limestone**: skeletal grainstone; fine grained, nodular, thin bedded, massive to rubbly, resistant, grey weathering	5.5 (1.7)	10.5 (3.2)
1	**Limestone**: skeletal grainstone; very sandy, medium bedded, weathers grey and brown, massive.	5 (1.5)	5 (1.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC locs. 87976 (lowest) to 87981 (highest) were collected in ascending order from Units 1 through 4, inclusive. All are assigned to the upper *Bonnia-Olenellus* Zone Loc. 87981 *Onchocephalus* sp. Loc. 87980 *Onchocephalus* sp. Loc. 87979 *Antagmus* sp. *Bonnia columbensis* Resser, 1936 *Onchocephalus* sp. *Olenellus* sp. monoplacophoran Loc. 87978 *Antagmus*? sp. *Olenellus* sp. *Periomma* sp. Loc. 87977 *Antagmus* sp. *Olenellus* aff. *O. gilberti* Meek, 1874 *Onchocephalus* sp. *Periomma* sp. Loc. 87976 *Antagmus*? sp. *Olenellus* sp. *Onchocephalus* cf. *O. thia* (Walcott), 1917 cf. *Sombrerella* sp. or *Periomma* sp. Gradational contact.		

SUB-PEYTO STRATA
(90.5 ft/27.6 m)

The sub-Peyto sandstone beds of the Gog Group are about as resistant as the overlying Peyto Formation and form topographic ribs, separated by notches overlying the subordinate, recessive weathering shale units.

8	**Sandstone**: yellow-white and pink, brown-weathering, mainly medium grained, very calcareous; tangential crosslamination in 15 to 30 cm sets. One 7 cm thick shale bed near the top	22.5 (6.9)	90.5 (27.6)
7	**Shale**: greenish grey, fissile, with 10 per cent very thin beds of quartzite: white, green speckled, very fine grained, bioturbated. The unit grades upward to mainly bioturbated siltstone	7.5 (2.3)	68 (20.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Sandstone**: carbonate cemented as below, locally dull purple-red, mainly medium grained; with minor quartzite. Unit shows an upward gradation from thick sets of low-angle tabular crossbeds to 7 to 30 cm sets of tangential crossbeds. The upper part of the unit has a thin bedded appearance	22 (6.7)	60.5 (18.4)
5	**Shale**: greenish grey, chippy	3 (0.9)	38.5 (11.7)
4	**Sandstone**: dominated by very calcareous (or sideritic?) sandstone as below. 25 per cent, 10 to 30 cm thick intervals of sandstone with dolomite intraclasts; sandstone with dolomitized oncoids, and minor limestone: grey, very sandy. Unit weathers mainly rusty brown	11 (3.4)	35.5 (10.8)
	GSC loc. 87975 *Bonnia* sp. *Olenellus* sp. *Bonnia-Olenellus* Zone		
3	**Sandstone** and **quartzite** As Unit 1	9 (2.7)	24.5 (7.5)
2	**Shale**: greenish grey, rusty weathering, very fissile	5.5 (1.7)	15.5 (4.7)
1	Alternating carbonate-cemented **sandstone** and **quartzite**. Mainly fine and medium grained, as underlying beds; top one foot (30 cm) is coarse grained.	10 (3)	10 (3)
	Exposures continue downward.		

Reference section for the Peyto Formation at Mount Kerkeslin

Section AC–99

(lat. 52°39′21″N, long. 117°50′13″W)
(For access, see Appendix C)

This section is dominated by rocks that are typical of the northern sections of the Peyto Formation, but distinct from the type section and other sections in the south (see below). Accordingly, the Mount Kerkeslin section is here recognized as a **second reference section.**

SNAKE INDIAN FORMATION

Section continues upward through the complete Snake Indian Formation to the Eldon Formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Weed Member (186 ft/56.7 m)		
1	**Sandstone** and **siltstone** Sandstone: very fine grained. Siltstone: mainly deep green, minor pale grey, calcareous, medium to thick bedded. Knots and lenses of sediment of different colours and grades, apparently due to bioturbation. A few well defined burrows and feeding traces. Minor pink coloration near the top. Unit is very hard, resistant, massive; a strong cliff former, weathering very dark grey-green.	138 (42.1)	138 (42.1)
	Abrupt, planar contact. Hockley (1973) reported evidence of erosion nearby.		

GOG GROUP

PEYTO FORMATION
(420.5 ft/128.2 m)
(Reference section)

Strata of the Peyto Formation weather pale grey with dusky red bands and form a nearly vertical cliff in an unbroken profile with the overlying, sombre coloured rocks of the Weed Member.

26	**Limestone**: white, fenestral, as below	7.5 (2.3)	420.5 (128.2)
	GSC loc. 87467 (uppermost 2 ft/0.6 m) *Olenellus* sp. *Onchocephalus* sp. *Zacanthopsis* sp.		
25	**Limestone**: oncoidal, as Unit 18; oncoids up to 1.5 cm in diameter	2 (0.6)	413 (125.9)
24	**Limestone**: pale grey, fenestral, as below	46.5 (14.2)	311 (125.3)
	GSC loc. 87466 (basal 2 ft/0.6 m) *Onchocephalus* sp. *Zacanthopsis* sp.		
23	**Limestone**: pink, fenestral, as below (highest red-weathering band)	3.5 (1.1)	364.5 (111.1)
22	**Limestone**: cryptalgal laminite; yellowish grey, fenestral, stylolitic; trace of authigenic feldspar	31 (9.4)	361 (110)
21	**Limestone**: as Unit 20, but 70 per cent pink to brick red, slightly argillaceous near the top	32 (9.8)	330 (100.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
20	**Limestone**: fenestral and laminoid fenestral lime mudstone; pale grey, pinkish grey, yellowish white, grey weathering; subordinate, fenestral pale-pellet grainstone. Nonbedded, massive, strongly cliff forming	23 (7)	298 (90.8)
19	**Limestone**: as Unit 20, but mainly pale grey. Oncoids widespread in the upper two thirds (as floatstone). Uppermost 14 feet (4.3 m) is largely either pink or red-mottled. At the top, large, hemispherical thrombolites	24.5 (7.5)	275 (83.8)
18	**Limestone**: as below at the base, with scattered oncoids less than 1 cm in diameter (oncoid floatstone). Grades upward to oncoid packstone with skeletal packstone matrix and oncoids to 2 cm diameter	5.5 (1.7)	250.5 (76.4)
17	**Limestone**: pale grey, fenestral, cryptalgal laminite	15.5 (4.7)	245 (74.7)
16	**Sandstone** and sandy **dolomite** As below	8 (2.4)	229.5 (70)
15	**Limestone**: lime mudstone and intraclast floatstone; medium to dark grey, partly fenestral, locally dolomite-mottled, medium and thick bedded, massive. In the middle, a 3 ft (1 m) thick bed of dolomite: dark grey, microcrystalline, argillaceous, slightly calcareous, massive	23.5 (7.2)	221.5 (67.5)
14	**Sandstone** and **dolomite** (interlaminated) Sandstone: pale grey, coarse grained, well sorted, very dolomitic. Dolomite: pale grey, microcrystalline, very sandy. Massive, brown weathering	6 (1.8)	198 (60.4)
13	**Limestone**: calcisiltite and lime mudstone; strongly dolomite mottled (burrow mottled) at the base, thin to thick bedded, grey weathering, massive and cliff forming	34 (10.4)	192 (58.5)
12	**Limestone**: as Unit 11, but pink to brick red, weathers brick red; siliceous and argillaceous, with subordinate interbeds of grey limestone; medium bedded, and resistant	26 (7.9)	158 (48.2)
11	**Limestone**: mainly pale-pellet grainstone; grey to very pale grey, minor pale orange-grey, partly fenestral, medium to very thick bedded, massive, locally dolomite mottled, resistant; gradational into overlying unit	42.5 (13)	132 (40.2)
10	**Sandstone**: greyish white, greenish white, and pinkish white, orange weathering, partly calcareous, partly dolomitic, mainly medium grained, minor coarse grained, well sorted, thick bedded, massive, strongly cliff forming	21.5 (6.6)	89.5 (27.3)
9	**Dolomite** and **limestone** (mainly finely interlaminated) Dolomite: grey, microcrystalline. Limestone: grey, microcrystalline, with scattered grains of quartz sand (cryptalgal laminite).		
	Minor thick beds of fine grained skeletal packstone, thin beds of argillaceous trilobite wackestone, and thick beds of dolomite: dark grey, orange weathering, microcrystalline.		
	A resistant unit, weathering laminated orange and grey	13.5 (4.1)	68 (20.7)
8	**Sandstone**: pale grey, orange-brown weathering, medium grained, well sorted, dolomitic, thick bedded, massive; with subordinate layers of dense, sandy dolomite. Two medium beds of shale: dark grey, hard	11.5 (3.5)	54.5 (16.6)
7	**Limestone**: skeletal wackestone; fine grained, sandy, thin bedded, with partings of argillaceous dolomite. In the middle, a 15 cm thick bed of shale: grey, fissile	5 (1.5)	43 (13.1)
6	**Mudstone** and minor **shale** Dark brownish grey, tan weathering, very dolomitic, platy; with minor thin beds and nodules of grey, microcrystalline limestone. In the middle, a 2 ft (60 cm) thick bed of limestone: fine grained skeletal packstone; nodular, thin bedded	10.5 (3.2)	38 (11.6)
	GSC loc. 57639 (middle 2 ft/60 cm) *Olenellus* sp. *Olenellus* cf. *O. eagerensis* Best, 1952 *Atnagmus* sp.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
5	**Sandstone**: pale yellowish and brownish grey, medium and coarse grained, well sorted, calcareous, soft, thick bedded, with tangential cross-lamination. At base and top, one foot (30 cm) thick beds of dolomite: grey, fine crystalline, sandy	11 (3.4)	27.5 (8.4)
4	**Siltstone** and **dolomite** Siltstone: grey, yellowish grey, very dolomitic. Dolomite: microcrystalline, silty, laminated, platy. Minor shale: as below	3.5 (1.1)	16.5 (5)
3	**Dolomite**: dark grey, microcrystalline, argillaceous, thin bedded, flaggy; with partings of grey shale	5 (1.5)	13 (4)
2	**Sandstone**: grey, pale brown, coarse grained, poorly sorted with rare granules, calcareous. A single, brown weathering bed	4.5 (1.4)	8 (2.5)
1	**Dolomite** and **sandstone** Dolomite: dark grey, microcrystalline, very sandy. Sandstone: very dolomitic, coarse grained, poorly sorted. Unit weathers brown and mottled, owing to the patchy distribution of sand (through bioturbation?).	3.5 (1.1)	3.5 (1.1)

MAHTO FORMATION

The resistant sandstone and quartzite beds of the Mahto Formation form a steep, ledgy slope. The sandstone is greyish white to snow white, very fine and fine grained, with minor medium grained, and a trace of altered glauconite. Sorting is generally excellent – some beds are bimodal. The sandstone occurs in thick and very thick, tangentially crosslaminated beds, separated by thin beds of green and greenish grey shale. Sandstones become patchily calcareous in the uppermost 20 ft (6.1 m), and are coarse grained in the uppermost bed.

Lithology

The Peyto Formation is lithologically unique among the Cambrian formations of the region. At and near the type section it is characteristically dominated by coarse grained, ooid and skeletal grainstone and packstone, and contains spectacular beds of oncoid packstone and wackestone (alternatively, oncoid rudstone or floatstone, Figure A-54) in which the oncoids reach the extraordinarily large diameter of six centimetres. Quartz sand is normally present at one or more levels, so that sandy limestones intergrade with calcareous (skeletal, oolitic, etc.) sandstone and most sections include one or more units of medium to coarse grained sandstone and, locally, grit. Wavy to nodular, thin and medium bedding predominate, but thick bedded, massive oolite beds are present locally. Sharp contacts, probably erosional, are common between beds of contrasting lithology.

Regional variation in the composition of the Peyto limestone can be described in terms of five principal lithofacies (Fig. 9). The type section and most of the sections near the Banff – Jasper Highway represent a thick, high-energy, upper ramp facies, coarse grained and richly skeletal (Fig. 54). At Mount Kerkeslin, however, the lithofacies is distinct and the Peyto Formation is dominated by pale-pellet grainstone and fenestral lime mudstone that is partly pale cream coloured and partly dusky red (Fig. 8). Thrombolitic and stromatolitic masses are prominent, and skeletal and coarsely particulate beds are greatly reduced. This is mainly a low-energy, lagoonal lithofacies.

At localities southwest of the platformal and lagoonal facies, oolitic and oncoidal beds decrease in importance in the Peyto Formation and skeletal beds are rarely as coarse as those in the platformal facies. Units of calcisiltite, parted and burrow-mottled lime mudstone, and green-grey to brown-grey shale become prominent. Quartz sand is reduced in the carbonate rocks, but one or more units of quartzose sandstone commonly persist. The southwestern facies has a lower-energy aspect and may be part of the lower ramp.

Two distinct pinchout, or "shoreline", lithofacies occur in the thin, easternmost sections of the Peyto Formation. Notwithstanding the fact that the Peyto Formation is partly erosionally bevelled at the sub-Middle Cambrian unconformity, it is clear that, at Beauty Creek (Section AC–48) and southward, the Peyto thins in part by intertonguing with the uppermost Gog Group sandstones (Fig. 11). As sandstone units appear progressively higher in the formation and the quartz-sand content of carbonate beds increases, coarse grainstones, especially ooid grainstones, become increasingly prominent. Complete or nearly complete dolomitization characterizes the thinnest sections – for example, at Whirlpool Point and the type section of the Mount Whyte Formation. In its southernmost exposures, the Peyto Formation comprises a thin interval of dolomitic sandstone that includes beds with abundant skeletal fragments, ooids, oncoids, and intraclasts preserved as ferruginous dolomite (Fig. 10).

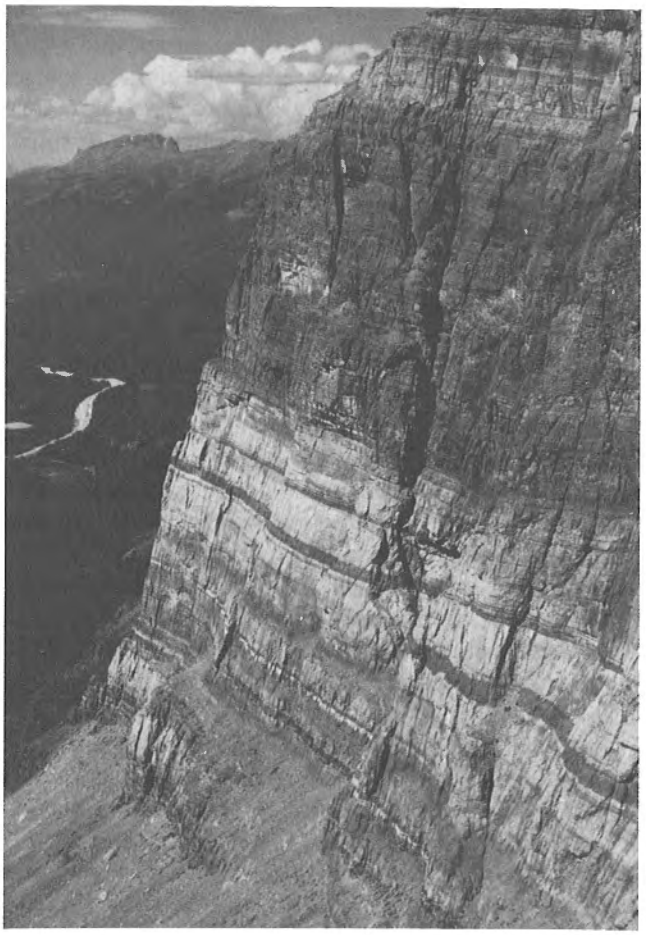


Figure 8. *The Peyto Formation and Weed Member of the Snake Indian Formation at Mount Kerkeslin (Section AC–99), view to the north-northwest. The Banff–Jasper Highway is on the left. Mount Tekarra is in the background on the left. Note the extremely pale weathering colour of the pale-pellet grainstones and cryptalgal laminites of the Peyto Formation; the bands appearing dark in this photograph are red. The Weed Member forms the dark, uniform cliff above the Peyto carbonates; note the abrupt contact between the two. ISPG photo 1569-5.*

North of Beauty Creek, the pinchout, or "shoreline", lithofacies lies east of the lagoonal facies described from Mount Kerkeslin, and is of appropriately low-energy aspect. The carbonate rocks, mainly dolomite, are stromatolitic and contain tepee structures. Interbedded shales are partly red, partly grey. Minor red limestone resembles that at the Mount Kerkeslin section. Oscillation ripple marks and mudcracks are prominent. The basal red member of the type Snake Indian Formation is probably a shoreline facies of the Peyto Formation (Fig. 14), but the correlation cannot yet be demonstrated conclusively.

Contacts

The base of the Peyto Formation is conformable and interbedded with the underlying sandstones of the Gog Group. As Hockley (1973) pointed out, any reasonable bed-by-bed lithological correlation of the Peyto demonstrates that the carbonate units pinch out shoreward (northeastward) between basinward-pinching sandstone units (Figs. 9, 11, 12, 14); the base of the formation is therefore diachronous, younger northeastward.

Palonen (1976, p. 56, 57) was impressed by an erosional surface or surfaces near the base of the Peyto "Member", and suggested that the contact may represent a significant erosional event. As noted above, surfaces of erosion are common within the Peyto Formation; thus, Palonen's evidence is not compelling.

The top of the Peyto Formation is abrupt and concordant but disconformable with the overlying Mount Whyte Formation - the evidence is discussed under the latter heading.

Distribution and thickness

The Peyto limestone is a formation of the Main Ranges of the Rocky Mountains. Northeastward, or shoreward, it wedges out (Figs. 11-14, 16). Regardless of the degree to which it may have been bevelled by sub-Middle Cambrian erosion, it is clear from the pattern of lithofacies discussed above that the Peyto Formation never extended much farther eastward than it does today. Southeastward along the structural grain, from the axis of maximum thickness, the Peyto Formation thins depositionally and by erosional bevelling, and is missing at Vermilion Pass (Section AC–53) and southward. Deep sub-Middle Cambrian erosional bevelling between Vermilion Pass and Mount Assiniboine has been demonstrated (Palonen, 1976), but Peyto Formation sediments may never have been deposited very far south of Lake Louise.

Northwestward, the Peyto Formation becomes the Hota Formation of the Mount Robson district. At the Cinnamon Peak/Whitehorn section (AC–165), the Hota has a lower ramp aspect. The prominence of dolomite at the Coleman Brook and Mumm Peak sections described by Fritz and Mountjoy (1975) might suggest that Peyto strata at these two localities belong to a shoreline facies, but their considerable thickness (essentially that of Cinnamon Peak/Whitehorn) stands against such a conclusion.

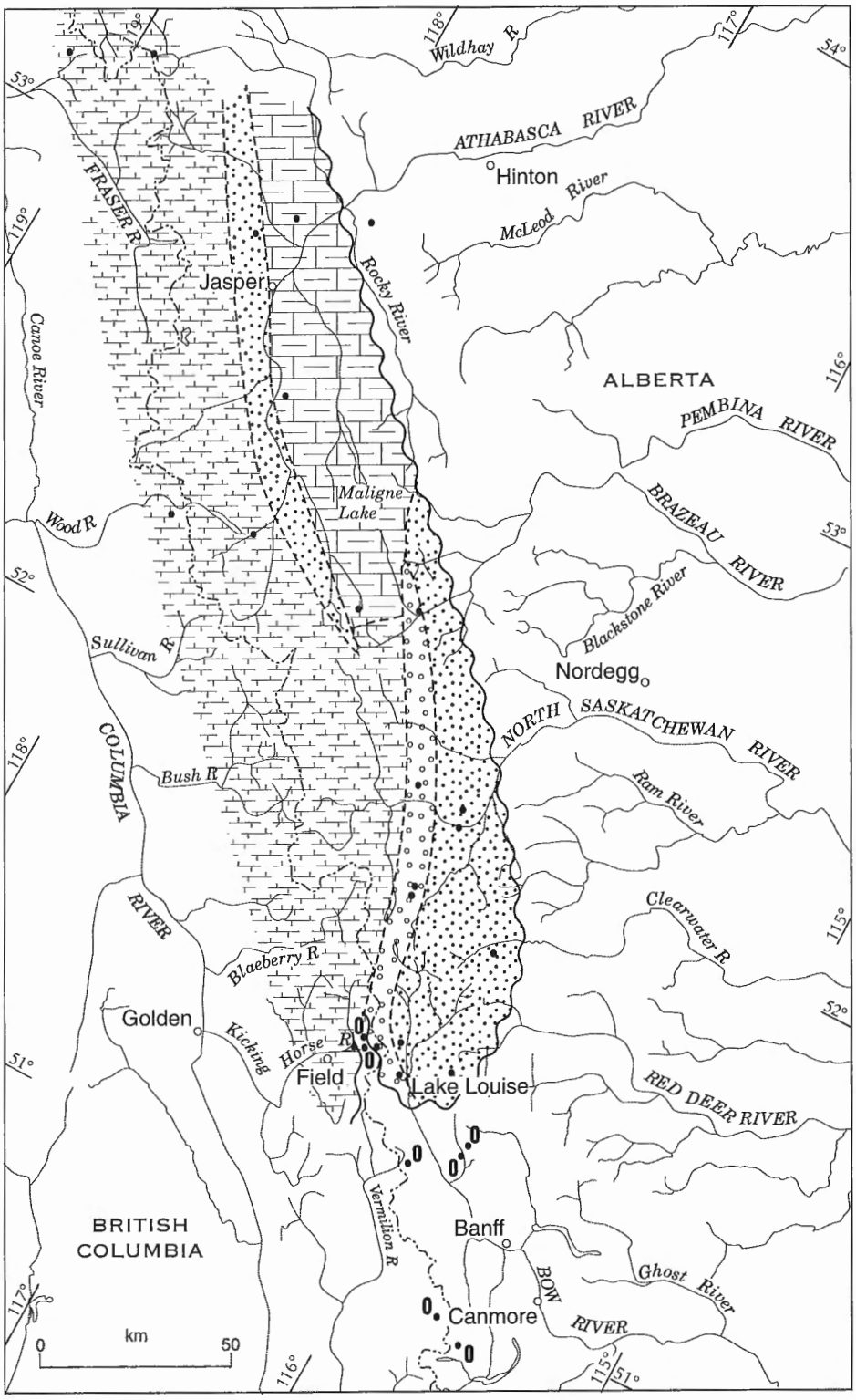


Figure 9. *Map showing the prinicipal facies of the Peyto Formation and correlatives. The long, southward-pinching tongue of sandstone–a barrier bar, inferred south of Jasper in a belt for which there is no information–is considered necessary to account for the lagoonal facies to the east. The map is non-palinspastic.*

Figure 10. *Oncoids of ferrodolomite in a matrix of quartz sandstone–a marker bed of the Peyto Formation in the Lake Louise/Lake O'Hara area. (Naturally weathered surface.) ISPG photo 786-4.*

The maximum measured thickness of the Peyto Formation is 420.5 ft (128.2 m), at Mount Kerkeslin (Section AC–99).

The Peyto Formation thins westward, as well as eastward, from a line along strike through Lake Louise (Fig. 16), near the Trans-Canada Highway, and is missing, at least locally, at Vermilion Pass, Mount Odaray, Mount Stephen, and Mount Field. At the last two localities, thin limestone lenses with a *Bonnia-Olenellus* Zone fauna, interbedded with sandstone at the top of the Gog Group, have been referred to the Peyto Formation (e.g., McIlreath, 1977), but no obvious or mappable carbonate lithosome is present. It has long been uncertain whether the westward thinning of the Peyto was depositional, or due to erosion at the sub-Middle Cambrian unconformity. The answer is found in outcrops, located in a gully above a waterfall, along the railroad track 2 km (1.2 miles) northeast of Field (and thus west of the sections in which the Peyto is missing). In these outcrops, white crystalline dolomite (5 m/16.5 ft thick) at the top of the Gog quartzites (i.e., Peyto Formation) is overlain at a distinct erosional surface by the Naiset Formation. This westward reappearance of the Peyto Formation demonstrates that the Peyto is missing along the axis of the Kicking Horse Rim by erosion at the crest of a subtle anticlinal feature – the very feature earlier postulated to have localized the rim as expressed in Middle and Upper Cambrian strata.

The question as to whether a western "thin" may be regional, and not merely a feature of the Trans-Canada transect, is raised by the fact that the Peyto Formation section at Mount Clemenceau (AC–163), is only 57 ft (17.4 m) thick. Further work is required on this question, if indeed suitable exposures are available for study.

Paleontology and age

All fossils collected from the Peyto Formation belong to the latest Lower Cambrian, *Bonnia-Olenellus* Zone.

Interpretation

Most of the Peyto Formation fits perfectly a model of a gently sloping, high-energy, low-latitude, carbonate ramp. The more basinward beds were deposited in part below fairweather wave-base, while shoreward, the coarse grainstones intertongue with high-energy, littoral quartz sandstones. It is interesting that sandstones within the Peyto Formation are coarser than is typical for sub-Peyto sandstones. Clearly, the Peyto platform was exposed to open-sea wave and current energy; no significant Kicking Horse Rim existed during Peyto deposition (Fig. 9).

The northern, low-energy lagoonal facies poses a distinct problem. Hockley (1973) concluded that it accumulated in a shoreline embayment cut off from the open sea by bars or shoals that initially consisted of siliciclastic sand and later of carbonate sand. This satisfactory hypothesis is illustrated in Figure 9.

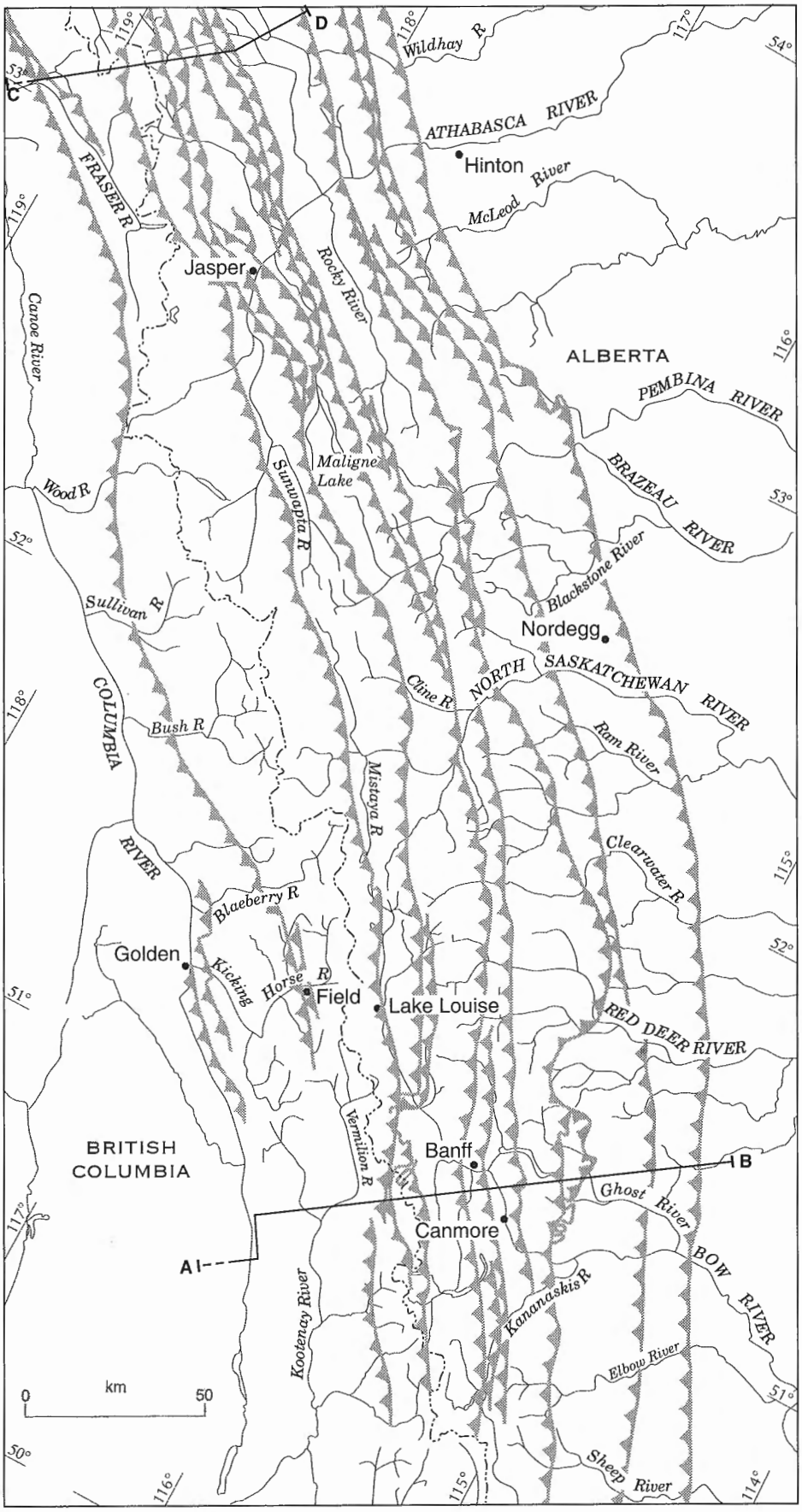


Figure 15. *Regional map, showing major thrust faults. This map was used as the base for the palinspastic restorations in Figures 23, 48, 49, 58, 78, and 84.*

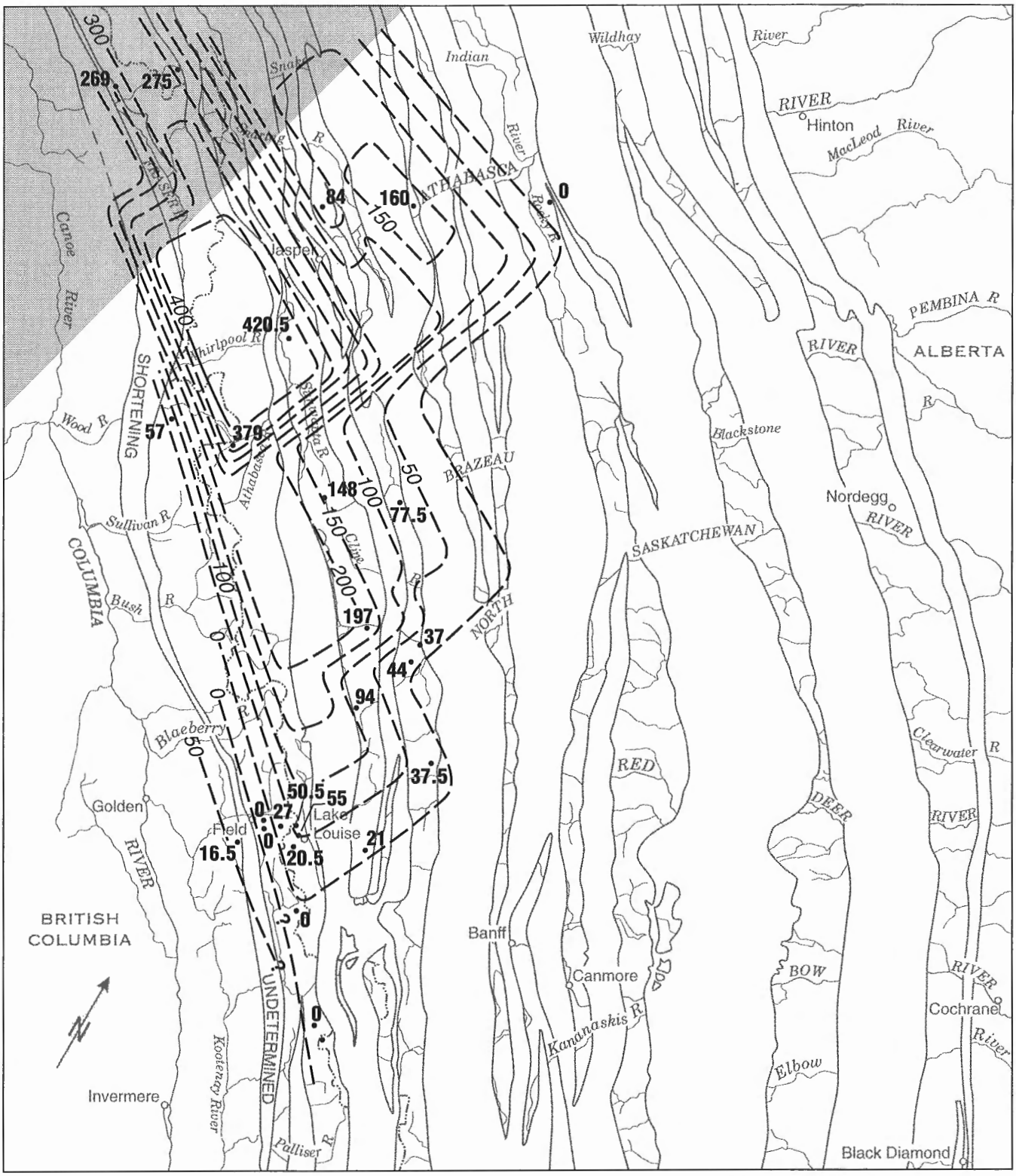


Figure 16. *Isopach map of the Peyto and Hota (shaded area) formations. (Palinspastic restoration based on Fig. 15.)*

Recommended sections

In addition to the reference section at Mount Weed, the following reasonably accessible sections are recommended as providing a good composite, regional impression of the Peyto Formation.

Park Boundary section

Section AC–41, on the south-facing wall of the valley of the North Saskatchewan River at the east boundary of Banff National Park, provides superb exposures of a thick Peyto section (197 ft/60 m) that displays nearly all of the characteristic rock types.

Whirlpool Point

The easternmost aspect of the Peyto Formation, as it passes by facies change into uppermost Gog Group sandstones, is easily viewed in the roadcuts at Whirlpool Point on Highway 11. At this locality, the formation is only 25 ft (7.6 m) thick, and consists entirely of sandstone, sandy dolomite and dolomite, partly oolitic and glauconitic.

Mount Kerkeslin

The lagoonal facies of the Peyto Formation is exposed in the thickest known section of the formation (420.5 ft/128.2 m), at Mount Kerkeslin. The section is visible from the Banff – Jasper Highway at Athabasca Falls, and is reached by a steep scramble of about 900 m (3 000 ft). En route, the limestones of the Mural Formation are crossed, about 215 m (700 ft) below the top of the Gog sandstones.

Eiffel Peak

The southern aspect of the Peyto Formation can be examined in the southern cliffs of Eiffel Peak and Pinnacle Peak, accessible by walking trails (about 2 hours) from Moraine Lake.

Hota Formation

The Hota Formation of the Mount Robson district (Walcott, 1913, 1928) is the lithostratigraphic and chronostratigraphic equivalent of the Peyto Formation (Fritz and Mountjoy, 1975). Fritz and Mountjoy pointed out that the name has priority over "Adolphus Formation" (Burling, 1923); the latter term is thus obsolete.

Adolphus Formation

Fritz and Mountjoy (1975) concluded that the name "Adolphus Formation" of Burling (1923) is a junior synonym of the Hota Formation and recommended, appropriately, that it be suppressed.

Mumm Formation

Burling (1923) established that the name "Mumm Formation" of Walcott (1913) was a synonym for the "Adolphus Formation" [Hota Formation]. Burling's arguments appear to have been accepted by Walcott, inasmuch as the Mumm is not mentioned in the latter's synthesis of 1928.

Mount Whyte Formation

Definition

The Mount Whyte Formation (Figs. 6, 7, 17, 30, 31, 32), is a recessive weathering to ledgy, mappable unit of shale, siltstone, and minor sandstone, interrupted by limestone beds of various kinds. It is Middle Cambrian in age, and overlies sandstones of the Gog Group in the east and carbonate strata of the Peyto Formation in the west. A widely applicable division into lower, Weed, and upper, Chephren, members is proposed here.

Origin of names

The Mount Whyte Formation was named by Walcott (1908a) from a type locality near Lake Louise, given as, "Mt. Whyte, above Lake Agnes, and eastern slope of Popes Peak, southwest of Mt. Saint Piran."

The Weed Member (new) is named after Mount Weed, designated here as the type section of the member and reference section for the formation. The Chephren Member (new) is named after Mount Chephren, 13 km (8 miles) northwest of its type section at Mount Weed.

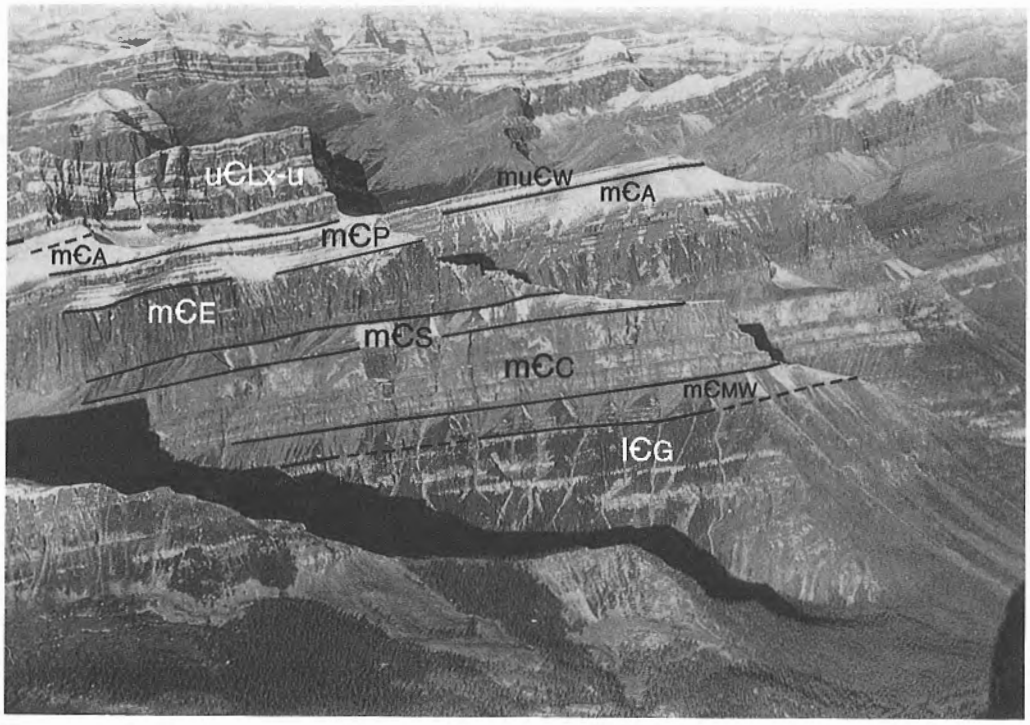


Figure 17. *The Middle Cambrian section at Escarpment River.* lЄG*–Gog Group (including thin Peyto equivalent at the top);* mЄMW*–Mount Whyte Formation;* mЄC*–Cathedral Formation (the two thin, dark-weathering members in the lower half are the Ross Lake and Trinity Lakes members);* mЄS*–Stephen Formation;* mЄE*–Eldon Formation;* mЄP*–Pika Formation;* mЄA*–Arctomys Formation;* muЄW*–Waterfowl Formation;* uЄLx-u*–Lynx Group (upper division). ISPG photo 1518-51.*

Type and reference sections

Rasetti (1951, p. 56-58) considered at length Walcott's ambiguous indication of the type section at Mount Whyte, and which of the two sections described by Walcott would be suitable as type. Having rejected Deiss' (1939) improper proposal to transfer the type section to Ptarmigan Peak, Rasetti (op. cit., p. 57) designated the type section as follows: ". . . in the immediate vicinity of the Plain of Six Glaciers, 1 1/2 miles southwest of the upper end of Lake Louise . . . . the formation is exposed on both sides of the gully between Popes Peak and Mount Whyte."

Given the history of the formation, Rasetti's choice was an excellent one; the section designated as type is accessible, easily identified on the ground, adequately fossiliferous, and representative of the relationships with overlying and underlying formations. It is clearly one of the localities that Walcott had in mind.

Rasetti's description of the type section for the Mount Whyte Formation is presented below, side-by-side with my redescription. It will be noted that the unit-for-unit correspondence of the two descriptions is good. The differences mainly reflect Rasetti's dominating interest in paleontology and biostratigraphy and my prevailing interest in lithostratigraphy and sedimentology. (Rasetti's fossil lists are complete, and hence are not duplicated.) Part of the difference in the thicknesses given arises from the amendment of the definition of the upper contact in this report.

Type section of the Mount Whyte Formation

Rasetti (1951)

CATHEDRAL FORMATION

Unit No.	Lithology	Thickness feet (m)
1	**Dolomite**: crystalline, light grey, tan weathering, thick bedded; with lenses of undolomitized dark grey limestone.	295 (89.9)
	Contact with overlying Cathedral Formation well marked.	
	MOUNT WHYTE FORMATION (211 ft/64.3 m) (lat. 51°24′00″N, long. 116°15′15″W)	
9	**Limestone**: finely crystalline or oolitic, dark grey with tan clay partings and flakes; in irregular beds 1 to 6 inches thick	45 (13.7)
8	**Shale** and **limestone** Thin alternating layers of grey, subcrystalline limestone and grey, siliceous shale	20 (6.1)
7	**Limestone**: as Unit 9	10 (3)
6	**Shale** and **limestone** As Unit 8	24 (7.3)
5	**Limestone**: as Unit 9. Contains fragments of trilobites (Locality W3c)	12 (3.7)
	Fossils: *Amecephalus cleora* (Walcott) *Plagiura cercops* (Walcott)	
4	**Shale** and **limestone** As Unit 8, mostly shale in lower third	73 (22.25)
	(Lake Agnes shale lentil: type locality)	
3	**Shale**: siliceous, very fine grained, fissile, green-blue-grey, highly fossiliferous (Locality W3b)	5 (1.5)
	Fossils: *Acrotreta* sp. *Amecephalus agnesensis* (Walcott), 1912 *Poliella prima* (Walcott), 1908 *Syspacephalus perola* (Walcott), 1917 *Wenkchemnia walcotti* Rasetti, 1951	
2	**Shale** and **limestone** Siliceous, grey shale with thin, nodular beds of fine grained, grey limestone. A limestone nodule yielded fragments of *Amecephalus*	6 (1.8)
1	**Shale**: siliceous, fine grained near base, coarser in upper part, green-grey.	16 (4.9)
	ST. PIRAN SANDSTONE	
	Peyto Member	
1	Sandstone: calcareous and limonitic; grading into sandy limestone near the top. The more calcareous layers are filled with Bonnia and olenellid fragments.	20 (6.1)
	Underlain by brown and purple, thick bedded sandstone	

Aitken (this study)

CATHEDRAL FORMATION

Unit No.	Lithology	Thickness feet (m)
3	**Dolomite**: pale grey, weathers partly pink-buff, partly grey, fine and medium crystalline, fenestral fabric prominent	not measured
2	**Limestone**: fine skeletal wackestone/packstone with subordinate dolomitic ooid grainstone; irregularly thin bedded. At several levels, widely spaced loaf-to mushroom-shaped thrombolites	21 (6.4)
1	**Limestone**: skeletal packstone/wackestone; nodular below, becoming nodular thin bedded upward, with wispy partings of tan weathering argillaceous dolomite. Grades upward to parted lime mudstone, partly medium bedded.	13 (4)
	MOUNT WHYTE FORMATION (193 ft/58.8 m)	
11	**Limestone** and **siltstone** (thinly interbedded) As Unit 9. Top 3 ft (0.9 m) of strata intergrade with the overlying unit. Local lenses of oncoid floatstone	16 (4.9)
10	**Limestone**: thrombolitic; a nonbedded mass in which many pillow shaped thrombolites are embedded in nodules of skeletal wackestone with argillaceous dolomite partings	10 (3)
9	**Siltstone** and **shale** (thinly interbedded) As Unit 7. 15 per cent thin lenticular beds of skeletal ooid grainstone and very fine skeletal grainstone/calcisiltite. 6 and 13 ft (1.8 and 4 m) above base, 8 cm thick beds of oncoid floatstone/rudstone; oncoids to 2 cm diameter in a skeletal packstone matrix. Shale diminishes upward; unit becomes silty calcisiltite and crosslaminated siltstone, thinly and lenticularly interbedded	27 (8.2)
8	**Limestone**: fine ooid grainstone/packstone and oolitic skeletal grainstone/packstone; irregularly, indistinctly, medium bedded, massive. Several beds contain flat pebbles of siltstone	9.5 (2.9)
7	**Shale** and **siltstone** (thinly interlaminated) **Shale**: green. Siltstone: grey, calcareous, grading to silty calcisiltite. Beds generally 1 to 2 cm; a few beds of siltstone up to 7 cm. Feeding burrows and trails well developed	17.5 (5.3)
6	**Siltstone** (60%) and **limestone** (40%) (interlaminated, varve-like) Siltstone: pale green, calcareous, argillaceous. Limestone: grey, silty calcisiltite, partly skeletal, in lenticular laminae. Green micaceous bedding planes reveal many feeding burrows and trails. In top 4 ft (1.2 m), a few lenticular beds, up to 8 cm thick, of skeletal ooid grainstone: dolomitic, poorly sorted, with rare oncoids. Top of unit supports spheroidal thrombolites up to 30 cm high	41 (12.5)
5	Covered	9.5 (2.9)
4	**Shale** (argillite): green, compact, non-fissile (except where slaty), olive weathering, cliff forming. Trilobites abundant at the base. Scattered nodules of dense limestone in upper half. Near the top, the shale acquires fine, varve-like, calcareous laminae	28.5 (8.7)
3	Massive unit of **limestone nodules** (extended in plane of bedding), rarely exceeding 2 cm thickness, with partings of siltstone: grey, green, shaly, calcareous, bioturbated, rusty weathering. Limestone is oolitic skeletal wackestone	6.5 (2)
2	**Sandstone** (75%) and **Shale** (25%) Sandstone: thin and medium beds, grey and green-grey, very fine grained, well sorted, calcareous, richly skeletal (trilobite fragments). Lenses of trilobite coquina and medium grained sandstone. Shale: as below, green, thin and medium beds	24.5 (7.5)
1	**Shale**: pale green, compact, slaty.	

Unit No.	Lithology	Thickness feet (m)
	GOG GROUP	
	PEYTO FORMATION (20.5 ft/6.2 m)	
2	**Limestone:** hyolithid-trilobite packstone/wackestone with calcisiltite matrix; dolomitic; abundant irregular laminae of fine quartz sand and thin interbeds of green shale	4 (1.2)
1	**Dolomite:** grey, fine, equicrystalline, sandy to very sandy, with abundant "floating" oncoids up to 2 cm in diameter; nonbedded, massive, cliff forming, rusty weathering. Local relict masses of limestone, and oncoid floatstone. Oncoids supported by very sandy skeletal packstone.	16.5 (5)

Underlying beds

Sandstone: patchily calcareous, pale grey, mottled with pale brown, weathers grey and cream-coloured, fine grained, well sorted, crosslaminated, thick bedded, resistant.

In the vicinity of the type section the Mount Whyte Formation is rather thin and its topographic expression is weak compared to sections to the north. Furthermore, neither the Weed Member nor the limestones typical of the formation regionally are well developed. For these reasons, the section at Mount Weed (AC–171), continuous with the reference section of the Peyto Formation, is hereby designated the principal reference section for the Mount Whyte Formation and the type section of the Weed and Chephren members (Fig. 6).

Reference section for the Mount Whyte Formation and type section of its Weed and Chephren members; lower slopes of Mount Weed, above the Banff–Jasper Highway

Section AC–171

(lat. 51°47′06″N, long. 116°32′17″W)

CATHEDRAL FORMATION

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
3	**Dolomite:** ex-parted lime mudstone; grey, white, with dark grey mottling, weathers greyish orange, fine and locally medium crystalline, locally vuggy, indistinct thin and medium bedding	19 (5.8)	65 (19.8)
2	**Limestone:** skeletal wackestone at the base, irregularly thin bedded, parted; passing upward into mainly burrow-mottled lime mudstone with minor parted lime mudstone; minor beds of dark-pellet grainstone; scattered oncoids. Replacement contact with dolomite at the top crosses at least 19 ft (5.8 m) of strata	35 (10.7)	46 (14)
	GSC loc. 87992 (12 ft/3.7 m above base) *Paralbertella* sp.		
	Albertella Zone		
1	**Limestone:** parted lime mudstone grading to skeletal wackestone.	11 (3.4)	11 (3.4)
	Contact gradational, interbedded.		

MOUNT WHYTE FORMATION
(415.5 ft/126.6 m)
(Reference section)

The Mount Whyte Formation supports a ribbed topography, formed by resistant limestone units alternating with recessive weathering units of fine grained clastic strata.

Chephren Member
(263.5 ft/80.3 m)
(Type Section, Units 2 to 23)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
23	Covered: recessive weathering	8 (2.4)	415.5 (126.6)
22	**Limestone:** as Unit 16	6 (1.8)	407.5 (124.2)
21	Poorly exposed. **Shale:** as below; with subordinate thin beds of limestone: as below	8 (2.4)	401.5 (122.4)
20	**Limestone:** as Unit 16	3 (0.9)	393.5 (119.9)
19	**Shale:** with lenses of limestone. As Unit 17. One 2.5 cm thick bed of skeletal wackestone	7 (2.1)	390.5 (119)
18	**Limestone:** oncoid floatstone; scattered oncoids supported by skeletal wackestone; dolomitic	1.5 (0.5)	383.5 (116.9)
17	**Shale:** as below; with lenses of limestone (?calcisiltite)	3.5 (1.1)	382 (116.4)
16	**Limestone:** trilobite wackestone; thin bedded	3 (0.9)	378.5 (115.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 87991 (2 ft/60 cm above base) *Amecephalus* sp. *Fieldaspis* cf. *F. celer* (Walcott) *Kochaspis*? sp.		
	"*Plagiura-Poliella*" Zone		
15	**Shale**: as below. In the middle, one 5 cm thick bed of limestone: as below	10 (3)	375.5 (114.5)
14	**Limestone**: as Unit 12; oncoids prominent, matrix argillaceous	5.5 (1.7)	365.5 (111.4)
13	**Shale/slate**: grey, weathering green-grey	0.5 (1.7)	360 (109.7)
12	**Limestone**: nodular trilobite wackestone; argillaceous, with minor intervals of oncoid floatstone	5 (1.5)	354.5 (108.1)
11	**Shale/slate**: brown to greenish grey, partly calcareous, recessive weathering	5 (1.5)	349.5 (106.5)
10	**Limestones** (heterogeneous) At the base, silty calcisiltite, grading upward to thin and medium bedded trilobite-echinoderm packstone/grainstone, partly oolitic. Several medium beds of oncoid packstone. Locally, 2 ft (0.6 m) of dolomitized beds at the top. Thrombolites reported by Hockley (1973)	53 (16.2)	344.5 (105)
	GSC loc. 87990 (41 ft/12.5 m above the base) *Nyella* sp. *Coreospira* sp. *Poliella* sp.		
9	**Limestone**: mainly ooid grainstone/packstone, thin to thick lenticular bedded, resistant. Gradational into overlying unit	23 (7)	291.5 (88.8)
8	**Limestone** and **siltstone** (very thinly interbedded to interlaminated) Limestone: calcisiltite, partly silty, argillaceous. Siltstone: calcareous, argillaceous, crosslaminated. Feeding traces prominent on bedding planes. Thin and medium beds and lenses of trilobite packstone and wackestone increase upward	28 (8.5)	268.5 (81.8)
	GSC loc. 87989 (11 ft/3.4 m above the base) *Kochaspis*? sp. *Plagiura* sp.		
7	**Limestone**: silty calcisiltite; thin bedded, with silty dolomitic partings; minor thin beds of ooid grainstone/packstone; thin bedding interrupted by stromatolitic thrombolite masses 0.5 to 6 ft (0.15 to 2 m) in diameter	19 (5.8)	240.5 (73.3)
	GSC loc. 87988 (11 ft/3.4 m above the base) *Amecephalus* sp. *Plagiura* sp.		
6	Covered: recessive weathering	12 (3.7)	221.5 (67.5)
5	**Limestone**: ooid grainstone, commonly very coarse grained, thin to thick bedded, massive. Minor skeletal grainstone/packstone. Near the top, some very coarse brachiopod grainstone in medium beds	16 (4.9)	209.5 (63.9)
	GSC loc. 87987 (1 ft/30 cm below the top) *Nisusia* sp. *Plagiura*? sp.		
	GSC loc. 87986 (4 ft/1.2 m above the base) cf. *Kochina* sp. *Onchocephalus*? sp. *Wimanella* sp.		
4	**Limestone**: mainly thin bedded calcisiltite with silty dolomitic partings. Minor ooid grainstone at the base	11 (3.4)	193.5 (59)
3	**Limestone**: massive unit of stromatolitic thrombolites	7 (2.1)	182.5 (55.6)
2	**Limestone**: mainly calcisiltite; partly silty, very thin bedded; partings of siltstone common. Minor flat-pebble rudstone.	23.5 (7.2)	175.5 (53.5)
	Abrupt but gradational contact.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Weed Member (152 ft/46.3 m) (Type section)		
1	**Siltstone**: greenish grey, calcareous, argillaceous, micaceous; minor sandstone: very fine grained, thin and very thin bedded and laminated; minor partings of shale: greenish grey, laminated, partly calcareous. Feeding burrows and general bioturbation prominent throughout. At 141.5, 143.5, and 154 ft (43.1, 43.7, and 46.9 m) above the base, medium, lenticular beds of limestone, ooid grainstone and rudstone.	152 (46.3)	152 (46.3)
	Erosional contact.		
	GOG GROUP		
	PEYTO FORMATION (113.5 ft/34.6 m) (Reference section)		
	Except for thin shale units near the top, the Peyto Formation is resistant, and forms a marked topographic rib.		
11	**Sandstone, shale,** and **limestone** (intermixed) Sandstone: grey, quartzose, very fine grained. Shale: green-grey, calcareous, appearing rotten. Limestone: sandy, trilobite grainstone. Near the base and in the middle, the sandstone occurs in decimetre-scale pods. This suggests that the sand was introduced into solution-openings in the limestone, and that the unit has been altered by weathering at the sub-Mount Whyte contact	6 (1.8)	113.5 (34.6)
	GSC loc. 87985 *Olenellus* sp. *Onchocephalus* sp.		
	GSC loc. 89440 *Olenellus* sp. *Onchocephalus* sp.		
10	**Shale**: olive, silty, fissile, noncalcareous	17.5 (5.3)	107.5 (32.8)
9	**Limestone**: mainly ooid and skeletal grainstone; irregularly thin bedded	16 (4.9)	90 (27.4)
	GSC loc. 87984 *Olenellus* sp. *Onchocephalus* sp.		
	GSC loc. 87983 *Antagmus* sp. *Bonnia fieldensis* (Walcott), 1916 *Micromitra* sp. *Olenellus* sp. aff. *Syspacephalus ?uncus* (Walcott), 1917		
	GSC loc. 87982 *Bonnia fieldensis* (Walcott), 1916 *Olenellus* sp. *Paterina* sp. aff. *Syspacephalus ?uncus* (Walcott), 1917		

Weed Member

The Weed Member typically forms a single moderately to strongly resistant unit at the base of the Mount Whyte Formation or, near Jasper, the base of the Snake Indian Formation (Fig. 8). It consists mainly of quartz siltstone and minor very fine grained sandstone which are grey and greenish grey, argillaceous, and partly calcareous. Minor glauconite is present at eastern localities. Laminae containing abundant comminuted phosphatic brachiopod debris and sparse trilobite fragments are common. Planar to irregular, coarse lamination and very thin bedding are emphasized by partings, laminae, and thin interbeds of shale. The shale is greenish grey to deep green and calcareous in part. Minor intervals of purple-red shale occur at shoreward (northeastern) localities. At sites close to the Kicking Horse Rim, laminae are planar and regular, or varve-like (Figs. 18, 19). Elsewhere, intense bioturbation has produced irregular lamination. Well developed burrows and feeding trails characterize the member (Figs. 20-22). Most inorganic primary sedimentary structures have been destroyed, and small-scale ripple marks and crosslamination are seen only locally.

Grain-size variation in the Weed Member follows a distinct pattern. The localities at which sandstone predominates over siltstone occur along a shoreward, westwardly concave arc from Lake Louise to Mount Henry (Section AC–164). West of this arc, the member contains little sand, and units of shale interrupt the siltstones. A parallel change is noted in the trace fossils; feeding burrows at eastern localities (Ghost River and Martin Lake, Sections AC–109, AC–140) were made by organisms much larger than those at the central and western sites (Fig. 22).

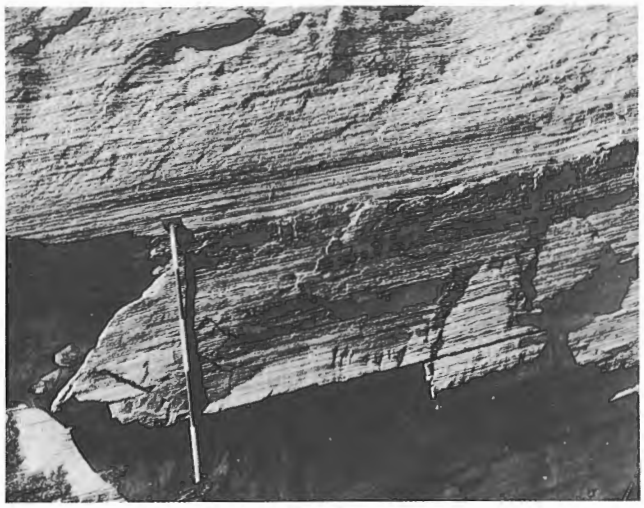


Figure 18. *Varve-like bedding in siltstone/shale couplets of the Weed Member of the Mount Whyte Formation at Mount Bosworth. Jacob's staff is graduated in feet. ISPG photo 1994-5.*

The predominant, detrital strata of the member are interrupted by minor lenses, laminae and thin beds of limestone, mainly silty calcisiltite, and, less commonly, fine grained skeletal grainstone. In a few sections, thin and medium beds of ooid grainstone associated with flat-pebble rudstone are present near the top.

The Weed Member is best developed at localities along the Banff-Jasper Highway and northwestward along strike to the Mount Robson district (as the Weed Member of the Snake Indian and Chetang formations). Northeastward, or shoreward, tongues of strata identical to the Weed Member, appear progressively higher in the Mount Whyte Formation, and the definition of an upper contact for the Weed Member becomes difficult. Alternatively, the entire Mount Whyte interval at such localities might be assigned to the Weed Member. A similar situation obtains at the type section of the Mount Whyte. It is preferable not to divide the Mount Whyte into members where the upper contact of the Weed Member is not reasonably distinct.

Chephren Member

The Chephren Member is a recessive weathering or ledgy unit, consisting of alternating siliciclastic and limestone units, between the Weed Member and the cliff-forming carbonate strata of the Cathedral Formation. The siliciclastic units are shale – mainly greenish grey, but also grey and grey-brown and calcareous in part – and subordinate siltstone, similar to that of the Weed Member. Some purple-red shale appears at eastern localities. The limestones are varied and, in order of diminishing importance, comprise:

Figure 19. *Varve-like bedding in siltstone/shale couplets in the Weed Member of the Mount Whyte Formation at the Cinnamon Peak/Whitehorn Mountain section (Section AC–165). Jacob's staff is graduated in feet. GSC photo 5-5-66.*

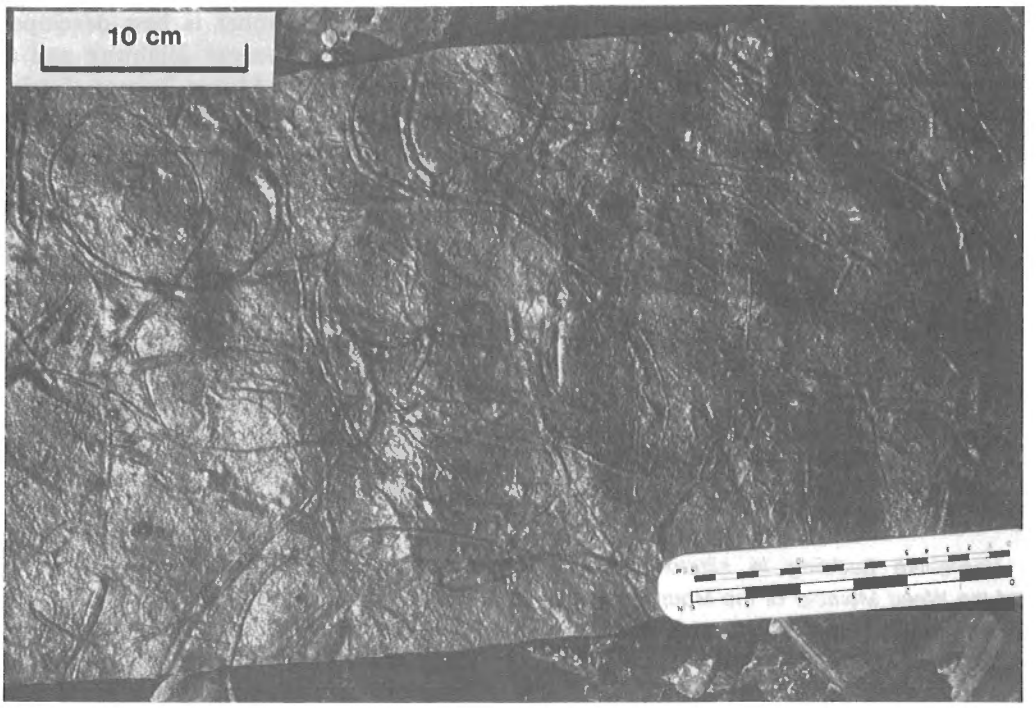


Figure 20. *Feeding traces in the Weed Member of the Mount Whyte Formation at Ross Lake. ISPG photo 1569-14.*

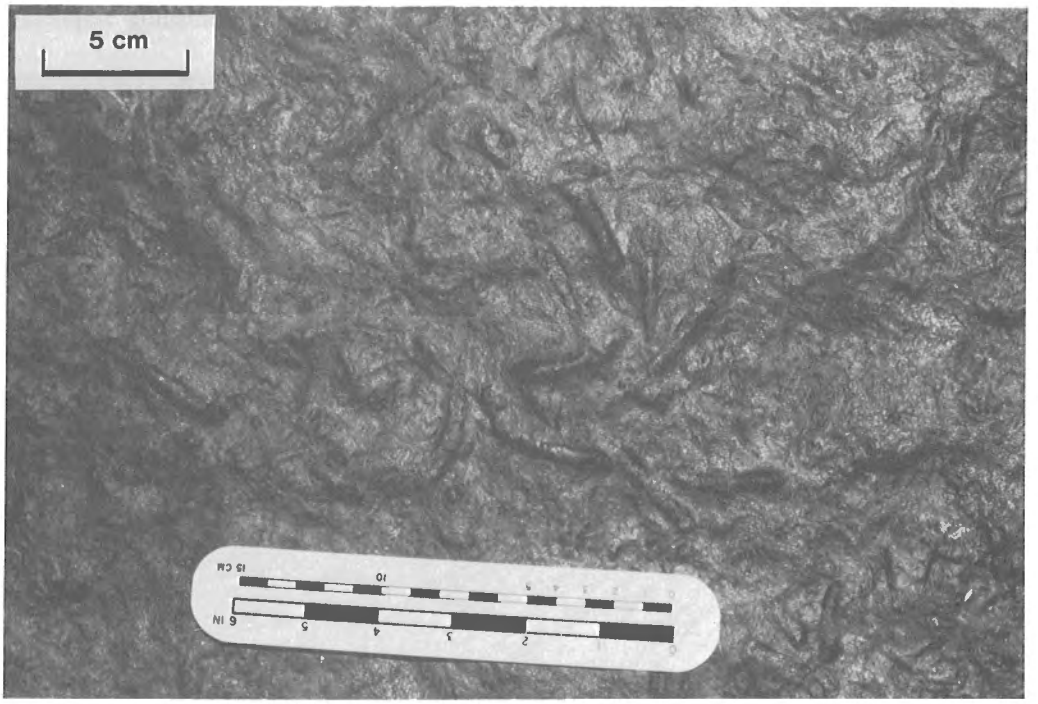


Figure 21. *Feeding traces of different organism than that illustrated in Figure 20; Weed Member of the Mount Whyte Formation at Ross Lake. ISPG photo 1569-12.*

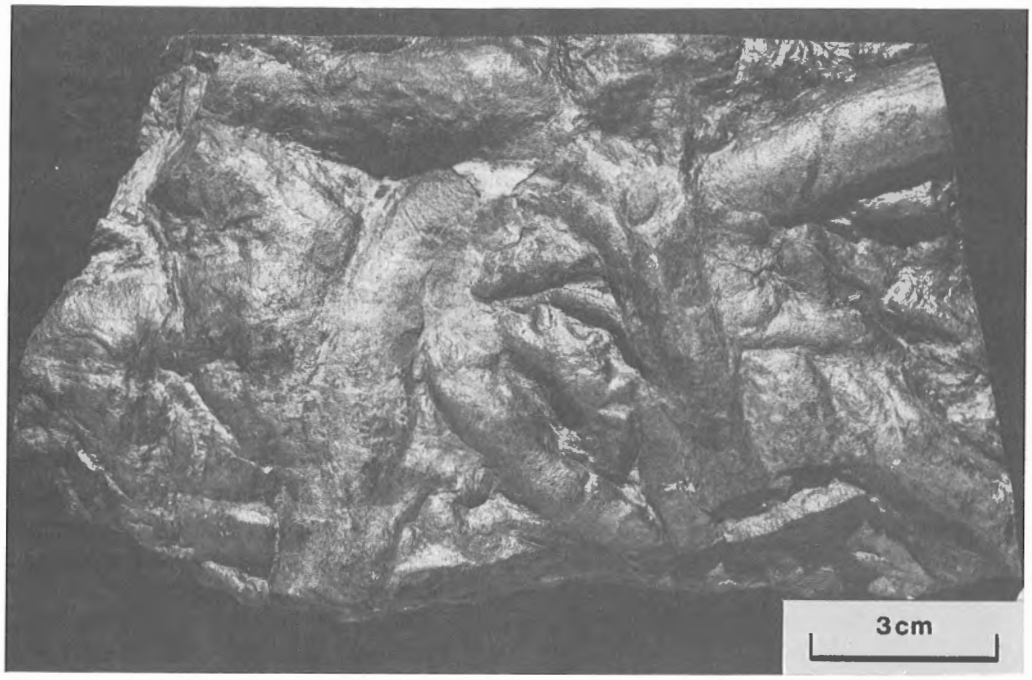


Figure 22. *Feeding traces; Mount Whyte Formation at Ghost River. ISPG photo 786-10.*

calcisiltite, commonly silty, crosslaminated and burrowed; ooid grainstone; skeletal grainstone, packstone and wackestone; parted and burrow-mottled lime mudstone; flat-pebble rudstone; and thrombolites and algal stromatolites (Fig. 23). Oncoids commonly occur at several levels. Dolomitized limestone is local and minor.

Much of the Chephren Member can be subdivided into repetitive, shallowing- and clearing-upward subcycles (cycles of upward-diminishing siliciclastic content). These subcycles are in all respects identical to subcycles (described fully under "Stephen Formation") characteristic of the Stephen and Pika formations and the Ross Lake and Trinity Lakes members of the Cathedral Formation.

Recognition of the Chephren Member depends upon the presence of a definable Weed Member. The two members are thus coextensive, except for those most westerly localities at which the Weed Member represents the entire Mount Whyte Formation.

Contacts

At most localities where the Mount Whyte Formation rests on carbonate strata of the Peyto Formation, the base of the Mount Whyte is abrupt and easily recognized beneath the burrowed siltstones of the Weed Member, or similar and equivalent siltstones and sandstones of the undifferentiated Mount Whyte. Locally, where the uppermost Peyto or basal Mount Whyte beds are shale, a few feet of shale at the contact may be of doubtful assignment, unless fossiliferous.

Rasetti (1951, p. 54) set forth clearly the arguments for an unconformity at the base of the Mount Whyte Formation:

1. The sharp faunal change across the contact, and the complete absence of a transitional fauna.

2. The abrupt change in rock type.

3. Evidence that the formation was deposited on a "somewhat irregular surface," namely (op. cit., p. 60; see also his Figure 5), "The paleontologic evidence seems to indicate that the youngest beds of the formation are approximately of the same age everywhere, while older strata that are present in the thicker sections are absent where the formation is thinner."

The following arguments now can be added to the list:

4. Physical evidence of erosion beneath the Weed Member at Mount McDonald (Section AC-94) and Mount Kerkeslin (Section AC-99), cited by Hockley (1973).

Figure 23. *Stromatolites in the Chephren Member of the Mount Whyte Formation at Loudon Creek (Section AC–45). ISPG photo 758-2.*

5. Evidence of tectonic movement following deposition of the Peyto Formation (this report).

6. The marked sub-Middle Cambrian unconformity, demonstrated by Palonen (1976), which progressively cuts out the upper third of the Gog Group southward to Mount Assiniboine.

The intent of Walcott (1908a, 1928) as to criteria for placement of the Mount Whyte/Cathedral contact can only be guessed at from his described sections, and this is further complicated by the fact that Walcott frequently did not distinguish between limestone and dolomite. In a number of sections, he placed the contact well above the highest siliciclastic beds, at the top of beds described as oolitic limestone and beneath beds that would be described in this report as mottled lime mudstone or derived dolomite.

Deiss (1939, p. 999, 1000) emended Walcott's sections by removing the "Ptarmigan Limestone" (basal limestone interval of the Cathedral Formation) from the top of the Mount Whyte Formation, and placing the Mount Whyte/Cathedral contact at the top of the highest siliciclastic bed or unit. He thus arrived at the criterion adopted here, which is unaffected by the degree to which the supposed Lower Cambrian age of the Mount Whyte (i.e., Deiss, 1939, 1940) is introduced into Deiss' definition.

Rasetti (1951) rejected Deiss' arguments *in toto*, and consistently placed the Mount Whyte/Cathedral contact where limestone was succeeded upward by dolomite, despite the fact that he recognized that this change "does not follow the bedding planes" (op. cit., p. 62). Although the change from limestone to dolomite is objective and easily observed, even at a distance, it records diagenesis rather than deposition and is unsuitable for ordinary geological mapping purposes. In fact, because certain sections of the Cathedral Formation are completely undolomitized it is, at least locally, inapplicable.

The most suitable contact criterion for modern stratigraphic and mapping purposes embodies the idea of Deiss; that is, to place the Mount Whyte/Cathedral contact at the top of the highest bed of shale or siltstone (including shale or siltstone partings in bedded limestone) underlying cliff-forming carbonate rocks. Because shaly tongues appear progressively higher in the Cathedral Formation toward the northeast, any unit comprising 100 ft (30 m) or more of cliff-forming carbonate strata has been excluded from the Mount Whyte and identified as basal Cathedral, except in one or two sections where limestone units between 100 and 200 ft (30.5 and 61 m) thick are overlain by thick shaly intervals of Mount-Whyte-like lithology. The Mount Whyte/Cathedral contact is, therefore, gradational by interbedding (intertonguing) and diachronous. At the type section, the contact is well below the lowest occurrence of *Albertella*. At the Mount Weed reference section, it is very close to the boundary between the *Plagiura–Poliella* and *Albertella* zones; and, at the mountain front (e.g., Sections AC–28/109), at least the upper part of the Mount Whyte Formation is in the *Albertella* Zone. *Albertella* also occurs within the Weed Member of the Snake Indian Formation at Chetamon Mountain (Mountjoy and Aitken, 1978). In the most westerly or basinward sections studied – Chaba River and Cinnamon Peak (Sections AC–143, AC–165) – the top of Mount Whyte lithological equivalents is again well down in the *Plagiura–Poliella* Zone.

Distribution and thickness

Variation in the thickness of the Mount Whyte Formation reflects the interplay of at least two

independent regional influences, and is thus difficult to interpret. Northeastward depositional thinning is more than offset by the rise in the Mount Whyte/Cathedral contact through facies change (Figs. 11-13, 24).

The maximum measured thickness of the Mount Whyte Formation is 618.5 ft (188.5 m) at Mount McDonald (Section AC–94). The formation is missing at Mount Odaray and Vermilion Pass (Section AC–53), apparently by depositional pinchout against early Kicking Horse Rim topography, and may be missing underground near the Monarch and Kicking Horse mines (Aitken, 1971). Northwestward, along strike, the part of the Snake Indian Formation equivalent to the Mount Whyte (Section AC–99) is 1147.5 ft (349.8 m) thick at Mount Kerkeslin, but, at Cinnamon Peak (AC-165), the Mount Whyte equivalent in the basal Chetang Formation is only 411 ft (125.3 m) thick. Westward thinning on to the Kicking Horse Rim is general; for example, 170 ft (51.8 m) at Chaba River and 219 ft (66.8 m) in Kicking Horse Pass (AC-122).

As discussed below, the basinal equivalent of the Mount Whyte Formation is lithologically distinct and is assigned to the Naiset Formation; thus, the Mount Whyte is not recognized southwest of the Kicking Horse Rim.

Paleontology and age

The Mount Whyte Formation is of early Middle Cambrian age. In the western part of the region it is entirely within the *Plagiura-Poliella* Zone, but eastward, toward the mountain front, it rises into the *Albertella* Zone.

Recommended sections

In addition to the type section and the reference section at Mount Weed, each of the sections recommended for the Peyto limestone provides good exposures of the Mount Whyte Formation (at Mount Kerkeslin, the formation overlying the Peyto Formation is the Snake Indian, but the Weed Member is very well developed).

Naiset Formation

Definition

Naiset Formation is the name applied to a Middle Cambrian unit of shale and mudstone, with minor siltstone, sandstone and limestone, lying between sandstones of the Gog Group and carbonate strata of the Cathedral Formation in the Mount Assiniboine region (Fig. 25). Although homotaxial and largely coeval with the Mount Whyte Formation, it is of outer-detrital aspect and position, and lithologically distinct. The name Naiset Formation is here extended to any and all basal Middle Cambrian, clastic-dominated units occurring in the Rocky Mountains west of the Kicking Horse Rim.

Origin of name

Deiss (1940) named the formation from its type section at Naiset Point, below Mount Assiniboine.

Type and reference sections

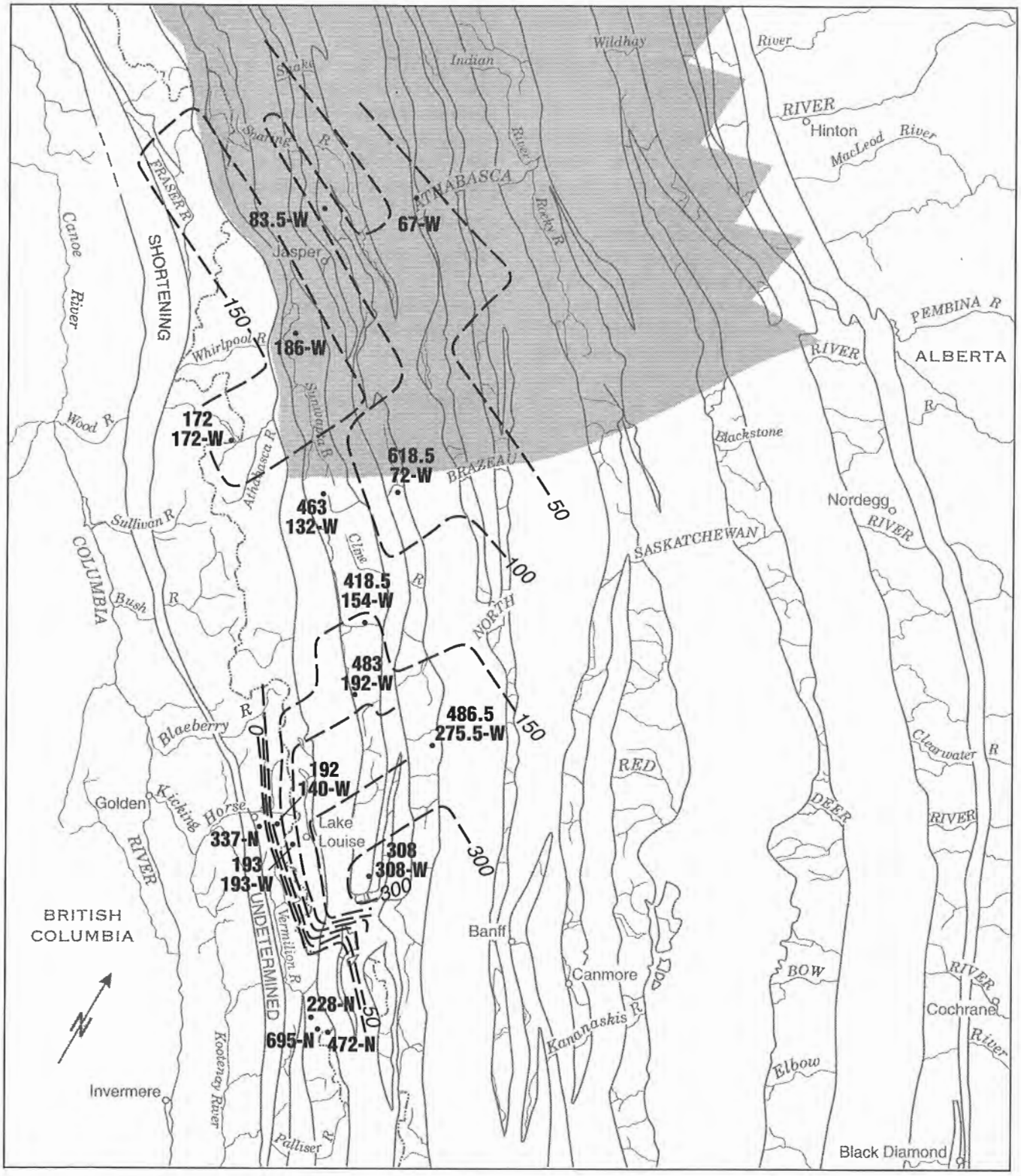
Deiss (1940) located the type section of the Naiset Formation (Section AC–105 of this report) "on the upper-middle part of the east side of Naiset Point." He illustrated the section in his Plate 3, figure 2. These exposures (Fig. 25) had been assigned by Walcott (1928, p. 296-299) to the Mount Whyte Formation. Naiset Point is correctly identified in Walcott's (op. cit.) Plate 58; the mountain identified in his Plate 59 is "The Towers".

I remeasured the type section along Deiss' route, and, despite a jumble of minor faults near the base, obtained a virtually identical thickness - 472 ft (143.9 m) compared to Deiss' 475 ft (144.8 m).

A much more satisfactory section (AC-103, Fig. 25) was studied on Wedgewood Peak, 1.8 miles (2.9 km) west of the type section, and is here designated a reference section. The section follows a bulge on the east side of the Wedgewood Peak/Sunburst Peak[1] ridge, where the base of the Naiset Formation, 0.4 miles (700 m) west of the southern tip of Lake Magog, lies roughly 1000 ft (305 m) above lake level (Fig. 25).

The reference section is thicker than the type section (695 ft versus 472-475 ft/211.8 m versus 143.9-144.8 m). The greater thickness probably reflects additional beds, at the base of the reference section, that are older than the basal beds at the type section. Unlike the type section, it is structurally undisturbed, and slaty cleavage is at most incipient. Partly because of this, the reference section has yielded more stratigraphically useful fossils than the type section.

[1]Sunburst Peak is the spectacular quartzite tower, elevation about 8900 ft (2713 m) that overlooks Sunburst Lake, at the terminus of the north ridge of Wedgewood Peak. It is illustrated in Walcott's (1928) Plate 61.



Measured thickness, Mount Whyte Fomation (feet) **193**
Measured thickness, Weed Member (feet) **140-W**
Measured thickness, Naiset Formation (feet) **228-N**
Isopach of Weed Member (interval 50 ft) . . . . . .

Figure 24. *Isopach map of the Weed Member, and thickness measurements of the Mount Whyte and Naiset formations. (Palinspastic restoration based on Fig. 15.) In the shaded area, Mount Whyte equivalents are part of the Snake Indian Formation.*

Finally, the base of the Naiset Formation at the reference section is easily traced to Sunburst Peak, where its erosional nature is well displayed. A complete Cathedral and Stephen section can be traversed above the reference section.

The reference section offers no severe mountaineering difficulties, but the use of a rope is advisable for a few difficult pitches.

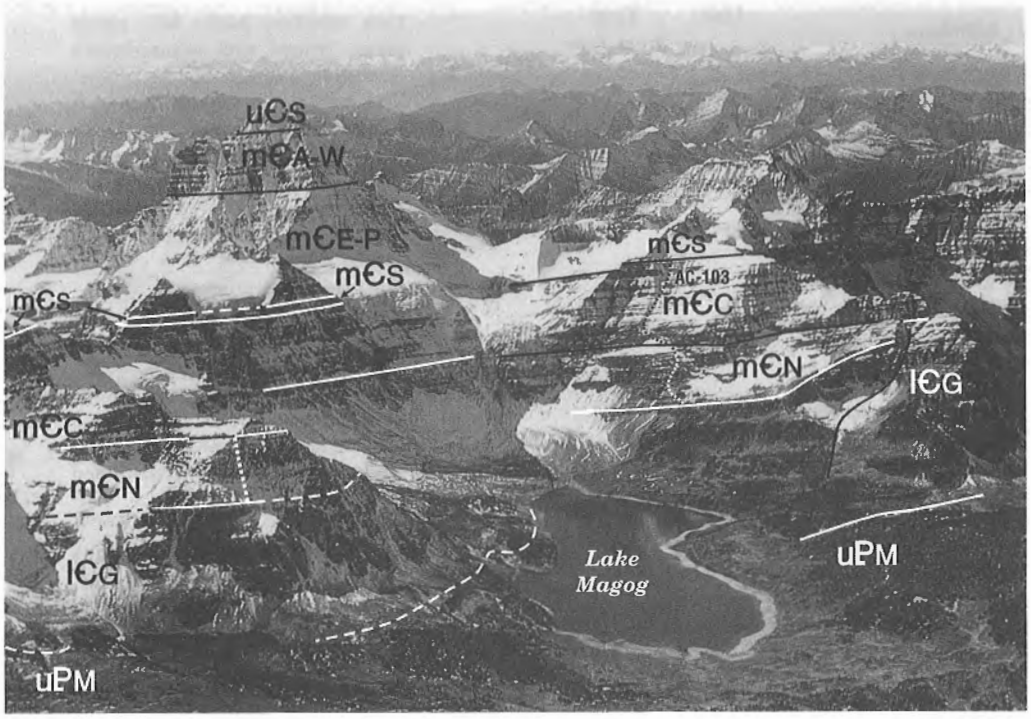


Figure 25. *The Mount Assiniboine massif, viewed southwestward across Lake Magog, showing the Cambrian succession.* uPM*–Miette Group;* lЄG*–Gog Group;* mЄN*–Naiset Formation;* mЄC*–Cathedral Formation;* mЄS*–Stephen Formation;* mЄE-P*–Eldon and Pika formations, undivided;* mЄA-W*–Arctomys and Waterfowl formations, undivided;* uЄS*–Sullivan Formation. Dotted line at left marks the type section of the Naiset Formation; dotted line at right marks the reference section (Section AC–103). ISPG photo 1518-88.*

Type section of the Naiset Formation on the east side of Naiset Point

Section AC-105

(lat. 50°53′40″N. long. 115°36′40″W)

CATHEDRAL FORMATION

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
4	**Limestone**: dolomitic, entirely fine to coarse ooid grainstone/packstone, in irregular, massive, medium beds, weathers dark grey, cliff forming. Large pods are altered to dolomite: pale yellow-grey, yellow weathering, fine crystalline, with relict oolitic texture		
3	**Limestone**: parted lime mudstone with silty partings; interrupted by stromatolitic masses up to 1 m high	2 (0.6)	15.5 (4.7)
2	**Lime mudstone** and **siltstone** (thinly interbedded) 1 to 2 cm thick beds, dark blue-grey, orange-brown weathering, calcareous, micaceous, resistant. One hundred metres southeast, this unit disappears into limestone similar to that in Unit 3	1.5 (0.5)	13.5 (4.1)
1	**Limestone**: very dolomitic, grey oncoid packstone, with ovoid oncoids up to 2 cm in length; nonbedded or obscurely bedded, weathers grey strongly mottled with orange.	12 (3.7)	12 (3.7)
	NAISET FORMATION (472 ft/143.9 m) (Type Section)		
5	**Shale**: blue-green, tan weathering, calcareous, platy, with 5 per cent or less of massive, thin and medium beds of orange weathering dolomitic limestone: oncoid packstone with skeletal matrix (echinoderm plates prominent). One 10 cm thick bed of very sandy lime mudstone (very fine quartz sand) in the middle	24 (7.3)	472 (143.9)
4	**Shale** and **sandstone** Shale: greenish buff to green, calcareous, slaty. Sandstone (20-25%): 0.4-2 cm thick beds, pink-buff, rusty-specked, calcareous, very fine grained. Unit weathers partly tan, partly green, striped with orange-brown (sandstone beds). Remarkably rhythmic, varve-like sedimentation.	186 (56.7)	448 (136.6)
	Minor faulting throws doubt on accuracy of measurement. Section crosses a small fold. Slaty cleavage obscures much primary detail.		
3	**Slate**: as below, with 20 per cent regularly spaced beds of siltstone. Siltstone: beds 0.4-2 cm thick, grey-brown, calcareous, with low-angle crosslamination. Unit weathers blue-green, recessive, and poorly exposed	52 (15.8)	262 (79.9)
2	**Shale**: light buff-green, weathering blue-green, slightly calcareous, recessive, poorly exposed; abundant specks of blue-green chlorite, partly concentrated on bedding planes, partly dispersed, and partly "plated" on cleavage surfaces – circular specks are <1 mm to 5 mm in diameter	98 (29.9)	210 (64)
1	**Mudstone**: blue-green, weathers green, rust-brown, tan, and orange, silty, micaceous, partly massive, partly flaggy. Rare lenses, up to 10 cm thick, of sandstone: pale brown-grey, weathering deep brown, calcareous, medium grained, poorly sorted.	112 (34.1)	112 (34.1)
	Line of measurement crosses a jumble of minor faults. This may affect the measured thickness by tens of feet.		
	Planar contact.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GOG GROUP		
	Quartzite: mainly pale grey, vitreous, fine grained and minor medium grained; thick and very thick bedded, minor medium bedded, planar and lenticular bedding, minor crossbedding. The presence of brown calcareous sanstone near the top, and discontinuous thin shale bodies in the top one foot suggest that basal Naiset sandstone (see Wedgewood Peak section) may be included.		

Reference section of the Naiset Formation on the east side of Wedgewood Peak/Sunburst Peak ridge above Lake Magog

Section AC-103

(lat. 50°53′36″N. long. 115°39′17″W)

CATHEDRAL FORMATION

Section continues upward.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Oolite**: as below; mainly fine and very fine grained, and irregularly thin bedded in the basal 15 ft (4.6 m); partly medium and coarse grained in the remainder of the unit with a few medium and rare thick beds; dolomitic partings are prominent at the base but disappear upward. Rare medium beds of coarse skeletal grainstone, with abundant trilobites that resist collection. Unit steepens upward from recessive at the base to cliff forming at the top	58.5 (17.8)	73 (22.3)
	The units described below are moderately recessive.		
3	**Shale**: as below	1 (0.3)	14.5 (4.4)
2	**Limestone**: grey ooid grainstone; mainly very fine, partly fine at top, very dolomitic, beds 7 to 10 cm thick, partly crosslaminated; argillaceous-dolomitic partings at the top. Basal 12 cm thick bed of coarse grained trilobite grainstone	11 (3.4)	13.5 (4.1)
1	**Limestone** and **shale** Limestone: grey, dense, stromatolitic, in a bed 0.6 to 3 ft (0.2 to 0.9 m) thick, supporting well developed hemispherical to ellipsoidal stromatolites, buried in shale: as below. The limestone between the stromatolites is skeletal grainstone.	2.5 (0.8)	2.5 (0.8)

NAISET FORMATION
(588 ft/179.2 m)
(Reference Section)

The units described below form steep cliffs interrupted by narrow ledges.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
12	**Shale**: blue-green, weathering olive-green, brown, and tan; calcareous, platy; spots of chlorite occur, as below. Several very thin beds of medium grained, slightly oolitic, skeletal grainstone occur in the uppermost 15 ft (4.6 m)	67 (20.4)	588 (179.2)
	GSC loc. 57654 (10 to 20 ft/3 to 6.1 m above the base) *Amecephalus* sp.		
11	**Shale** and **siltstone** (interlaminated) Shale: blue-green, calcareous. Siltstone: argillaceous, similar to the shale. At the base, where the rock is especially silty, numerous burrows are present. Chlorite spots occur, as below. Unit weathers green and greenish tan	131.5 (40.1)	521 (158.8)
	GSC loc. 57655 (41.5 to 56.5 ft/12.6 to 17.2 m above the base) *Amecephalus* sp.		
	GSC loc. 57663 (28.5 to 31.5 ft/8.7 to 9.6 m above the base) *Amecephalus* cf. *A. agnesensis* (Walcott), 1917		
	GSC loc. 57642 (talus originating below loc. 57663) *Chancia* sp. *Amecephalus agnesensis* (Walcott), 1917		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Mudstone**: pale green-grey, and blue-grey, weathers bright tan, calcareous, soft, slightly silty, with abundant very thin laminae of siltstone; very low-angle cross-lamination, with some mildly contorted laminae; slightly recessive, flaggy. The interval from 41 to 44 ft (12.5 to 13.4 m) above the base has been involved in a major slump movement accompanied by the production of large, recumbent, penecontemporaneous folds and the rotation of large blocks through an angle of 20°. Specks and spheroids, up to 5 mm in diameter, of blue-green chlorite are closely crowded on widely spaced bedding planes. Upward, the unit develops alternating bright tan and green and brown weathering zones	56.5 (17.2)	389.5 (118.7)
9	**Shale** (75%) and **siltstone/sandstone** (25%) Shale: as below, calcareous, very micaceous. Siltstone and very fine grained sandstone: pale green and blue-green, calcareous, very micaceous; very thinly interbedded with shale. Chlorite specks occur throughout the unit. A strong cliff former, weathering green, light brown, and tan	38.5 (11.7)	333 (101.5)
8	**Mudstone**: as below, with many thin lenticles of sandstone: white, calcareous, very fine grained, brown weathering	15 (4.6)	294.5 (89.8)
7	**Mudstone/shale**: as below, but lacking sandstone	52.5 (16.0)	279.5 (85.2)
6	**Mudstone/shale**: pale green and grey-green, weathers light brown and green, laminated, platy, prominent and abundant chlorite spots, manganese dendrites prominent on weathering. Widely spaced, thin beds and lenses of sandstone: as below, largely pebbly	29 (8.8)	227 (69.2)
5	**Sandstone**: grey, brown weathering, very coarse grained, pebbly, calcareous. Lateral extent of unit not determined	2 (0.6)	198 (60.4)
4	**Mudstone/shale**: as Unit 2, but laminated and weathering deeply to pale brown. 57 ft (17.4 m) below the top is the lowest occurrence noted of porphyroblasts of blue-green chlorite. These porphyroblasts, where best developed, are oblate spheroids, up to 5 mm in diameter and 2 mm thick. They are almost continuously present above their lowest occurrence, in zones up to 2.5 cm thick and spaced at 7 to 15 cm intervals, and also occur as thin circular plates on bedding surfaces. The unit forms a modest lichen-covered cliff	132 (40.2)	196 (59.7)
3	**Mudstone**: as below, very slightly dolomitic, massive, tan weathering, laminae of greenish blue chlorite. A 6 mm thick lamina of sandstone (medium grained, dolomitic) at the top	34 (10.4)	64 (19.5)
2	**Mudstone**: blue-grey, weathers olive and brown, platy, micaceous. Rare lenses and laminae of sandstone: brown, coarse grained and pebbly, calcareous	19 (5.8)	30 (9.1)
1	**Sandstone** and **quartzite**: grey, coarse grained, largely pebbly, with large patches of brownish grey, brown weathering, calcareous sandstone; thick bedded; less resistant than underlying quartzites. Large chips of shale occur in the upper 2 ft (0.61 m) and are bent between undulating bedding planes. Basal contact is planar, upper contact gently undulating. This unit is assigned to the Naiset Formation, because, at Sunburst Peak, it crosscuts underlying beds.	11 (3.4)	11 (3.4)

Obscure unconformity.

GOG GROUP

Quartzite: white, greyish white, and pinkish grey; mainly fine and very fine grained, minor medium grained; thin to thick bedded, prominently crossbedded and crosslaminated; resistant.

Lithology

The Naiset Formation consists mainly of massive to platy, silty and sandy mudstone and platy shale. These strata are blue-green, blue-grey, grey-green, and pale green and most are calcareous (dolomitic near the base). Weathered colours are brown, pale brown, olive, and green. In the type area, spots of distinctive blue-green neomorphic chlorite record incipient metamorphism. The mudrocks contain very thin beds, lenses, and laminae of calcareous, pale green and blue-green, tan weathering siltstone that is conspicuously micaceous and commonly crosslaminated. Lenses, thin beds, and rare thick beds of calcareous, brown weathering, gritty and pebbly sandstone are prominent in the basal 200 ft (61 m) of the formation, but gradually disappear upward. A peculiarity of the platy shales is their tendency, on mature weathering, to develop manganese dendrites along parting surfaces.

Although trilobites are by no means abundant in the Naiset mudrocks, a high proportion of those found are complete specimens.

Rhythmic or varve-like interbedding of dominant shale and subordinate siltstone characterizes numerous intervals of the Naiset Formation. Organic burrowing is prominent in the upper part of the formation. Contorted lamination, attributed to slumping, is common in the upper half of the reference section. One interval, 152.5 to 155.5 ft (46.5 to 47.4 m) above the base of the section, consists of slide deposits, with attendant truncation of bedding (Fig. 26) and the development of penecontemporaneous, attenuated folds.

In the uppermost 30 ft (9.1 m) of the type and reference sections, several very thin, minor beds of limestone - oolitic skeletal (trilobite, echinoderm) packstone with some oncoids - occur in the shales.

The relatively thin section (228 ft/69.5 m) of Naiset Formation at Ferro Pass (Section AC–129) differs lithologically from the reference section only 7 miles (11.3 km) distant. At the base of the Ferro Pass section, a 13 ft (4 m) thick unit of massive quartz-pebble conglomerate overlies an erosion surface (Fig. 27) with 3 ft (1 m) or more of local relief. Overlying the conglomerate is an 86 ft (26.2 m) thick unit of pyritic, nearly black, ribbon-bedded lime mudstone, with prominent dolomite partings and abundant trilobite fragments on bedding planes. The limestone is succeeded by slaty, laminated mudrocks of

Figure 26. *Truncation of bedding in the Naiset Formation at Mount Wedgewood (Section AC–103). Penecontemporaneous slide-surfaces isolate wedge shaped "packets" of laminated, mudstone/siltstone couplets. Jacob's staff is graduated in feet. ISPG photo 1569-6.*

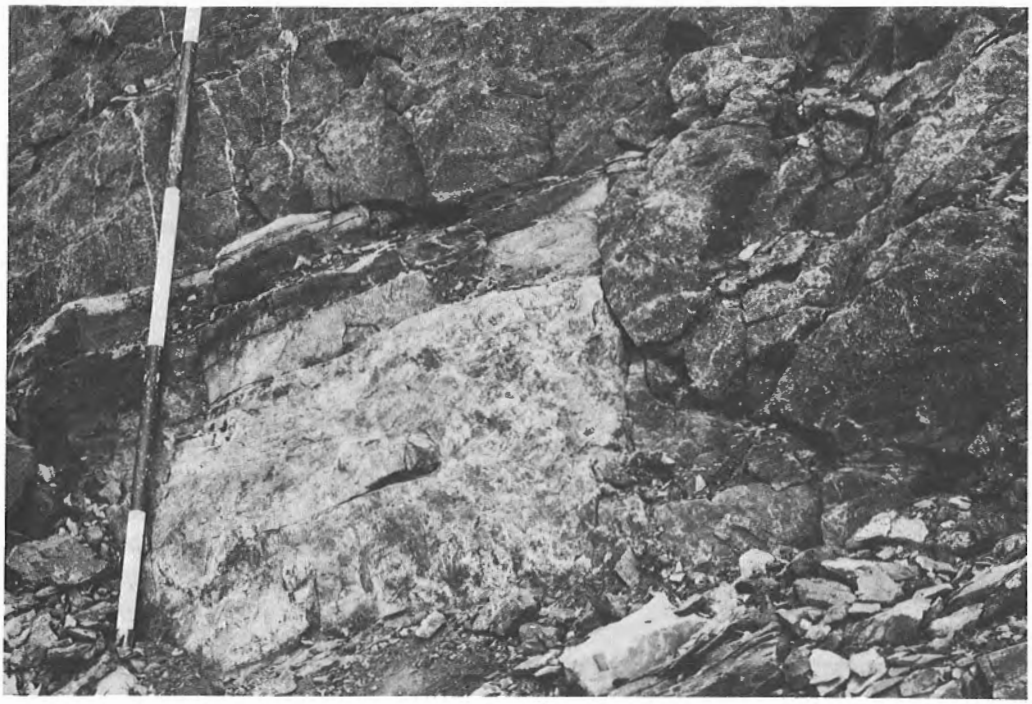


Figure 27. *Unconformable base of the Naiset Formation at Indian Peak (Section AC–129). Jacob's staff is graduated in feet. GSC photo 15-10-65.*

more usual Naiset aspect, but containing 40 per cent lime mudstone as laminae, thin beds, and rare thick beds.

At Mount Stephen and Mount Field, the Naiset Formation displays, especially in its upper parts, some of the characteristics of the Mount Whyte Formation, with much more lime mudstone than in the type area and a prominent unit of oolite. Strata at these localities were assigned to the Mount Whyte Formation by Walcott (1908, 1928), Rasetti (1951), and McIlreath (1977). These strata can be regarded as transitional to the Mount Whyte.

Contacts

In the type area, the base of the Naiset Formation is easily mapped where relatively recessive weathering, thin bedded mudrocks of the Naiset overlie massive, resistant sandstones of the Gog Group. The contact is unconformable, as attested by erosional relief and a paleoregolith at Sunburst Peak and Ferro Pass (Fig. 27); and by Palonen's (1976) demonstration that hundreds of feet of Gog sandstones are missing at Sunburst Peak as the result of erosion.

I observed no evidence of sub-Naiset erosion at the North Gully on Mount Stephen (Section AC–112), nor at Mount Field, where the massive Peyto carbonate is absent. A mile to the southwest, however, the Peyto Formation is present, in the form of at least (the base is covered) 16.5 ft (5 m) of massive, pale grey crystalline dolomite topped by an erosion surface with at least 2 ft (60 cm) of relief. These observations imply that the Peyto Formation is missing as a result of sub-Middle Cambrian erosion at North Gully and Mount Field.

The Naiset/Cathedral contact is conformable and gradational, and is marked by the appearance of multibed units of limestone within the fine grained clastic strata. The contact is drawn where carbonate becomes dominant upward; thus, thin units of detrital mudrocks are included in the base of the Cathedral Formation where it overlies the Naiset. At the type section, the mudrock units can be seen to pinch out.

Distribution and thickness

The Naiset Formation onlaps and wedges out against the western flank of the Kicking Horse Rim (Figs. 12, 13). Accordingly, it displays rapid changes in thickness

(Fig. 24) and lithology, as noted above. The Naiset is 472 to 475 ft (143.9 to 144.8 m) thick at the type section, 695 ft (211.8 m) at the Wedgewood Peak reference section, and only 228 ft (69.5 m) thick at Ferro Pass (Section AC–129). About one mile northwest along strike from Ferro Pass it disappears completely. The disappearance appears to be more by facies change than by pinchout.

At Mount Stephen (North Gully), the Naiset Formation is 337 ft (102.7 m) thick. It has not been identified anywhere north of Mount Field, but the basal Chetang Formation at Cinnamon Peak (Section AC–165) is very Naiset-like.

Fauna and age

Deiss (1940, p.775) did not report any fossils from the lower 419 ft (128 m) of the Naiset Formation at the type section. Rasetti (1951, p. 60, 62) stated that the trilobites collected by Walcott, and Deiss' (ibid.) list of the fossils collected near the top of the type section, confirm that the Naiset Formation is an equivalent of the Mount Whyte Formation.

The fossils that I collected at Sunburst Peak (GSC loc. 57656) are from talus originating in the basal 150 ft (46 m) of the Naiset Formation and include *Pachyaspis* sp. and cf. *Stephenaspis bispinosa* Rasetti, 1951.

At the Wedgewood Peak reference section, *Chancia* sp. and *Amecephalus agnesensis* were collected from talus (GSC loc. 57642) originating more than 163 ft (50 m) below the top of the Naiset Formation. The interval from 529 to 563 ft (161 to 172 m) above the base (GSC locs. 57663, 57655) yielded specimens of *Amecephalus*, including cf. *A. agnesensis*.

An interesting fossil found widely in the type area of the Naiset Formation, in talus, is the relatively rare eocrinoid *Gogia prolifica* Walcott, 1917.

W.H. Fritz has commented (pers. comm., 1978) that basal Middle Cambrian faunas in the Canadian Rocky Mountains are characterized by long-ranging trilobites. The fossil species identified above are assigned to the *Plagiura–Poliella* Zone, but Fritz notes that *Plagiura* first appears high in the Mount Whyte Formation, and that *Stephenaspis* and *Wenkchemnia* seem to appear earlier than *Kochaspis* and *Plagiura*. In any event, the Naiset Formation is early Middle Cambrian and is, at least largely, correlative with the Mount Whyte Formation of the Main Ranges.

Interpretation

The Naiset Formation contains facies of the outer detrital lithosome: absence of shallow-water features (except at the top), regular thin bedding and lamination, absence of "high-energy" deposits (except at the top), and a sparse fauna of long-ranging forms commonly preserved as entire specimens. Its position west of the Kicking Horse Rim, and structures recording sliding and slumping, suggest deposition on the westward slope into the open basin. The massive (structureless) pebble conglomerate at Ferro Pass and the lenses of coarse grained sandstone near the base of the formation in the type area may be grain-flow deposits ("proximal turbidites").

The upward appearance in the Naiset Formation of bioturbation followed by thin grainstones with ooids and oncoids, record progressive shallowing in a manner comparable to that seen in the "basinal" Stephen Formation west of the Cathedral escarpment (see below, under "Stephen Formation"). Conversely, the absence of burrowing in the lower part of the formation suggests that the initial transgression over an erosion surface was rapid, quickly "drowning" the sediment/water interface too deeply to support an abundant and active bottom fauna. At the close of Naiset time, shallowing produced by progradation of detrital muds provided a platform over which shallow-water limestones of the Cathedral Formation could prograde to the west.

Rasetti (1951) was wrong to reject Deiss' Naiset Formation, which he had not visited. Despite the fact that Deiss' (1940) reasons for distinguishing the Naiset from the Mount Whyte related in part to his concept of the Mount Whyte as a Lower Cambrian formation, the fact remains that the two formations consist of profoundly different rocks. To extend the name Mount Whyte to the Naiset Formation, as Walcott (1928) and Rasetti did, is to obscure one of the most significant paleogeographic relationships preserved in the Middle Cambrian record of the region.

Cathedral Formation

Definition

The Cathedral Formation is the lower of the two great, Middle Cambrian, cliff-forming carbonate formations of the southern Rocky Mountains of Canada (Figs. 7, 17, 25, 28, 29, 31, 32, 37, 39, 43, 51, 52, 70, 74, frontispiece). As shown by Rasetti (1951), Deiss' (1939) reference to the formation as the "Cathedral dolomite" is inappropriate.

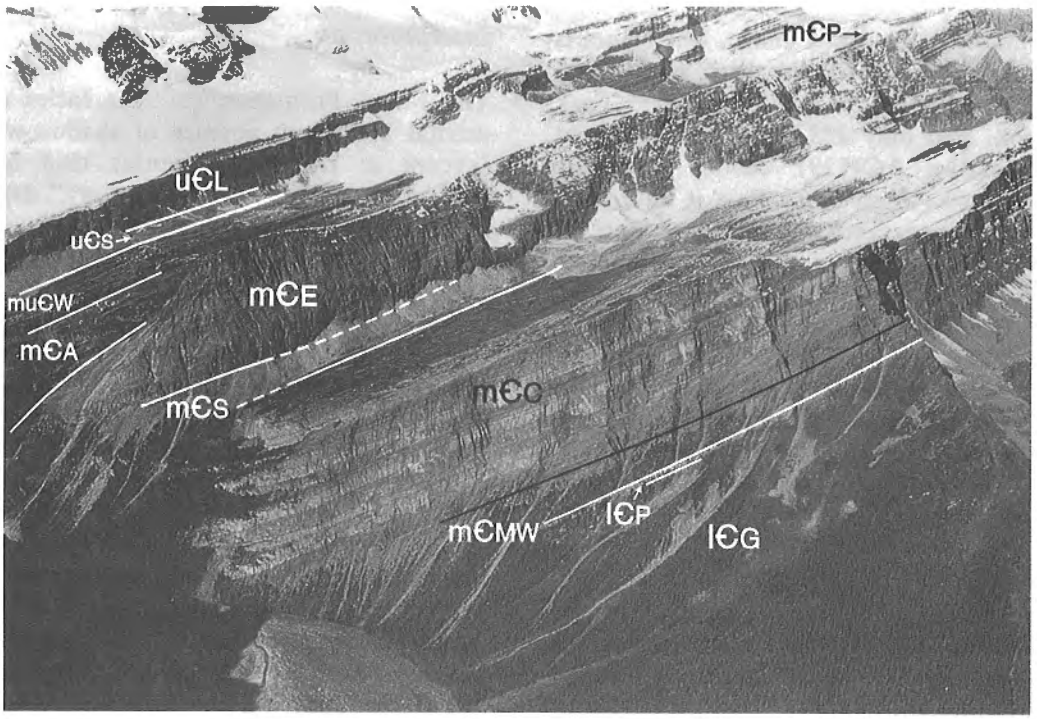


Figure 28. *Middle Cambrian section at Hector Lake. (Oblique air photograph; view to the northwest.)* l€G*–sandstones of the Gog Group;* l€P*–Peyto Formation;* m€MW*–Mount Whyte Formation;* m€C*–Cathedral Formation;* m€S*–Stephen Formation;* m€E*–Eldon Formation;* m€P*–Pika Formation;* m€A*–Arctomys Formation;* mu€W*–Waterfowl Formation;* u€S*–Sullivan Formation;* u€L*–Lyell Formation. The Arctomys and higher formations are downdropped on the southwest side of a normal fault. ISPG photo 1518-75.*

The formation is of particular significance in that, locally, it provides an outstanding example of a Middle Cambrian reef. The reef front, known as the Cathedral Escarpment (Ney, 1954; Fritz, 1972; McIlreath, 1977a) supports the partly near-vertical outer edge of the regional carbonate platform, designated the Cathedral Formation.

Two shaly tongues are recognized within the Cathedral Formation: the Ross Lake Shale (Member) (Walcott, 1917a) below, and the Trinity Lakes Member (new) above. The thin extension of the lower Cathedral west of the Cathedral Escarpment at Mounts Stephen and Field, formerly referred to as the "thin Cathedral" (Fritz, 1972; McIlreath, 1977a), is named the Takakkaw Tongue (new) of the Cathedral Formation.

Origin of names

The formation was named by Walcott (1908a) after Cathedral Mountain and Cathedral Crags, east of Mount Stephen.

The Ross Lake Member was named by Walcott (1917a) after Ross Lake, adjacent to the reference section for the formation and type section of the member (see Figures 31, 43). The Trinity Lakes Member (new) is named after Trinity Lakes, 7 miles (11.3 km) north of Sunwapta Pass, and on the line of the Beauty Creek reference section for the Cathedral Formation (see Figure 32). The Takakkaw Tongue (new) is named after Takakkaw Falls, 7 miles north of the type section of the tongue on the north flank of Mount Stephen.

Type and reference sections

Rasetti (1951, p. 64) reviewed Walcott's (1928) change of the type locality from Cathedral Mountain to the south face of Mount Bosworth (i.e., Section AC–2, Fig. 30), and Deiss' (1939; 1940, especially p. 745) acceptance of that change, and endorsed the change himself. It is interesting that a type section has never been explicitly identified, although Deiss (1940) obviously treated the Mount Bosworth section as the type. Although the shift of type section violates modern stratigraphic practice [North American Stratigraphic Code, 1983, Article 22(c): " ... a type section ... once specified, must not be changed."], nothing is to be gained by differing with Walcott, Deiss and Rasetti, and the Mount Bosworth section (Fig. 30) is accepted as the type section.

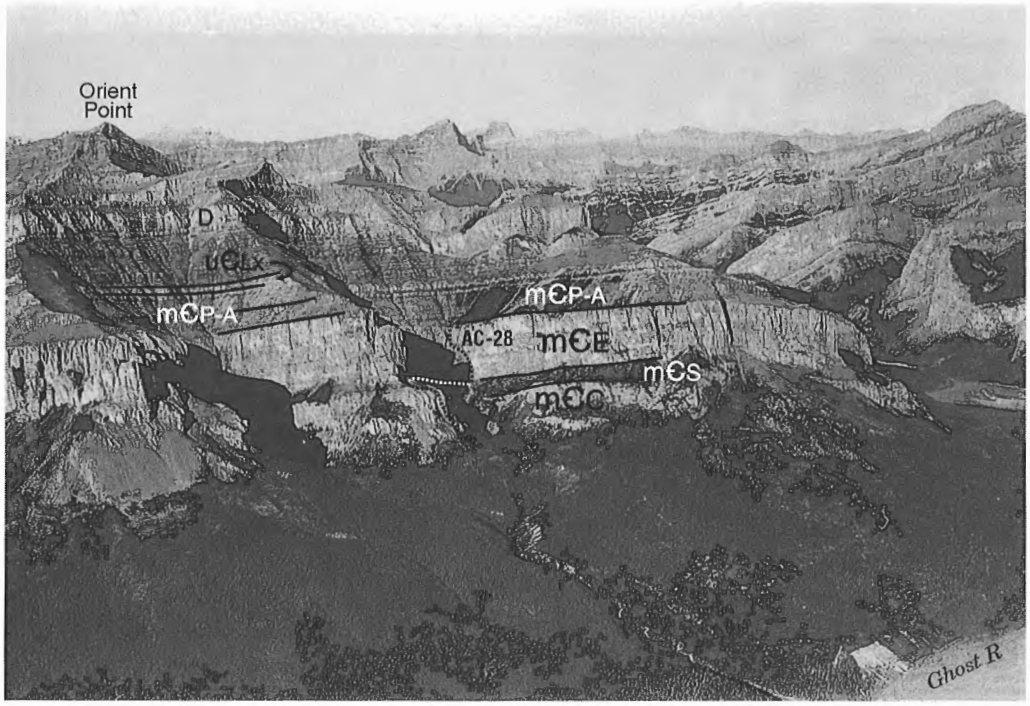


Figure 29. *Cambrian section at Ghost River (Orient Point). (Oblique air photograph; view westward.) The dotted line indicates the route of measurement for Section AC–28.* mЄc*–Cathedral Formation;* mЄs*–Stephen Formation;* mЄE*–Eldon Formation;* mЄP-A*–Pika and Arctomys formations, undivided;* uЄLx*–Lynx Group;* D*–Devonian. ISPG photo 1518-3.*

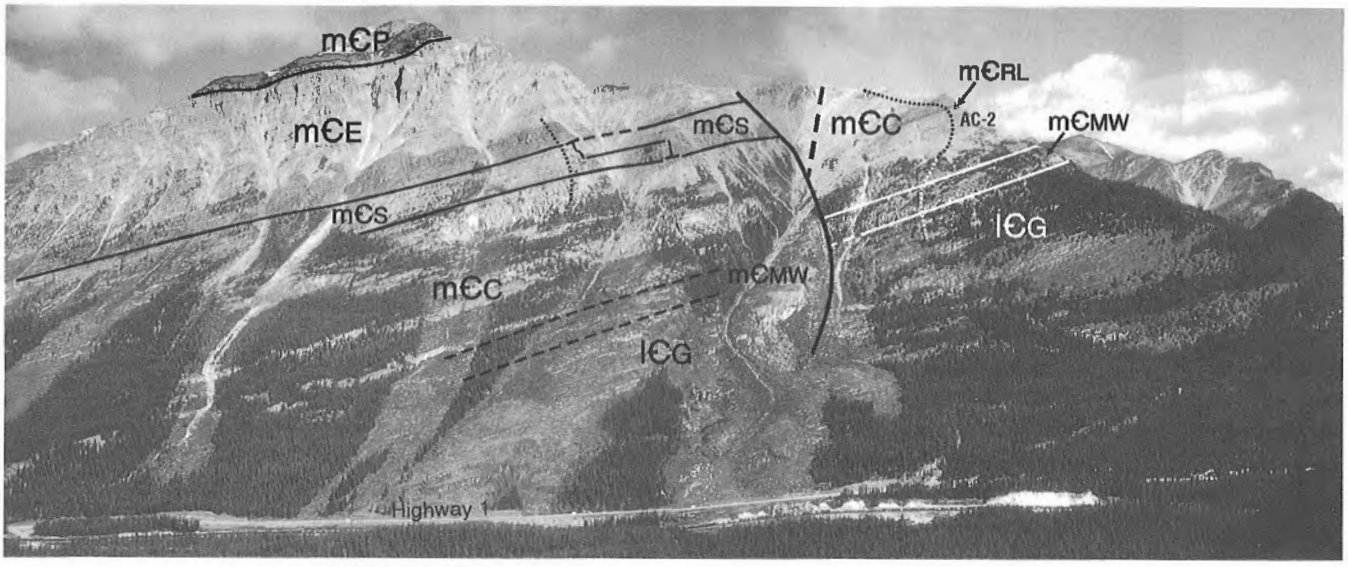


Figure 30. *Cambrian section at Mount Bosworth, viewed from above Ross Lake.* lЄG*–Gog Group, including thin Peyto Formation at the top;* mЄMW*–Mount Whyte Formation;* mЄc*–Cathedral Formation (*mЄRL*–Ross Lake Member);* mЄs*–Stephen Formation (type section);* mЄE*–Eldon Formation;* mЄP*–Pika Formation. The dotted lines indicate the route of measurement for Section AC–2; the offset solid lines indicate the type section of the Stephen Formation and its Narao and Waputik members. ISPG photos 1569-1/1569-2.*

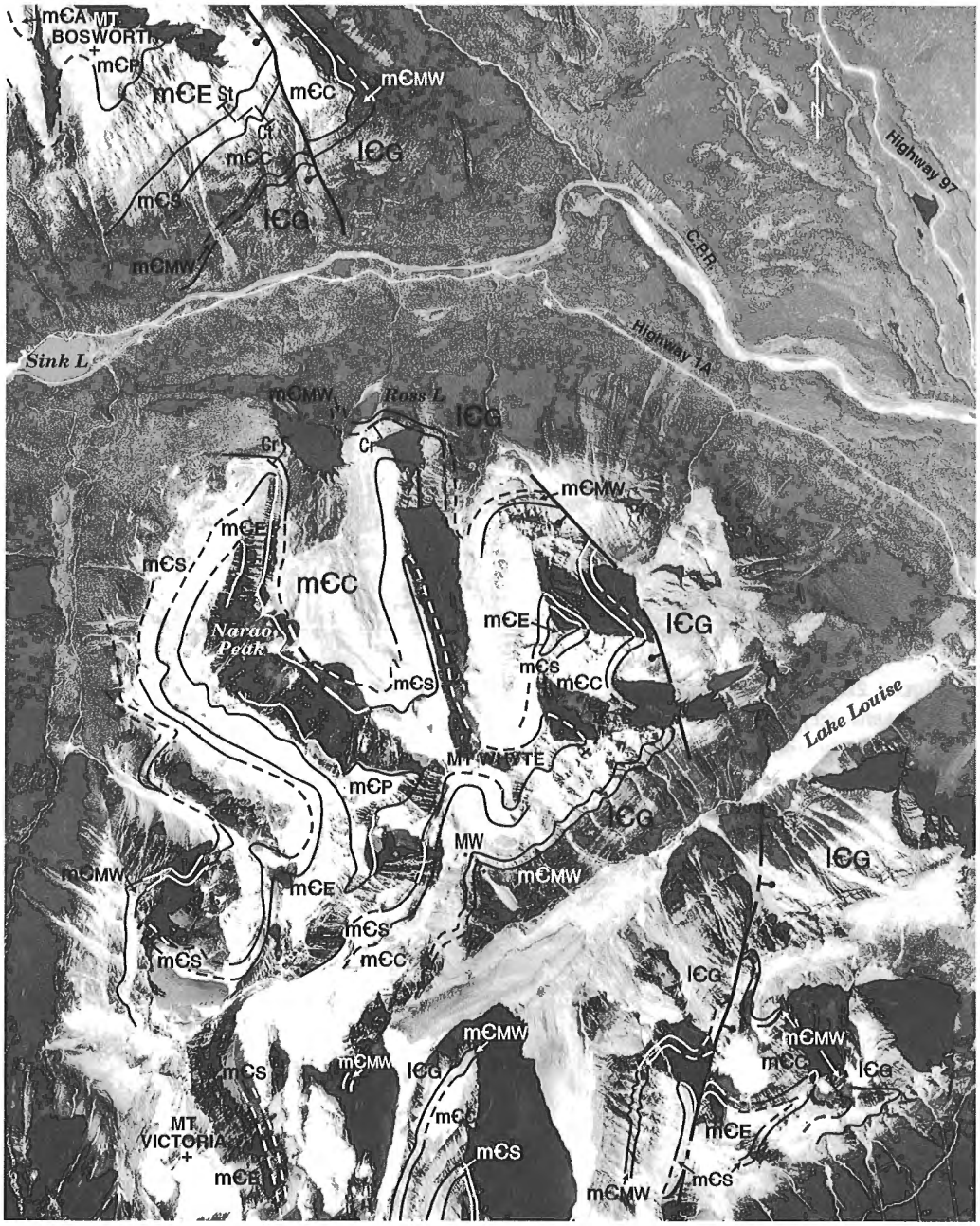


Figure 31. *Kicking Horse Pass and vicinity, showing the type and reference sections of the Mount Whyte, Cathedral and Stephen formations. Annotation as for Figure 30, with the addition of:* mЄA*–Arctomys Formation.* MW*–(type section) of the Mount Whyte Formation (Mount Whyte);* Ct *and* Cr*–type and reference sections of the Cathedral Formation (Mount Bosworth and Ross Lake);* St*–type section of the Stephen Formation (Mount Bosworth). Precambrian strata (Miette Group) are exposed locally beneath the Gog Group. National Air Photo Library, part of Air Photo A13253-98.*

Figure 32. *The Beauty Creek area, showing the reference section of the Cathedral Formation and the type section of the Trinity Lakes Member.* lЄG*–sandstones of the Gog Group;* lЄP*–Peyto Formation;* mЄMW*–Mount Whyte Formation;* mЄC*–Cathedral Formation;* mЄS*–Stephen Formation;* mЄE*–Eldon Formation;* mЄP*–Pika Formation;* mЄA*–Arctomys Formation;* muЄW*–Waterfowl Formation;* uЄS*–Sullivan Formation;* O*–Ordovician strata;* D*–Devonian strata. Dotted line marks the route of measurement for Section AC–48; solid line marks the type section of the Trinity Lakes Member of the Cathedral Formation. National Air Photo Library, part of Air Photo A14812-94.*

At the type section, the Cathedral Formation is faulted and incomplete, as noted by Deiss and Rasetti, and is almost completely dolomitized so as to obscure many primary characteristics. Nevertheless, the position of the Cathedral in the stratigraphic succession is perfectly clear, and strata of the Ross Lake Member are well exposed and highly fossiliferous. The contact with the underlying Mount Whyte Formation is exposed east of the fault, that with the overlying Stephen Formation is exposed west of the fault. No one, including myself, has ever described the section exposed in the precipices of Cathedral Mountain.

Because of the shortcomings of the type section, two sections are proposed here as reference sections. The first, Section AC–172, is the section at Ross Lake (Figs. 31, 43), 1.5 miles (2.4 km) along strike to the south-southeast of, and in full view from, the upper part of the type section. This section includes the type section of the Ross Lake Shale. At this easily accessible locality, the Cathedral Formation is unfaulted and consists mainly of limestone. In order to examine good exposures of the basal Cathedral Formation and the Ross Lake Shale, it is necessary to traverse the section up to the shale member on the cirque wall east of the lake. Progress above the shale presents unacceptable mountaineering difficulties. By tracing the Ross Lake Member to the opposite (west) wall of the cirque, and following the fringe of brush and timber along the edge of the nearly vertical limestone cliffs, it is possible to continue measurement upward to the covered contact with the Stephen Formation.

Reference Section for the Cathedral Formation and type section of the Ross Lake Member at Ross Lake

Section AC–172

(lat. 51°25′22″N, long. 116°17′59″W)

STEPHEN FORMATION

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	Covered: very recessive weathering. By reference to the type Stephen Formation across the valley, the unit probably consists of parted lime mudstone.	not measured	

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	CATHEDRAL FORMATION (1231.5 ft/375.4 m) (Reference Section)		
	Units 23 to 27 form a nearly vertical cliff above the cirque, the upper part of 27 weathering back toward the top. In the vegetated northern exposures, they form a series of small cliffs and ledges.		
27	**Limestone**: as below, but bedding joints are strongly expressed. Intermittently exposed on line of section. Measurement approximate	72 (21.9)	1231.5 (375.4)
26	**Limestone**: burrowed lime mudstone; massive; variation in intensity of burrow development reveals thin bedding, but no partings or bedding joints are present	132 (40.2)	1159.5 (353.4)
25	**Limestone**: burrowed lime mudstone transitional to parted lime mudstone; strong expression of thin and medium bedding. Subordinate intervals of nonbedded, burrow-mottled lime mudstone	160.5 (48.9)	1027.5 (313.2)
24	**Limestone**: parted lime mudstone, transitional to burrow-mottled lime mudstone; massive in glaciated outcrop, crudely flaggy where weathered; slightly recessive	29 (8.8)	867 (264.3)
23	**Limestone**: burrow-mottled lime mudstone; irregular thin bedding is weakly expressed, but bedding joints are not developed	83 (25.3)	838 (255.4)
22	**Limestone**: parted lime mudstone; crudely flaggy, ledge-former	10 (3)	755 (230.1)
	Units 19 to 21 are strongly cliff forming, and Unit 20 is extraordinarily resistant.		
21	**Limestone**: burrow-mottled lime mudstone; very massive. In part, especially the basal 8 to 10 ft (2.4 to 3 m), dolomitized burrows make up more than 50 per cent of the rock, which is, therefore, calcareous dolomite	116 (35.4)	745 (227.1)
20	**Limestone**: pale-pellet grainstone, with equant and laminoid fenestrae; very thick bedded to nonbedded, massive. Sparse burrows in this unit are not emphasized by dolomitization. Minor intervals of burrowed lime mudstone	80 (24.4)	629 (191.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
19	**Limestone**: burrow-mottled lime mudstone; massive. Bedding manifested by variation in intensity of burrowing. Local tectonic brecciation	114 (34.7)	549 (167.3)
18	**Limestone**: parted lime mudstone; slightly less resistant than the overlying units	14 (4.3)	435 (132.6)

Ross Lake Member
(8 ft/2.4 m)
(Type Section, Unit 17)

The Ross Lake Member, together with underlying Unit 16, form a distinct ledge, dark in colour. The shale proper is more resistant than the limestone of Unit 16.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
17	**Shale**: dark grey, weathering olive to brown, slightly calcareous, flaggy to massive; richly fossiliferous – trilobites, brachiopods, conical gastropods, rare hyolithids. Two feet (60 cm) above the base, a six inch (15 cm) subunit of nodular-parted limestone (skeletal wackestone). At the top, limestone nodules reappear; grades upward into rubbly parted lime mudstone. Minor lenses of lime mudstone occur throughout the unit	8 (2.4)	421 (128.3)

Deiss (1939, p. 989) reported the following fauna:
Albertella bosworthi Walcott
A. helena Walcott
A. robsonensis Resser
A. similaris Resser
A. 2 n. sp.
"*Amecephalus*" *stator* (Walcott)
"*A.*" 2 n. sp.
Kochina bosworthensis Resser
Poliella chilo? (Walcott)
Ptarmigania sp.
Vanuxemella nortia Walcott
Hyolithes cercops Walcott
Acrothele colleni Walcott
Obolus parvus Walcott
Wimanella simplex Walcott

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
16	**Limestone**: parted lime mudstone; bedding very thin, very irregular to nodular; unit recessive weathering	17 (5.2)	413 (125.9)

Units 2 to 15 form a series of small cliffs and ledges on the line of section; to the south, they pass into a nearly vertical cliff.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	**Limestone**: burrow-mottled lime mudstone; mostly medium to thick bedded with minor obscure thin bedding. Minor intraclast grainstone	80 (24.4)	396 (120.7)
14	**Limestone**: fenestral lime mudstone; thick bedded, massive. Minor cryptalgal laminite with small, blister-like stromatolites. Minor burrow-mottled lime mudstone	21.5 (6.6)	316 (96.3)
13	**Limestone**: burrow-mottled lime mudstone; very dolomitic, massive, locally dolomitized	26.5 (8.1)	294.5 (89.8)
12	**Dolomite**: ex-burrow-mottled lime mudstone; mottled in shades of grey, fine crystalline. Minor ex-parted lime mudstone at the base	19 (5.8)	268 (81.7)
11	**Limestone**: grey, dense, with obscure particulate texture. A single massive, grey weathering bed. Passes laterally into dolomite	3 (0.9)	249 (75.9)
10	**Limestone** (very dolomitic) and **dolomite**: Cryptalgal laminite, with minor thin and medium beds of fenestral lime mudstone	19 (5.8)	246 (75)
9	**Limestone**: fenestral lime mudstone, overlain by massive, burrow-mottled lime mudstone; very dolomitic	9 (2.7)	227 (69.2)
8	**Dolomite**: cryptalgal laminite; pale grey, weathers cream, fine crystalline. In the middle, a 5 ft (1.5 m) thick unit is medium grey, nonlaminated, with white fenestrae. One distinct erosion surface occurs in the laminite	12.5 (3.8)	218 (66.4)
7	**Dolomite**: ex-burrow-mottled lime mudstone (mottling mainly evident on weathered surfaces); dark grey, yellow-brown weathering, fine equicrystalline, massive	27 (8.2)	205.5 (62.6)
6	**Dolomite**: largely ex-dark-pellet grainstone; grey, weathers dull grey-brown, fine crystalline, thin and medium planar-bedded	7 (2.1)	178.5 (54.5)
5	**Dolomite**: ex-parted lime mudstone; mottled in shades of grey, fine crystalline. Passes upward to ex-burrow-mottled lime mudstone. Traces of particulate texture. Weathers as below. Thirty per cent covered; measurement imprecise	62 (18.9)	171.5 (52.3)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Dolomite** and **limestone** At the base, parted limestone as below, passing upward after 10 ft (3 m) to dolomite: pale brownish grey to pale grey and pink, partly fine equicrystalline, partly inequicrystalline. Weathers distinctive pale tan. Horizons with indistinct thrombolites are abundant up to at least 50 ft (15 m) above the base	53.5 (16.3)	109.5 (33.4)
3	**Limestone**: parted limestone as below. Top 4 ft (1.2 m) consist of discontinuous, pillow-like thrombolites	11.5 (3.5)	56 (17.1)
2	**Limestone**: a continuous thrombolite biostrome, with one foot (30 cm) or more of domal relief at the top	11.5 (3.5)	44.5 (13.6)
1	**Limestone**: parted lime mudstone and parted skeletal wackestone with abundant oncoids; bedding is thin and very irregular at base, becoming thicker, more planar, and better defined upward.	33 (10.1)	33 (10.1)
	Conformable contact.		

MOUNT WHYTE FORMATION
(253 ft/77.1 m)

The Mount Whyte Formation forms a more ledgy interval, with many talus-covered ledges, below the lower Cathedral Formation in which the resistant units are thicker and dominant. For fossil lists, see Rasetti (1951).

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Siltstone** (60%) and **limestone** (40%) (Covered at base) Siltstone: pale grey, greenish grey, brownish grey, micaceous, calcareous to very calcareous, with lenses and nodules of silty limestone; centimetre-scale planar lamination due to variation in clay and calcite contents, partly ripple cross-laminated; abundant feeding traces on bedding planes. Limestone: grainstone as below, in 2 to 7 ft (0.6 to 2.1 m) thick subunits. A ledgy weathering unit	43.5 (13.3)	253 (77.1)
9	**Limestone**: ooid-skeletal grainstone; partly massive, partly crudely flaggy. Fifteen feet (4.6 m) above the base is the base of a pillow-shaped thrombolite at least 8 ft (2.4 m) high. Other thrombolites, widely spaced, occur laterally at the same level	30 (9.1)	209.5 (63.9)
8	**Siltstone**: with lenses and nodules of limestone; as Unit 10	8 (2.4)	179.5 (54.7)
7	**Limestone**: ooid-skeletal and skeletal-ooid grainstone/packstone; very irregularly thin bedded, with local crosslamination in 15 cm sets. Massive outcrop passes laterally to flaggy outcrop	20 (6.1)	171.5 (52.3)
6	**Sandstone, siltstone,** and **shale** (interlaminated) Sandstone/siltstone: very pale grey, quartzose, calcareous; sandstone is very fine grained, mostly planar laminated, with well developed feeding traces. Shale: green. Just below the top, two thin beds of ooid grainstone/packstone	9.5 (2.9)	151.5 (46.2)
	Section continues downward through the Peyto Formation.		

The second proposed reference section is the outstandingly informative Beauty Creek section (AC-48 of this report, Fig. 32). It is the type section of the Trinity Lakes Member, and illustrates the thickening of the shale tongues within the Cathedral Formation (Ross Lake and Trinity Lakes members) that culminates with the northward disappearance of the Cathedral Formation into part of the Snake Indian Formation. At Beauty Creek, the Cathedral is completely undolomitized and of more varied lithofacies than in less shaly sections.

Reference section for the Cathedral Formation and type section of its Trinity Lakes Member at Beauty Creek

Section AC–48

(lat. 52°18′30″N, long. 177°13′40″W)

STEPHEN FORMATION

Section continues upward.

7 Covered: recessive weathering

Units 1 to 7 form a ledgy weathering interval, markedly recessive relative to the upper Cathedral.

Narao Member

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Limestone**: as below, but beds slightly thicker (1 to 2.5 cm); trilobite remains as below	4.5 (1.4)	46.5 (14.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 55291 (1.5 ft/50 cm above base) *Alokistocarella* sp. *Kistocare*? sp. *Glossopleura boccar* Walcott, 1916 *Glossopleura* aff. *G. skokiensis* Rasetti, 1951		
5	Covered	7.5 (2.3)	42 (12.8)
4	**Limestone**: parted lime mudstone; exceptionally thin beds (laminae), 0.5 to 2 cm thick; ripple marks, abundant feeding and dwelling traces and coprolite-like bodies; large trilobite free cheeks (?*Glossopleura*) are abundant on bedding planes, and occur locally in heaps and "windrows"	14 (4.3)	34.5 (10.5)
3	Covered	11 (3.4)	20.5 (6.2)
2	**Limestone**: parted lime mudstone; partly rippled	2.5 (0.8)	9.5 (2.9)
1	**Limestone**: parted lime mudstone; argillaceous, planar and wavy laminated; flaggy at base, platy at top; recessive weathering.	7 (2.1)	7 (2.1)
	Abrupt, planar contact.		

CATHEDRAL FORMATION
(1422.5 ft/433.6 m)
(Reference Section)

Units 49 to 53 are strongly cliff forming.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
53	**Limestone**: burrow-mottled lime mudstone; becomes medium and thin bedded in top 5 ft (1.5 m)	26.5 (8.1)	1422.5 (433.6)
52	**Limestone**: (?)pale-pellet grainstone; nonbedded, massive, very resistant; widely scattered crystals of yellow-white dolomite weather in relief	49 (14.9)	1396 (425.5)
51	**Limestone**: burrow-mottled lime mudstone; replete with dolomitized burrows, approaching 50 per cent in some beds; massive; aligned mottling suggests thin bedding	41 (12.5)	1347 (410.6)
50	**Limestone**: burrow-mottled lime mudstone with minor parted intervals. Rare beds, up to 60 cm thick, of dark-pellet grainstone	95 (29)	1306 (398.1)
49	**Limestone**: parted lime mudstone with partings thinner and less argillaceous than below; strong cliff former	75 (22.9)	1211 (369.1)
48	**Limestone**: parted lime mudstone; very thin beds (laminae), 0.5 to 2.5 cm thick; weathers black with orange laminae; flaggy; weakly cliff forming	35 (10.7)	1136 (346.3)
	Contact gradational, marked by a distinct topographic knick.		

Trinity Lakes Member
(221 ft/67.4 m)
(Type section, Units 38 to 47)

The member is recessive weathering, relative to the underlying and overlying limestone intervals; the ledged profile reflects the cyclical alternation of recessive shale and more resistant limestone.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
47	**Limestone** and **shale** (cycle) A complete cycle, like those underlying; shale at the base overlies an abrupt contact and grades to parted lime mudstone at 15.5 ft (4.7 m) above the base; trilobites are widespread	55 (16.8)	1101 (335.6)
46	**Limestone** (upper part of cycle): as Unit 44; trilobite fragments both scattered and in thin coquinas	18 (5.5)	1046 (318.8)
45	**Shale** (lower part of cycle): as below; a few half-centimetre thick laminae of trilobite coquina	12 (3.7)	1028 (313.3)
44	**Limestone** (upper part of cycle): parted lime mudstone; argillaceous, flaggy; rare laminae of trilobite coquina	32 (9.8)	1016 (309.7)
43	**Shale** (lower part of cycle): grey, weathering pale buff to orange-brown; very calcareous, platy; abundant trilobites 22 to 42 ft (6.7 to 12.8 m) above the base; rare 2.5 cm thick beds of trilobite coquina in the upper 8 ft (2.4 m)	45 (13.7)	984 (299.9)
42	Covered	33.5 (10.2)	939 (286.2)
41	**Limestone** (upper part of cycle): parted lime mudstone; in "beaded", 1 to 2.5 cm thick, crudely flaggy beds; trilobite fragments common on weathered bedding planes, but do not break free of matrix	7.5 (2.3)	905.5 (276)
40	**Shale** (lower part of cycle): pale brownish grey, weathering silver-grey; calcareous, fissile; trilobites abundant	10 (3)	898 (273.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 55298 *Amecephalus* sp. *Glossopleura boccar* Walcott, 1916		
39	**Limestone**: lime mudstone; with sparse dolomite mottling and rare dolomitized oncoids; regularly medium bedded; weathers black with orange mottling	4 (1.2)	888 (270.7)
38	Covered	4 (1.2)	884 (269.4)
	GSC loc. 55294 (from talus of this unit) *Arellanella* sp. *Athabaskia* sp. *Glossopleura sp.*		
	Units 32 to 37 form a distinct cliff and rib.		
37	**Limestone**: largely dark-pellet grainstone; thin and very thin bedded	9 (2.7)	880 (268.2)
36	**Limestone**: (?)pale-pellet grainstone; irregularly medium and thin bedded, weathering "prickly" and pale grey	27.5 (8.4)	871 (265.5)
35	**Limestone**: burrow-mottled lime mudstone; distinctly medium bedded; less resistant than the underlying unit	28 (8.5)	843.5 (257.1)
34	**Limestone**: burrow-mottled lime mudstone (mottling unusually faint); nonbedded, massive	79 (24.1)	815.5 (248.6)
33	**Limestone**: as Unit 32; numerous beds of dark-pellet grainstone	17 (5.2)	736.5 (224.5)
32	**Limestone**: burrow-mottled lime mudstone; very massive, strongly cliff forming	26 (7.9)	719.5 (219.3)
	Gradational contact.		
31	**Limestone**: as below; scattered oncoids	30 (9.1)	693.5 (211.4)
30	**Limestone**: parted lime mudstone; flaggy only where maturely weathered; moderately resistant	36 (11)	663.5 (202.2)
	GSC loc. 55297 (14 ft/4.3 m above the base) *Diraphora* sp. *Kochina*? sp. *Olenoides*? sp.		
29	Covered	31.5 (9.6)	627.5 (191.3)
28	**Limestone**: parted lime mudstone; many cylindrical objects, about 2 mm in diameter (?coprolites), on bedding surfaces	17.5 (5.3)	596 (181.7)
	GSC loc. 55286 (basal 5 ft/1.5 m) *Acrothele* sp. *Paralbertella bosworthi* Walcott, 1908 *Paralbertella declevis* Rasetti, 1951 *Kochina*? sp. *Mexicella* sp. *Plagiura* sp. aff. *Proveedoria* sp. *Ptarmigania* sp. *Vanuxemella* sp. dolichometopid cranidium		
27	**Limestone**: parted lime mudstone and dark-pellet grainstone; in regular 5 cm thick beds; poorly preserved oncoids near the top; trilobite fragments are abundant in the uppermost beds	10 (3)	578.5 (176.3)
	Units 22 to 26 form an upward-steepening cliff.		
26	This unit consists of two completely different lithofacies in abrupt lateral contact.		
	A. **Limestone**: parted lime mudstone, with a 7.5 cm thick bed of oncoid packstone at the base		
	B. **Limestone**: a thrombolite complex. Cabbage-sized and- shaped thrombolites, in compound mounds 20 to 100 ft (6 to 30 m) across – some of which extend the full height of the unit. Regularly thin bedded to laminated dark-pellet grainstone between the mounds. The oncoid bed is missing beneath the thrombolite complex. The mounded relief atop the thrombolite complex is inherited upward through Unit 27		
	Thickness of Unit 26	89 (27.1)	568.5 (173.3)
25	**Limestone**: parted lime mudstone; argillaceous, laminated, with shaly fracture	56 (17.1)	479.5 (146.2)
	GSC loc. 55283 (upper contact) *Albertella* aff. *A. levis* Walcott, 1917 *Paralbertella* spp. *Ptarmiganoides*? sp. *Mexicella* sp. ptychoparioid		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
24	**Limestone**: parted lime mudstone with thick partings; rare thin beds of grainstone, especially near the base; bedding planes carry trilobite fragments and coprolite-like cylindrical objects	55 (16.8)	423.5 (129.1)
	GSC loc. 55296 (35 ft/10.7 m above the base) *Paralbertella* cf. *P. robsonensis* Resser, 1936 *Paralbertella* spp. *Mexicella* sp. cf. *Plagiura* sp.		
23	**Limestone**: skeletal grainstone; nonbedded, massive; small, spheroidal, algal stromatolites, 10 to 15 cm in diameter, rest on top of the unit	5 (1.5)	368.5 (112.3)
	GSC loc. 55281 (basal 2 ft/61 cm) *Paralbertella* sp.		
22	**Limestone**: parted lime mudstone; very thin bedded and laminated	4 (1.2)	363.5 (110.8)

Ross Lake Member
(164.5 ft/50.2 m)
(Units 9 to 21)

The member is relatively recessive weathering and presents a ledgy topographic profile.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	Covered Entirely **shale**(?), except for a 12 cm thick bed of skeletal grainstone 5 ft (1.5 m) above the base	8 (2.4)	359.5 (109.6)
	GSC loc. 55288 (5 ft/1.5 m above the base) cf. *Paralbertella*? sp. cf. *Albertella levis* Walcott, 1917 dolichometopid cranidium		
	GSC loc. 55289 (talus from Units 19 to 21) *Albertella* cf. *A. helena* Walcott, 1908		
20	**Shale** to **limestone** cycle As Unit 15	14 (4.3)	351.5 (107.1)
19	**Limestone**: cryptalgal laminite; pale grey. Uppermost 10 cm consists of ooid grainstone with extremely elongate ooids, largely accreted around trilobite spines	2 (0.6)	337.5 (102.9)
18	Poorly exposed **Shale** and **limestone**. At the base, argillaceous, blue-grey, thin bedded lime mudstone; grading upward to calcareous shale	20 (6.1)	335.5 (102.3)
17	**Limestone**: parted lime mudstone with a strong skeletal component	3 (0.9)	315.5 (96.2)
16	Covered: recessive weathering	13.5 (4.1)	312.5 (95.2)
15	**Shale** to **limestone** cycle At the base, shale: blue-grey, weathering brown and green; calcareous, and platy. Shale grades upward to (top half) limestone: lime mudstone; blue-grey, weathering orange-brown; argillaceous, thin bedded	14.5 (4.4)	299 (91.1)
14	**Limestone**: parted lime mudstone; rare beds are silty, pyritic, and micaceous	3.5 (1.1)	284.5 (86.7)
13	**Limestone**: lime mudstone; blue-grey, weathers orange-brown; very argillaceous, regularly thin bedded, laminated, platy to flaggy; fairly resistant. At the base, a 15 cm thick bed of oncoid packstone with skeletal packstone matrix	42.5 (13)	281 (85.6)
12	Covered Float of **shale**: green-grey, fissile	8 (2.4)	238.5 (72.7)
11	Poorly exposed **Shale**: blue-green, soft, very calcareous, platy; scattered trilobite fragments	10 (3)	230.5 (70.3)
10	Covered: recessive weathering	8 (2.4)	220.5 (67.2)
9	**Shale** (90%) and **siltstone** (10%) Shale: green-grey, calcareous, very fissile, with greenish black specks of neomorphic chlorite. Siltstone: in thin beds; grey, rusty weathering, calcareous, laminated. Feeding traces. Unit weathers silvery grey-green, recessive	17.5 (5.3)	212.5 (64.8)
8	**Limestone**: mainly parted lime mudstone; argillaceous, micaceous, with prominent partings of argillaceous, bright yellow-brown to orange weathering dolomite. Burrow-mottling occurs in a few beds. Many thin beds of ooid packstone in the basal 10 ft (3 m). A single layer of limestone pebbles occurs 46 ft (14 m) above the base. Unit weathers orange-brown, recessive	61.5 (18.7)	195 (59.4)

Units 2 to 7 form a distinct topographic rib.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
7	**Limestone**: thrombolitic. In the lower part, the individual heads are hemispheres, fist-sized to 1 ft (30 cm) in diameter. The top 10 ft (3 m) consist of large hemicylinders 10 to 15 ft (3 to 4.6 m) wide and at least 50 ft (15.2 m) long, oriented in the dip direction (southwest); some of these have small hemispheres perched on them. Coarse ooid grainstone/packstone forms a discontinuous infill between the thrombolites	23 (7)	133.5 (40.7)
6	**Limestone**: burrow-mottled lime mudstone at the base, grading up into parted lime mudstone. A few thin beds of ooid grainstone/packstone	18 (5.5)	110.5 (33.7)
5	**Limestone**: oolite; as Unit 4; a few beds of skeletal grainstone/packstone; trilobites and brachiopods are abundant, but poorly preserved. Unit again ends with pancake shaped stromatolites (?thrombolites), up to 2 ft (60 cm) in diameter	14 (4.3)	92.5 (28.2)
4	**Limestone**: ooid grainstone/packstone, partly dolomitic (ooids preferentially dolomitized); weathers dark grey, massive. Unit is capped by hemispherical stromatolites (?thrombolites), mostly 20 cm and less in diameter	22 (6.7)	78.5 (23.9)
3	**Limestone**: lime mudstone, interlaminated with argillaceous lime mudstone; flaggy; feeding traces abundant	7 (2.1)	56.5 (17.2)
	Gradational lower contact.		
2	**Limestone**: dark grey. At the base, dark-pellet grainstone, grading upward to ooid grainstone/packstone, in irregular beds, 5 to 10 cm thick, weathering dark grey. Beds of oncoid packstone, 10 cm thick, occur 12.5 and 23 ft (3.8 and 7 m) above the base. Above 13 ft (4 m), some beds of parted lime mudstone occur. Brachiopod and trilobite fragments are fairly abundant in the oolite beds, but poorly preserved. Ooids are preferentially dolomitized in many beds	24 (7.3)	49.5 (15.1)
1	**Limestone**: lime mudstone and fine grained skeletal wackestone/packstone; in irregular laminae and thin beds, rarely reaching 2.5 cm thick; significant silt content; bedding planes are micaceous; feeding traces are common. Rare oolitic and oncoidal beds. Unit is recessive weathering.	25.5 (7.8)	25.5 (7.8)
	Contact abruptly gradational.		

MOUNT WHYTE FORMATION
(106.5 ft/32.5 m)

Weed Member
(106.5 ft/32.5 m)
(Units 1 to 3)

The formation forms a dark, notched cliff.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
3	**Siltstone**: grey, mainly in massive (?bioturbated) 30 cm thick beds, as in Unit 1; becomes more argillaceous toward the top	27.5 (8.4)	106.5 (32.5)
2	**Siltstone**: as Unit 1, but green, very argillaceous, micaceous, intensely burrowed. A few beds, up to 10 cm thick, of crosslaminated, fine grained skeletal grainstone/packstone. Unit is more recessive weathering than Units 1 and 3	9 (2.7)	79 (24.1)
1	**Siltstone**: pale grey to white, locally greenish grey, brown weathering; quartzitic, slightly calcareous, in very regular, massive beds, 15 to 45 cm thick, with less than 10 per cent interbeds of similar, but shaly siltstone. Bedding planes are green, micaceous, marked with abundant feeding traces; moderate cliff former.	70 (21.3)	70 (21.3)
	Contact abrupt, concordant.		

GOG GROUP

PEYTO FORMATION
(148 ft/45.1 m)

The Peyto Formation is resistant, forming a cliff, with ledges developed on the more argillaceous, less resistant units.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Limestone**: fine grained ooid grainstone/packstone; crudely flaggy, weathering dark grey	4.5 (1.4)	148 (45.1)

Section continues downward.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

Type section of the Takakkaw Tongue, Cathedral Formation, Fossil Gully, Mount Stephen

The classic Fossil Gully section (Fig. 37) of Rasetti (1951) and McIlreath (1977), on the lower, north facing cliffs of Mount Stephen (Section AC–112/114 of this report), is designated the type section of the Takakkaw Tongue.

Section AC–114

STEPHEN FORMATION
(881.5 ft/268.7 m)

The lower units of the Stephen Formation are moderately recessive relative to the Cathedral, support more vegetation and weather mainly brown.

Amiskwi Member
(560.5 ft/170.8 m)

Section continues upward.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Limestone**: dark-pellet mudstone; in flaggy, regular, 2.5 to 7.5 cm thick beds; becomes finely laminated near the top. One hundred metres northeast, the upper half of this unit is a tongue of massive, resistant, pellet grainstone (the "boundary limestone")	55.5 (16.9)	166 (50.6)
3	**Shale**: as Unit 1, but lacks limestone beds and slump structures; grades into the overlying unit	17 (5.2)	110.5 (33.7)
2	**Mudstone**: pale greenish grey, weathers partly brown, partly green; slightly calcareous, siliceous, hard, non-fissile, abundant apatite(?) prisms; bedding obscure, appears thin/lenticular; almost entirely deformed by penecontemporaneous slumping, with well developed folds	32 (9.8)	93.5 (28.5)
1	**Shale** and **limestone** (very thinly interbedded and interlaminated) Shale (dominant): brownish grey, calcareous, siliceous, platy. Limestone (subordinate): siliceous lime mudstone; grey, argillaceous. Penecontemporaneous slump structures developed near the base, not seen higher. Unit weathers brown.	61.5 (18.7)	61.5 (18.7)

Abrupt lithological contact – probably a slide surface.

CATHEDRAL FORMATION
(794.5 ft/242.2 m)

Takakkaw Tongue
(Type Section)

The units described below form cliffs interrupted by thin, ledge-forming, recessive intervals. In views from the base of Mount Field, the recessive intervals pinch to the northeast, so that the Cathedral Formation forms an almost unbroken cliff at the Monarch Mine. To the southwest, the Cathedral Formation progressively loses its cliff forming character, and becomes indistinguishable, at a distance, from the underlying and overlying formations.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
16	**Limestone**: greyish brown, microcrystalline, siliceous, partly dolomitic; in very thin, planar, uniform beds 0.5 to 3.5 cm thick, with partings of orange-weathering, dense dolomite (ribbon-bedded lime mudstone). Penecontemporaneous slump structures are present throughout the unit, although most prominent in the basal 50 ft (15.2 m). The uppermost 25 ft (7.6 m) of the unit forms an anticline and syncline, truncated by the base of the overlying shales. Unit weathers dark grey with thin, orange partings	304.5 (92.5)	794.5 (242.2)
15	**Limestone**: lime mudstone; slightly dolomitic, 2.5 to 8 cm thick beds with thin, regularly wavy partings of grey, very fine crystalline dolomite (ribbon-bedded lime mudstone). Unit is massive, and continues the bedding style of the underlying dolomite	26 (7.9)	490 (149.2)

Replacement contact.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
14	**Dolomite**: pale brown to white, fine to medium crystalline, thin bedded, with 25 per cent partings of dark brown, very fine crystalline dolomite; flaggy. Stromatactoid dolomite occurs at intervals throughout, and is especially well developed in the middle of the unit. A 20 cm thick bed of coarse dolomite breccia occurs within this middle stromatactoid zone and contains slabs, up to 2.5 x 20 cm, of light coloured dolomite in a dark brown matrix (debris-flow breccia?). The beds of this unit pinch rapidly southwestward. Evidence of slumping includes contorted laminae and broken beds	34 (10.4)	464 (141.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
13	**Limestone**: mainly dark-pellet grainstone; partly recrystallized, nonbedded, very massive, resistant. Large masses have been altered to dolomite: pale grey and yellowish grey to white, medium inequicrystalline, vuggy, massive, with wisps of dark brown, very fine crystalline dolomite. A mass of dolomitized breccia, of unknown extent, occurs 20 ft (6.1 m) above the base and is probably debris-flow breccia. The breccia consists of pale fragments of dolomite, up to 5 x 30 cm in section, in a dark brown matrix. Another mass of similar breccia occurs 15 ft (4.6 m) below the top of the unit. The upper part of this massive unit terminates abruptly southwestward and is overlain by thin bedded dolomite with pronounced draping	70 (21.3)	430 (131.1)
12	**Dolomite** and **limestone** At the base, limestone: as Unit 10, thin and minor medium bedded, with thin partings of grey shale. Fifteen feet (4.6 m) above the base, limestone changes to dolomite: pale grey and pale brown to white, fine and minor medium to coarse crystalline, bedded precisely as the underlying limestone. Many beds display "grading" from fine crystalline at the base to medium or coarse crystalline at the top. Stromatactoid structure locally developed. Two feet (60 cm) below the top, an 8 cm thick zone displays apparent small-scale current ripple marks with a wavelength of 1 to 1.2 cm	59.5 (18.1)	360 (109.7)
11	"Beaded" **debris flow** This massive depositional unit, generally 3.5 ft (1.1 m) thick, has local, abrupt swellings to 6 ft (1.8 m). From most weathered surfaces and fresh fragments, it appears to be lime mudstone; however, thin section examination reveals that a specimen from one of the swellings is *Epiphyton* framestone. The unit was not recognized as a debris flow until after I.A. McIlreath's documentation of the character of these flows as they occur in the tongue. On very careful re-examination, the fragmental nature of the unit was recognized. Some of the "beads" are probably small *Epiphyton* bioherms, but the "beads" are known to consist elsewhere of matrix-supported breccia as well	3.5 (1.1)	300.5 (91.6)
10	**Limestone**: at the base the unit mainly consists of laminated to thin bedded, flaggy, parted lime mudstone, with partings of argillaceous dolomite and dark grey shale, and minor thin and medium beds of dark-pellet grainstone, partly skeletal. Pelleted beds increase upward so that the upper part of the unit is dominated by thin and medium bedded, dark-pellet grainstone, intraclast-pellet grainstone, and trilobite-pellet grainstone. Phenoclasts include cryptalgal fragments	46.5 (14.2)	297 (90.5)
9	**Limestone**: intraclast-skeletal-pellet grainstone; as Unit 10; massive, resistant	6.5 (2)	250.5 (76.4)
8	**Limestone** (50%) and **shale** (50%) (interbedded) Limestone: trilobite wackestone; black, carbonaceous, with splendent lustre, medium bedded. Shale: dark brown, weathering very pale yellow-brown, carbonaceous, slaty, slightly recessive	20 (6.1)	244 (74.5)
7	**Limestone**: lime mudstone(?); fine crystalline, bituminous, with laminae of oolitic trilobite-echinoderm packstone/wackestone; overall appearance is medium bedded, massive, with carbonaceous partings. Certain widely spaced medium beds develop swellings, or "beads", up to five times their normal thickness; these "beaded" beds are debris flows (cf. Unit 11), but their matrix-supported breccia character can be seen on only a few, especially favourable, "washed" surfaces. One debris flow, 27 ft (8.2 m) above the base, contains a massive spheroid, 19 ft (5.8 m) in diameter, of *Epiphyton* framestone; this appears to be a transported, *Epiphyton* bioherm	40 (12.2)	224 (68.3)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 65843 (19 ft/5.8 m above the base) *Nyella* sp. *Kochiella*? sp. *Ogygopsis* sp. *Pachyaspis* sp. *Pagetia* sp. *Stenothecoides* sp. cf. *Stephenaspis* sp. (?)*Plagiura-Poliella* Zone		
6	**Limestone**: grey, fine crystalline, argillaceous; in 7.5 to 20 cm thick regular beds, with subordinate interbeds of dark grey, calcareous shale; rare trilobites	25 (7.6)	184 (56.1)
5	**Limestone**: dark-pellet wackestone; largely recrystallized, nonbedded, massive, with scattered discontinuous wisps of tan weathering dolomite. A 2.5 ft (0.8 m) thick subunit of shaly limestone (as below) occurs in the middle of the unit	8 (2.4)	159 (48.5)
4	Covered: except for one small outcrop of limestone (as below) near the top of the unit	16 (4.9)	151 (46)
3	**Limestone**: mainly pelmatozoan wackestone at the base, in thin lenticular beds with interbeds of argillaceous, shaly limestone. Higher in the unit the limestone is mainly calcisiltite: silty, argillaceous, shaly, with abundant brachiopods and poorly preserved trilobites. Minor lenses of skeletal wackestone	40 (12.2)	135 (41.1)
2	**Limestone**: mainly skeletal dark-pellet grainstone; pyritic, nodular, with sparse partings of dense dolomite. A pillow shaped mass, 2 ft x 10 ft (0.6 x 3 m), occurs three feet (1 m) below the top of the unit. It consists of skeletal pellet wackestone and is presumably a slide block	19.5 (2.9)	95 (29)
1	**Limestone**: ooid grainstone; mainly medium grained, lenticular, thin and minor medium beds with tan weathering partings of dense dolomite. Beds of pelmatozoan-trilobite grainstone/packstone with abundant cryptalgal bioclasts are minor in most of the unit but dominate in the uppermost 15 ft (4.6 m).	75.5 (23)	75.5 (23)
	Abrupt contact and topographic break, from relatively recessive below to cliff forming above.		

The upward continuation of the section is offset two fifths of a mile (0.6 km) from North Gully (Section AC-112) to the rib between the Middle and Fossil gullies (Section AC-114). The two legs of the composite section are tied together on the basis of lithological sequence, verified by visual tracing of bedding – obvious changes in the character of the strata above and below the contact take place between the initial, lower, and offset, upper, lines.

Section AC-112

NAISET FORMATION
(337 ft/102.7 m)

The Naiset Formation is markedly less resistant than the Gog below and the Cathedral above; it forms steep, dark coloured, partly talus covered slopes.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Sandstone** and **limestone** At the base, sandstone: pale pinkish brown, very fine grained, well sorted, angular, siderite-cemented, finely laminated. The sandstone grades upward to brachiopod-trilobite wackestone: silty, sandy, laminated. Top of unit has a pronounced mamillated surface with 2.5 cm of relief	1.5 (.5)	337 (102.7)
10	**Limestone**: calcisiltite; very siliceous, abundant authigenic feldspar, finely laminated, massive, weathers dull orange, moderately resistant	72 (21.9)	335.5 (102.3)
9	Covered	5.5 (1.7)	263.5 (80.3)
8	**Limestone**: siliceous calcisiltite, as Unit 10. Abundant laminae and lenses of ooid grainstone: siliceous, locally sandy. Minor laminae of sandstone: very fine grained, dolomitic. Unit weathers "ribboned", dull orange and grey; massive, forms a minor cliff	53 (16.2)	258 (78.6)
	Section continues downward to the Gog Group.		

Lithology

The typical Cathedral Formation east of the Kicking Horse Rim is dominated by burrow-mottled lime mudstone and subordinate parted lime mudstone. These limestones are interrupted by minor thin and medium beds of dark-pellet grainstone and intraclast grain/rudstone. Nearly black oncoid wackestone and packstone generally form a few beds, especially in the interval extending for a few metres above shaly units. Minor intervals (lenses?) of pale-pellet grainstone, fenestral in part, occur in a few sections. A bed or beds of ooid grainstone and packstone occur at or within 100 ft (30 m) of the base of the formation in a number of sections. A unit of cryptalgal laminite occurs at, or just below the top of the formation in most of the more westerly sections. The thrombolites in the basal part of the Cathedral Formation in the vicinity of Ross Lake, and the bioherm-like mounds of thrombolites in a similar position at Beauty Creek, are local developments only.

Along the Kicking Horse Rim, as typified by the Wedgewood Peak, Mount Whymper, and Kicking Horse Pass roadcut sections, the lithological aspect of the Cathedral Formation is distinct. Much of the formation along the rim consists of dolomite, including abundant megacrystalline and stromatactoid dolomite (implying pale-pellet grainstone as a precursor). Where not dolomitized, the formation is characterized by pale-pellet grainstone, cryptalgal laminite, and fenestral lime mudstone. In the Kicking Horse Pass roadcut section, scattered laths of gypsum are present in pale-pellet grainstone 230 ft (70.1 m) above the base. Gypsum also occurs at the top of the Cathedral Formation at Tokumm Creek (McIlreath, 1977). Along the crest of the rim, and best preserved in the Monarch Creek section on Mount Stephen, there is a completely dolomitized facies of decimetre-scale cycles, correctly identified by McIlreath (1977) as a reef-flat facies. The most complete cycles are as follows:

4. Fenestral dolomite. Rarely, centimetre-scale algal stromatolites.

3. *Yoholaminites*[1] in tabular, encrusting, or nodular habit (Figs. 33-35).

2. *Epiphyton*, in layers and tufts, only rarely in a recognizable state of preservation (Fig. 36).

1. Dolomite, ex-ooid packstone/grainstone and wackestone (Fig. 33).

The cycles are generally separated by erosion surfaces, and some have minor erosion surfaces within them.

At Wedgewood peak (Section AC–103), the base of the Cathedral Formation is marked by algal stromatolites overlain by 140 ft (42.7 m) of skeletal ooid grainstone with beds of oncoid packstone. This shallow-water succession, which includes a biostrome of branching *Yoholaminites*, is interrupted by an interval of the ribbon-bedded lime mudstone facies (for which a deeper water origin is inferred). This facies grades upward through parted lime mudstone to peritidal facies deposits (fenestral lime mudstone, cryptalgal laminite) again. The interval of deeper water facies (presumably an eastward-pinching tongue) is an analogue of the Field Member of the Eldon Formation, though not so conspicuous, or (so far as known) as extensive.

At Mount Whymper (Section AC–53), three distinct, intra-unit surfaces interrupt the cryptalgal laminite. The surfaces are scalloped, consisting of decimetre-scale, bowl-like depressions separated by sharp ridges (Fig. 38). Laminae in the underlying bed terminate against the "bowls". Laminae filling the "bowls" are planar in some instances and draped into semiconformity with the sides of the "bowls" in others. The scalloped surfaces are interpreted as solution features developed intertidally or supratidally on lithified limestone bedrock (see Read and Glover, 1977). The occurrence of these erosional features at Mount Whymper, like the gypsum at Kicking Horse Pass and Tokumm Creek, constitutes important, independent, *objective* evidence supporting the existence of the Kicking Horse Rim during Cathedral time; the features were discovered years after the concept of the rim was first published.

Several accounts suggest that the Cathedral Formation consists mainly of dolomite, whereas, in fact, the bulk of the formation consists of limestone. The reason for this misconception is that Cathedral limestone is mainly expressed topographically as nearly vertical cliffs devoid of comfortable climbing holds, whereas the dolomitized parts of the formation form

[1] *Yoholaminites* is an organo-sedimentary structure characterized by fine, chevron-kinked laminae. It occurs in tabular, encrusting, nodular, and (rarely) erect, branching forms. McIlreath and Aitken (1976) concluded that it is an organic structure and might be a calcareous alga or a stromatoporoid. It has been found only in a dolomitized state of preservation. During a later field excursion with colleagues, conclusive evidence was found to prove that the structure is an unusual void-filling cement, possibly a tufa.

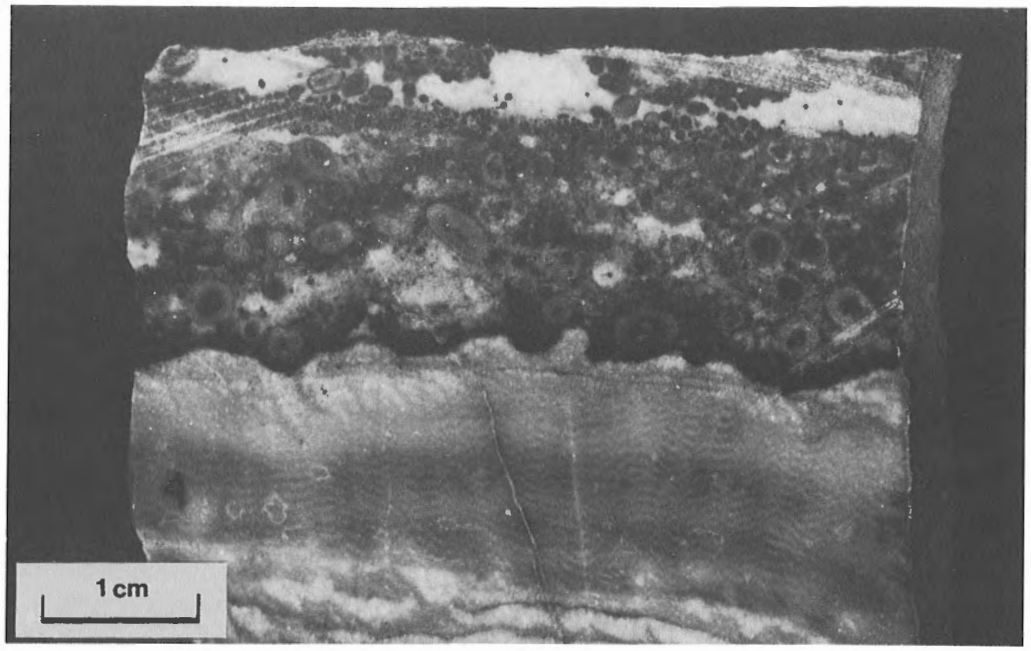


Figure 33. *Dolomite with layers of* **Yoholaminites** *and oolite, from the reef-flat facies of the Cathedral Formation, above Monarch Creek. (Polished slab.) Note the fine, chevron-kinked laminae diagnostic of* **Yoholaminites**. *The erosional contact at the base of the ooid packstone demonstrates that* **Yoholaminites** *encrusted a free depositional surface. ISPG photo 1601-7.*

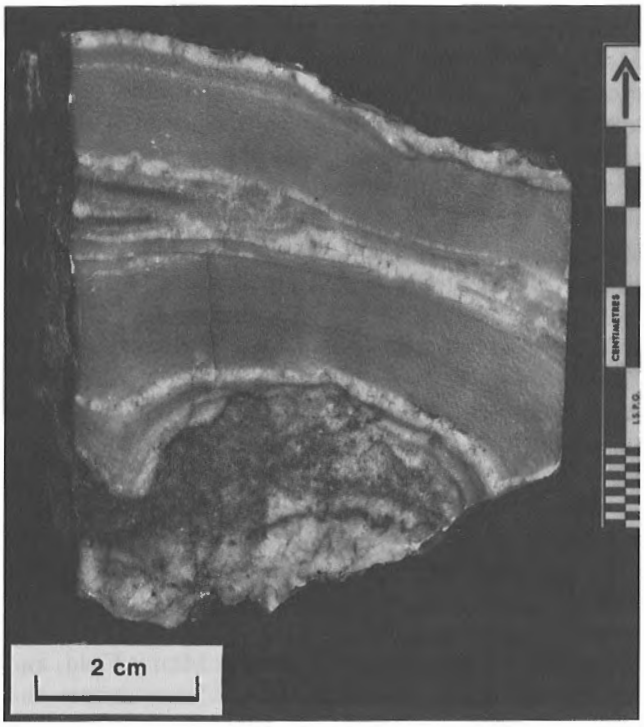


Figure 34. **Yoholaminites** *encrusting an erosion surface. (Polished slab.) From the same locality as the sample shown in Figure 33. ISPG photo 1601-4.*

more broken cliffs with many hand- and footholds. Understandably, the formation has been studied mainly where it can be traversed without resort to heroics. Base-to-top dolomitization of the Cathedral Formation is common (though not ubiquitous) only along the Kicking Horse Rim; elsewhere, it is seen only in the vicinity of faults that cut the bedding at high angles.

Cathedral Escarpment

The Cathedral Escarpment (Figs. 40, 41, 54) is not a stratigraphic entity but a depositional structure at the outboard edge of the Cathedral carbonate platform. The escarpment was anticipated by Rasetti (1951) to account for the "boulders" in what is here called the Takakkaw Tongue. Ney (1954) first recognized the escarpment, describing it as a depositional feature whose form "resembles that of a reef." Aitken and Fritz (1968), unaware of Ney's contribution, rediscovered the escarpment, and showed that, "The existence of a submarine bank of high relief is proved by the position of the contact between the *Glossopleura* and *Bathyuriscus–Elrathina* zones, which occurs at the top of the carbonate bank at its basinward edge, and 700 ft lower in the adjoining shaly section . . . ." They also concluded that the prolific Burgess Shale fauna had flourished at the toe of the escarpment.

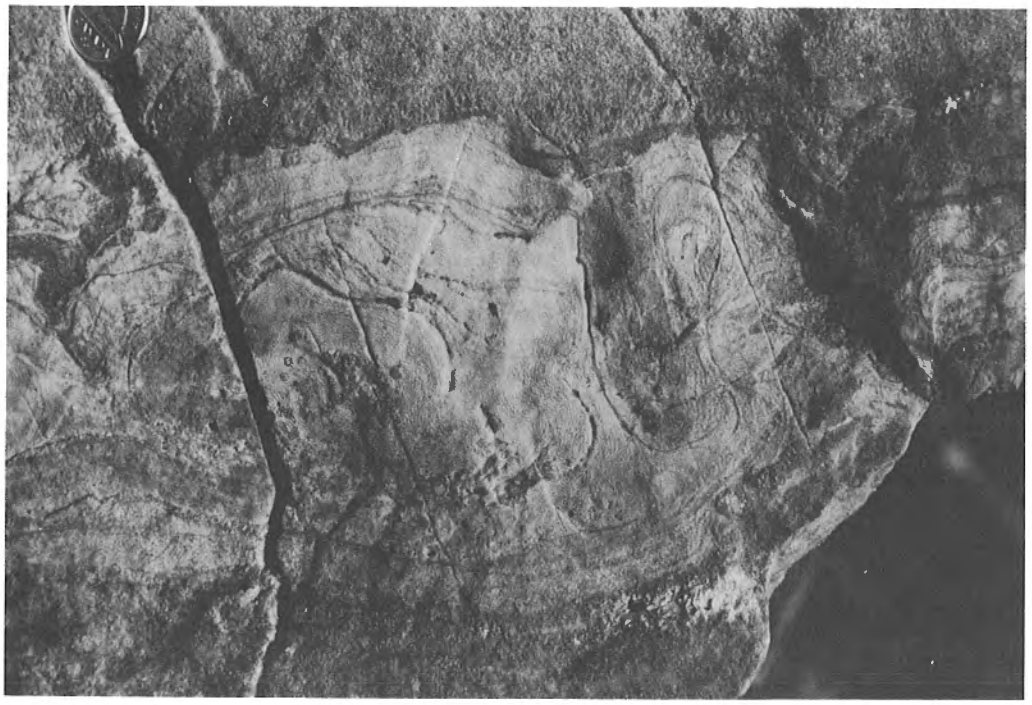


Figure 35. Yoholaminites *in nodular habit. (Weathered block.) From the same locality as the sample shown in Figure 33. The "overturned" laminae at the base of the specimen are characteristic of the nodular habit. One cent coin on the upper left for scale. ISPG photo 758-9.*

McIlreath (1975, 1977a, b) studied the critical area in detail. He concluded that the near-vertical escarpment of crystalline dolomite limiting the upper two-thirds of the carbonate platform was an organo-sedimentary reef, as is the unequivocal progradational reef limiting the lower third (Fig. 40).

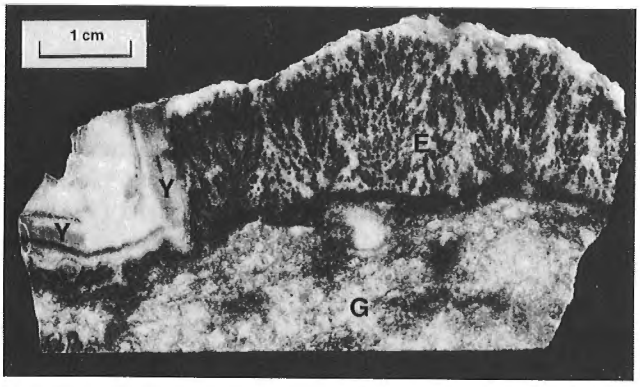


Figure 36. *Dolomite with* ***Epiphyton****, ex-ooid grainstone, and* ***Yoholaminites****, from the reef-flat facies of the Cathedral Formation at Mount Stephen. The grainstone* (G)*, and the* ***Yoholaminites*** (Y) *encrusting* ***Epiphyton*** (E) *are largely obscured by coarse, white, replacive dolomite. ISPG photo 1601-8.*

Ludvigsen (1989, 1990) challenged the objective existence of the escarpment, interpreting it as a rapid change of facies. Fritz (1990) and Aitken and McIlreath (1990) responded in defense of the escarpment, and regarded the reef model as still attractive. They noted, however, the work of Stewart (1989), who documented, along the west flank of the Kicking Horse Rim, several examples of escarpments resulting from large-scale gravitational failure of the platform margin. These were most notable at the level of the Eldon Formation, but also occurred at the level of the Cathedral. Stewart pointed out that the Cathedral Escarpment may be an escapment of this "collapse" type. If so, the critical evidence proving his other examples has not been discovered at Mount Field or Mount Stephen.

Values for the "height" of the escarpment (exclusive of the underlying, progradational reef) vary substantially. Ney (1954) gave the height at Mount Field as "nearly 400 feet". McIlreath's (1977) measurements were 700 ft (213 m) at Fritz's (1971) "Paradox" section, 450 ft (137 m) at Mount Field, and 625 ft (190 m) at Mount Stephen. Measurements and reconstructions arising from the present study (the escarpment cannot be measured in a single, continuous section) indicate that the total height of the dolomite wall at Mount Field is 733 ft (223 m). This does not

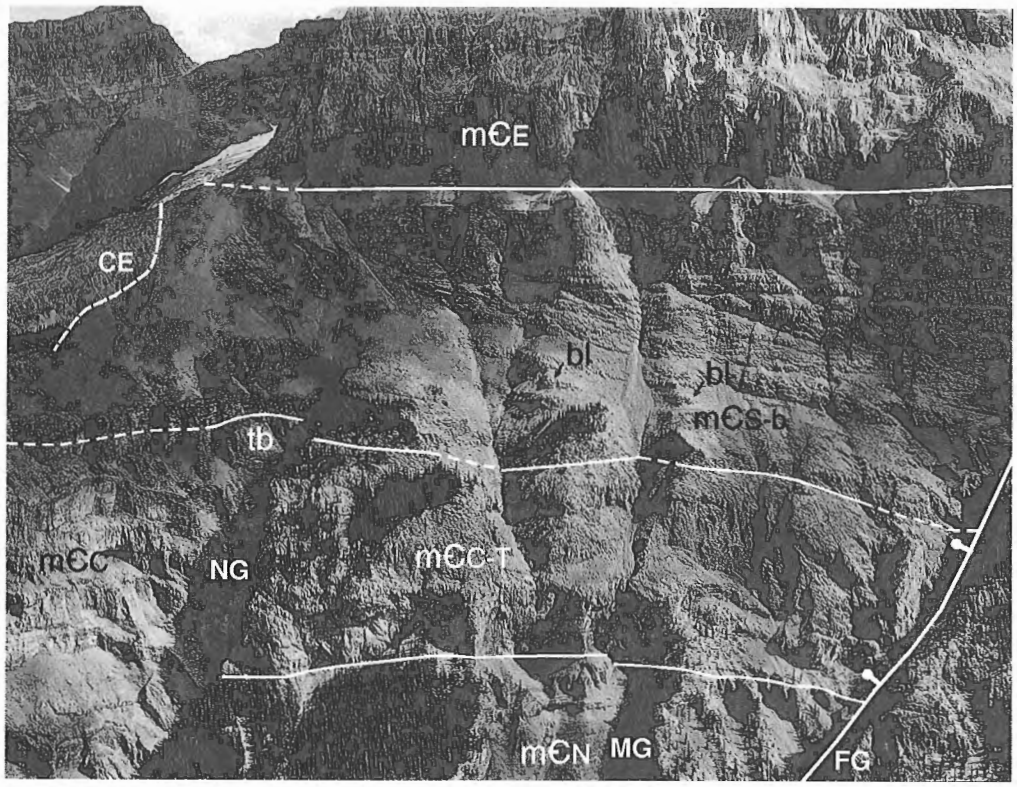


Figure 37. *The lower north face of Mount Stephen. (Oblique air photograph.)* NG–*North Gully;* MG–*Middle Gully;* FG–*Fossil Gully;* CE–*Cathedral Escarpment;* mЄN–*Naiset Formation;* mЄC–*Cathedral Formation;* mЄC-T–*Takakkaw Tongue of the Cathedral Formation (type section);* mЄE–*Eldon Formation;* mЄS-b–*"basinal" Stephen Formation;* bl–*"boundary limestone";* tb–*giant talus block from the Cathedral Escarpment embedded in the Takakkaw Tongue. ISPG photo 1577-2.*

mean that the escarpment ever stood that high above the sediments of the basin to the west. For example, immediately following the accumulation of the "boundary limestone", the submarine escarpment was only 528 ft (161 m) high (uncorrected for compaction). Its height declined thereafter, until the muds and lime sands of the Stephen Formation had buried the initial relief. Most of the variation in published values for the "height" of the escarpment at Mount Field relate less to differences in measurement than to different meanings of "height" in this context.

McIlreath (1977a, b) showed that undolomitized megaclasts in the Takakkaw Tongue, both isolated blocks and fragments contained in debris-flow breccias, included organosedimentary boundstones and framestones consistent with origin in a true reef. The principal framework builder is the alga *Epiphyton* (Fig. 42), with other algae, *Girvanella* and *Renalcis,* playing a minor role. Laminite-forming cyanobacteria and pervasive early marine cement also appear to have been important. The source of the megaclasts was the progradational reef (Fig. 39). No such clasts derived from the escarpment above are known; however, the reef-flat facies, described above, lies inboard of both the established reef and the escarpment; this implies that, even if the escarpment is a mass-collapse feature, a platform-margin reef existed formerly at that level also. The reef-flat facies is well preserved at the section on Mount Stephen above Monarch Creek, the switchbacks on the Yoho Valley road, the exposures immediately east of the exposed escarpment on the midde of three spurs on the southwest flank of Mount Odaray, and east of the Kicking Horse Mine adits in the south face of Mount Field.

Ross Lake Member

In the lower third of the Cathedral Formation, the Ross Lake Member (Figs. 11-13, 17, 30, 31, 43, 52) consists of recessive, dark grey shale that weathers olive-green to brown or pale orange-brown. Locally, as at the type section, nodules or lenses of micro-

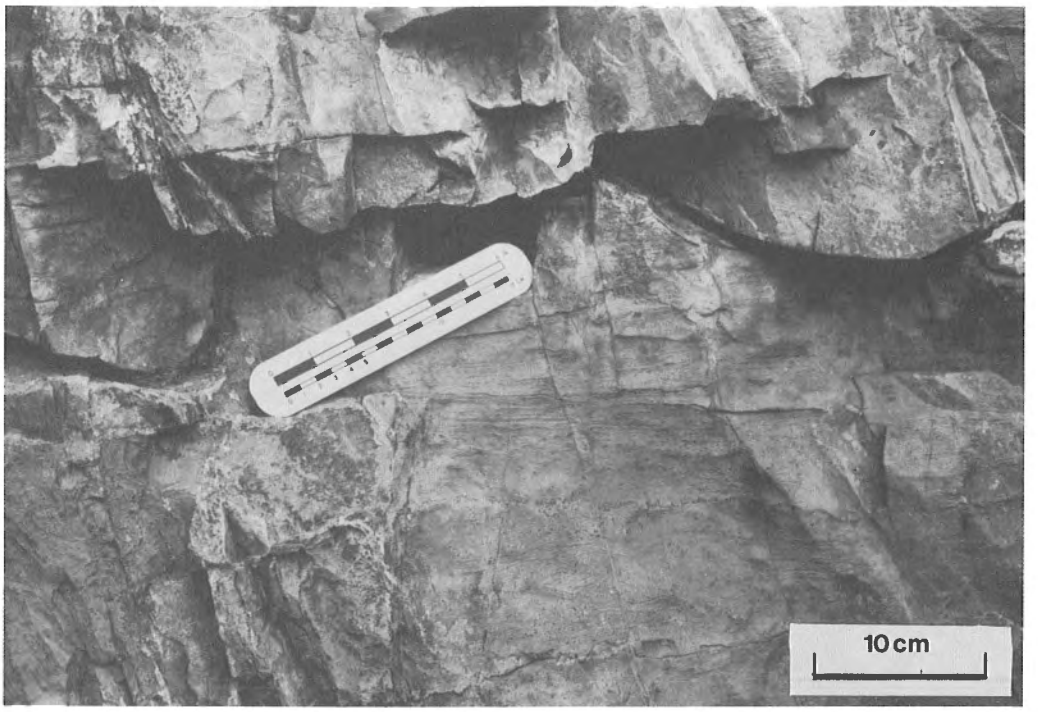


Figure 38. *Scalloped contact between successive units of cryptalgal laminite in the Cathedral Formation at Mount Whymper (Section AC–55). The contact is interpreted as a surface of solutional erosion, developed within reach of wave-surge or spray. ISPG photo 1659-9.*

crystalline limestone occur in the shale at the top of the member. At and near the type section, trilobites and other fossils of an *Albertella* Zone fauna are abundant in the shale (Fig. 44), as well as in a single, thin, limestone bed. Regionally, however, the shale is nearly devoid of useful fossils, although trilobites occur abundantly, both in the thin limestones of the member proper, and in the limestones that immediately overlie and underlie it. Because the shale and the immediately underlying parted lime mudstone are markedly recessive weathering, the Ross Lake Member is commonly covered. Even where covered, however, it can normally be identified as a sharp erosional notch or ledge, overlain by parted lime mudstone that is unusually thin bedded (or laminated) and dark ("sooty") in both the fresh and the weathered states.

Trinity Lakes Member

The Trinity Lakes Member (Figs. 7, 11, 12, 17, 32) is a tongue of shale and limestone, analogous to the Ross Lake Member, that lies in the upper half of the Cathedral Formation and bears *Glossopleura* Zone fossils. The member also can be identified within the Snake Indian Formation, as far north as Jasper.

Shale of the Trinity Lakes Member is generally calcareous, grey, brownish grey or olive and weathers greenish grey, bluish grey, or pale orange-brown. It is commonly rich in trilobites. Minor purple-red shale is seen at shoreward localities, especially within the Snake Indian Formation. At the type section of the member, four distinct subcycles are exposed (five, if shale is inferred to be present in the basal covered interval). Each subcycle commences with the abrupt appearance of shale above limestone. At mid-cycle, lime mudstone beds with shale partings appear; the partings become increasingly calcareous upward as the strata grade into normal parted lime mudstone facies, with trilobite fragments, laminae of trilobite coquina, and rare oncoids. The subcycle ends with the abrupt reappearance of shale.

Near its pinchout, as at Ghost River (Section AC–28), the Trinity Lakes Member consists of a single, recessive weathering, shale bed overlain by sooty, parted lime mudstone; and thus, except for the associated fossils, is indistinguishable from the Ross Lake Member elsewhere.

Takakkaw Tongue

The Takakkaw Tongue of the Cathedral Formation (Figs. 39, 54) is the westward projection of the lower Cathedral Formation beyond the Cathedral Escarpment. The tongue is 794.5 ft (242.2 m) thick at

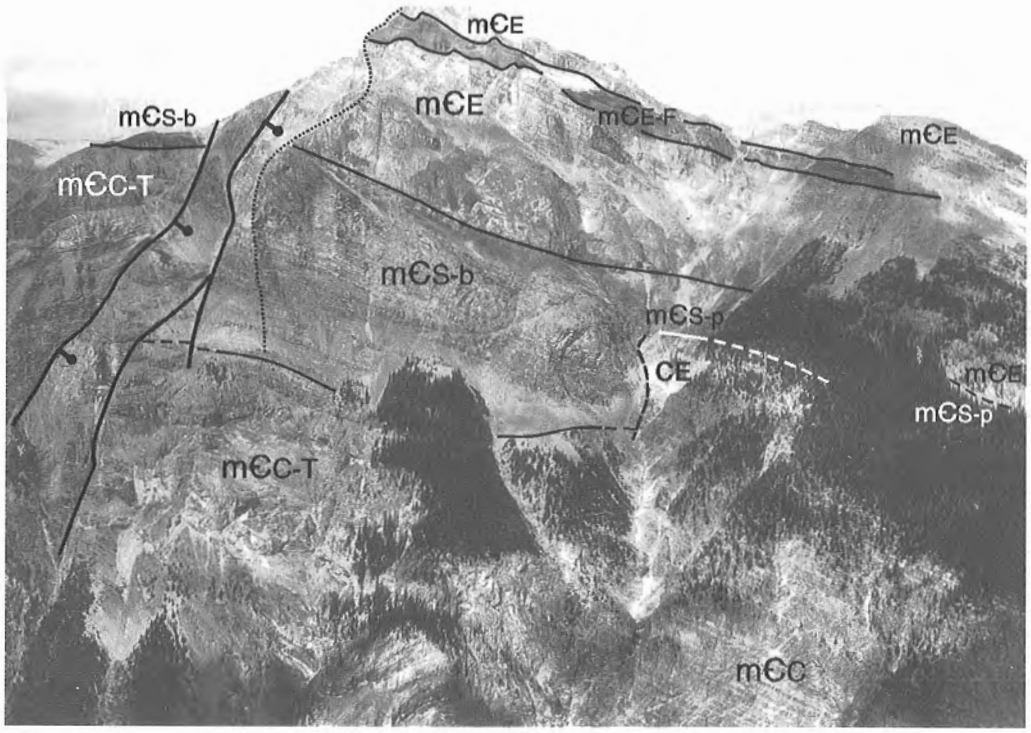


Figure 39. *The southeast face of Mount Field, viewed from the Cathedral Escarpment on Mount Stephen.* m€C*–Cathedral Formation;* m€C-T*–Takakkaw Tongue;* m€S-p*–"platformal" Stephen Formation;* m€S-b*–"basinal" Stephen Formation;* m€E*–Eldon Formation;* m€E-F*–Field Member;* CE*–Cathedral Escarpment. In the Cathedral Formation, note the east-to-west (right-to-left) passage from prominently bedded reef-flat facies, through massive dolomite (core of the progradational reef), to clinoform, fore-reef debris beds. Dotted line at left indicates the type sections of the Amiskwi and Wapta members of the Stephen Formation and the Field Member of the Eldon Formation. ISPG photo 1644-3.*

the type section [815 ft/248.4 m according to Fritz's (1971) measurement], and is dominated by sooty, ribbon-bedded lime mudstone containing abundant, commonly scoop-shaped, gravity slide surfaces (Figs. 45, 46). The strata are interrupted by debris-flow masses derived from the progradational reef (Figs. 47, 48) and by minor graded beds of skeletal wackestone and packstone (McIlreath, 1977). A unit of ooid and subordinate skeletal grainstone, 75.5 ft (23 m) thick, forms the base of the tongue. At the type section, much of the middle part of the tongue is altered to finely crystalline (locally medium and coarse crystalline) and stromatactoid dolomite; dolomitization apparently having been controlled by the Fossil Gully fault. The Takakkaw Tongue forms a major cliff at the type section, and becomes less of a feature-former as it thins westward.

Contacts

Criteria for locating the gradational Mount Whyte/Cathedral and Naiset/Cathedral contacts are discussed above, under the appropriate headings. Exceptions to general conformity occur at at least two localities on the Kicking Horse Rim, Vermilion Pass and Mount Odaray, where the Mount Whyte Formation is missing and the Cathedral Formation rests unconformably upon the Gog Group.

On the subject of the Cathedral/Stephen contact, Rasetti (1951, p. 69) wrote: "The thick-bedded limestone or dolomite of the Cathedral is usually overlain by thin-bedded, argillaceous, platy limestone of the Stephen and the contact is sharp in most of the sections." In that the burrow-mottled lime mudstone or derived dolomite is overlain at the contact by parted lime mudstone, Rasetti was correct, but to say that the contact is sharp (except as seen at a distance) is misleading. Regionally (with local exceptions), the Cathedral/Stephen contact is gradational, to the degree that its placement is uncertain within a few feet or metres. At the top of the Cathedral Formation, bedding in the mottled lime mudstones becomes progressively thinner, and the mottlings more abundant and argillaceous, until the rock must be assigned to the parted facies. A reduction in erosional resistance parallels these changes but, in most sections,

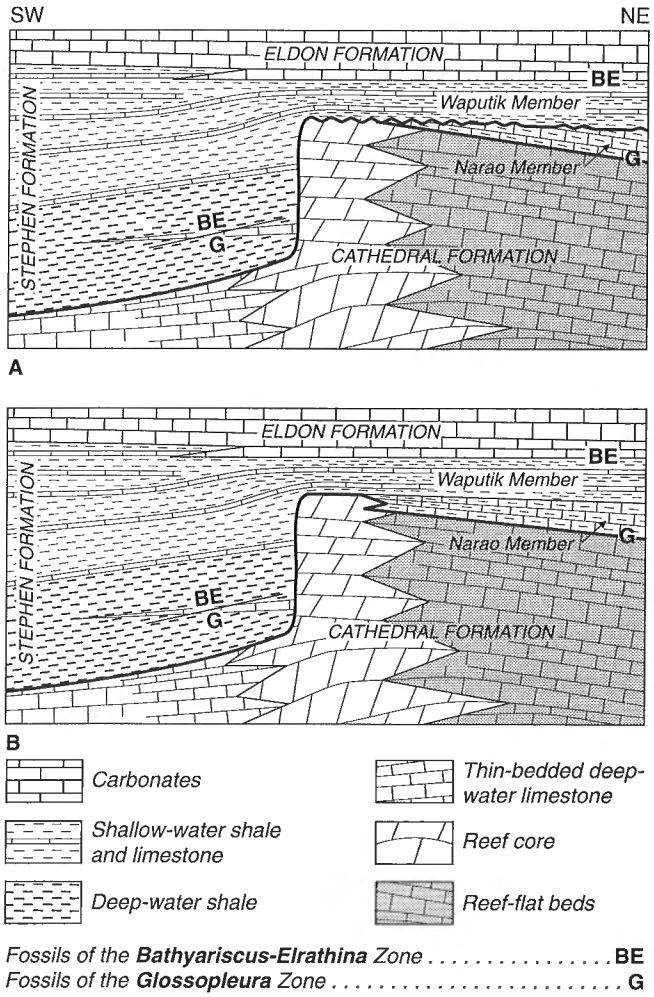


Figure 40. *Possible stratigraphic relationships at the Cathedral Escarpment.* ***A.*** *Base of Stephen Formation unconformable–either at the Kicking Horse Rim, or throughout the platform region (Deiss, 1940; Rasetti, 1951; Fritz, 1971; McIlreath, 1977). Evidence is the absence of the* ***Glossopleura*** *Zone fauna at the rim.* ***B.*** *Base of Stephen Formation conformable, except, possibly, strictly locally, at the rim (this paper). The Narao Member (with* ***Glossopleura****) changes facies to unfossiliferous, dolomitized, cryptalgal laminite over the rim.*

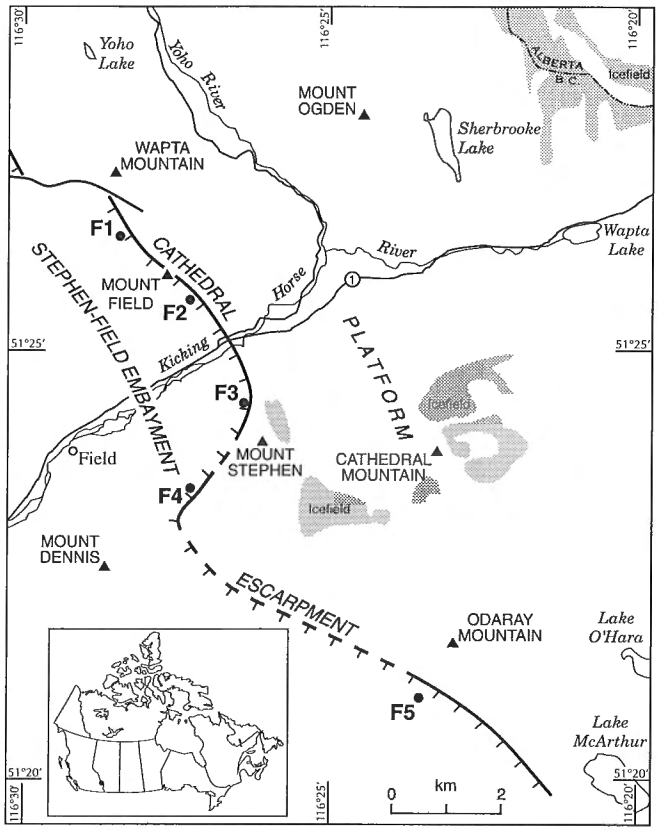


Figure 41. *Map of the Cathedral Escarpment, showing the prolific fossil localities.* F1–*Burgess Shale;* F2–*abundant* ***Bathyuriscus rotundatus****, sponges, and rare worms;* F3–***Canadaspis*** *sp.,* ***Anomalocaris*** *sp., and sponges;* F4–*Mount Stephen "Fossil Beds" (****Ogygopsis*** *shale), prolific* ***Ogygopsis klotzi****, and* ***Anomalocaris*** *sp.; and* F5–*Mount Odaray, west flank, abundant (deformed) trilobites. Each of these localities is associated with an exposure of the escarpment.*

the first actual ledge is within the Stephen Formation not at its base. Locally, dolomitization of the more susceptible burrow-mottled lime mudstone beds, beneath less susceptible parted lime mudstone beds that remain undolomitized, has produced a sharp and obvious contact – as in the Kicking Horse Pass roadcuts. Such contacts record diagenesis more than deposition, however, and must not be thought of as typical.

At localities along the Kicking Horse Rim, the Cathedral/Stephen contact is generally sharp, because there, the basal unit of the Stephen is the shaly Waputik Member, rather than the limestone-dominated Narao Member. This sharp contact has been interpreted as disconformable by Fritz (1971) and McIlreath (1977), but neither worker recognized that the lower member (Narao Member) of the Stephen Formation passes by facies change into beds that are included with the Cathedral Formation along the crest of the Kicking Horse Rim (and may be treated as the Narao Member of the Cathedral Formation). This relationship is discussed further under "Stephen Formation".

Regional conformity is indicated by the generally gradational nature of the Cathedral/Stephen contact and the fact that (except locally) faunules of the *Glossopleura* Zone occur on both sides of it.

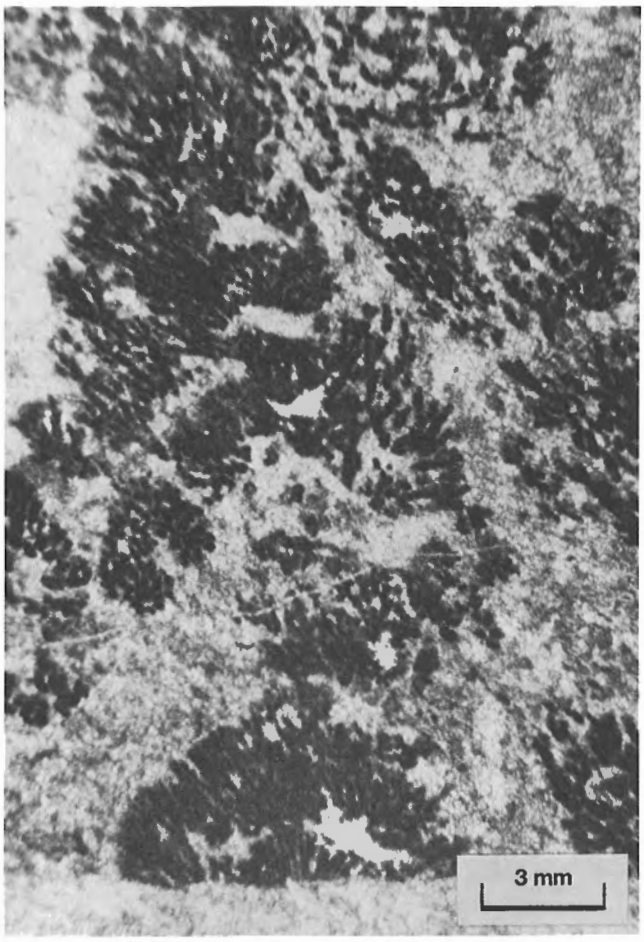


***Figure 42. Epiphyton** in limestone from a block contained in a coarse debris flow derived from the platform-margin reef–Takakkaw Tongue of the Cathedral Formation at Mount Stephen.*

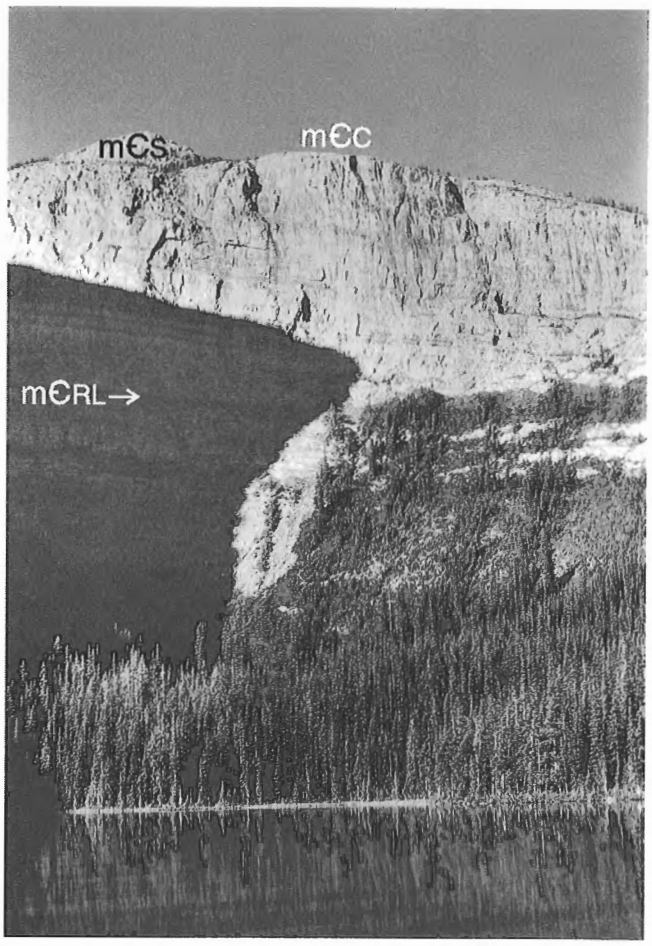


***Figure 43.** The reference section for the Cathedral Formation and type section of its Ross Lake Member at Ross Lake. The base of the Cathedral is covered at the west side of the cirque, shown here. m€RL–Ross Lake Member; m€c–approximate top of Cathedral Formation; m€s–Stephen Formation. Note the metre-scale sedimentary cycles at several levels in the Cathedral. ISPG photo 1644-2.*

Distribution and thickness

The Cathedral Formation is an extensive carbonate lithosome, limited in all directions by facies changes. Northward and northwestward along the structural grain, thickening of the shaly Ross Lake and Trinity Lakes members, and thickening of the Mount Whyte Formation at the expense of the overlying Cathedral Formation, result in a change from the limestone-dominated Cathedral Formation to a shale-dominated equivalent - part of the Snake Indian Formation. This change takes place along a line slightly north of Athabasca Glacier and Beauty Creek (Mountjoy and Aitken, 1978).

Eastward, the thinning Cathedral Formation extends into the subsurface of the Alberta Plain (Aitken, 1989). Farther east it passes into a detrital facies, part of the subsurface Earlie Formation, along a line drawn east of Edmonton and Medicine Hat (Pugh, 1971, fig. 5).

Southward, along tectonic strike, structural plunge carries the Cathedral Formation beneath the surface south of Mount Assiniboine. When coeval rocks next appear, at Windsor Mountain, south of Crowsnest Pass, shaleout of the lower Cathedral to Gordon Formation has progressed upward into the *Glossopleura* Zone, and the considerably thinned carbonate remaining is either the Elko Formation (510 ft/155.4 m), or (less likely) the Elko plus Windsor Mountain Formation (732 ft/223 m; Norris and Price, 1966).

Westward, the Cathedral Formation loses much of its thickness at the abrupt, syndepositional Cathedral Escarpment. West of the escarpment, the Cathedral exists only as the Takakkaw Tongue. McIlreath

Figure 44. *Trilobite-littered slab from the type section of the Ross Lake Member of the Cathedral Formation. This profusion of fossils is characteristic in the general vicinity of the type section. All but two or three of the specimens shown belong to the genus* ***Albertella****. ISPG photo 1644-1.*

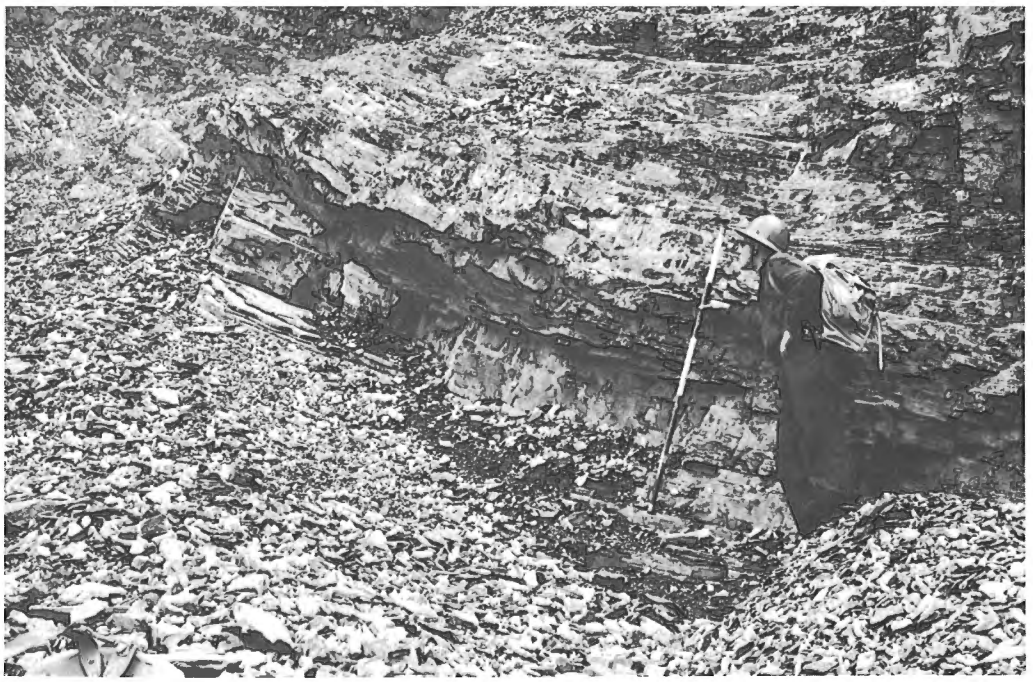


Figure 45. *Slide mass in ribbon-bedded lime mudstone–type section of the Takakkaw Tongue of the Cathedral Formation. More than 20 ft. (6 m) of beds are truncated at the underlying slide surface. Because of the proximity of the Cathedral Escarpment to the east (left), the distance of transport cannot have exceeded 300 m. Jacob's staff is graduated in feet. GSC photo 1-37-64.*

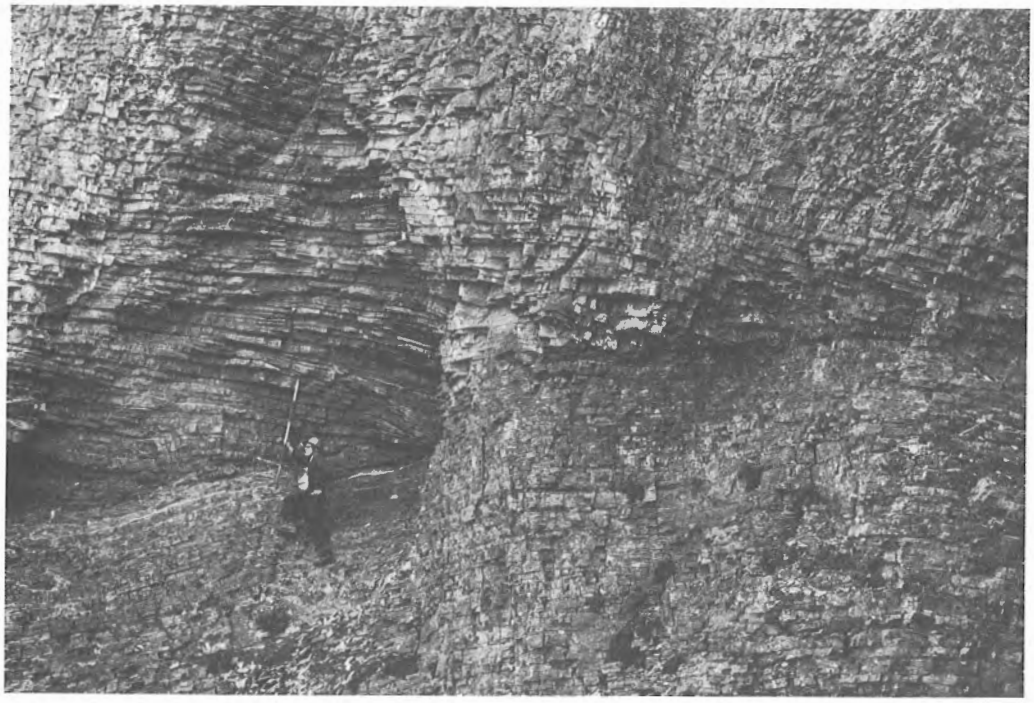


Figure 46. *Slide surface in ribbon-bedded lime mudstone–type section of the Takakkaw Tongue of the Cathedral Formation. Jacob's staff is graduated in feet. GSC photo 1-30-64.*

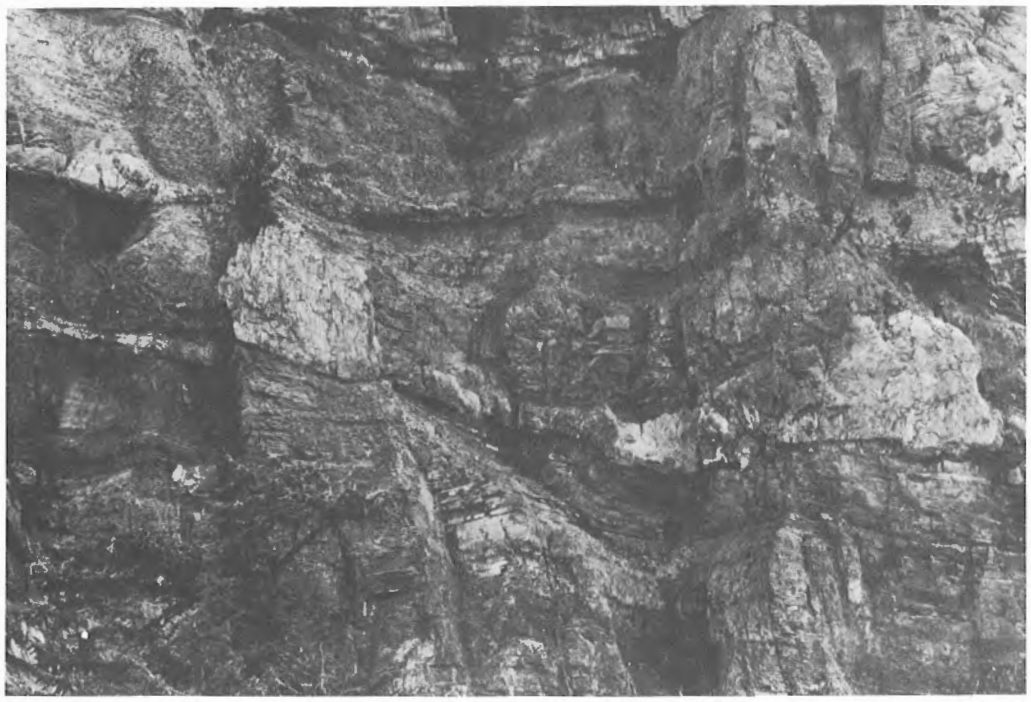


Figure 47. *Two debris flows in the Takakkaw Tongue of the Cathedral Formation at Mount Field. The megaclasts, or "beads", are connected by a massive, medium to thick bed of breccia–the remains of the flow that carried the megaclasts. GSC photo 1-8-66.*

Figure 48. A debris-flow breccia in the Takakkaw Tongue of the Cathedral Formation at Mount Field. The mass at the upper right is part of a megaclast more than one metre in diameter. Twenty-five cent coin for scale. ISPG photo 1569-8.

(1977b) pointed out that the Takakkaw Tongue ("thin Cathedral") is not observed to change facies westward into assumed shaly equivalents of the Chancellor Formation, as postulated by Cook (1975). Nevertheless, the following changes from the regional character of the lower Cathedral Formation to and within the Takakkaw Tongue (documented by McIlreath, op. cit.) call for the conclusion that the Cathedral underwent a rapid facies change between Mount Stephen/Field and the point at which its westward dip carries the formation from view, just west of Field:

1. The Takakkaw Tongue is dominated by dee9-water, slope facies – in contrast to the prevailing shallow-water, subtidal facies east of the Cathedral Escarpment – and contains much more argillaceous material than the Cathedral Formation does regionally.

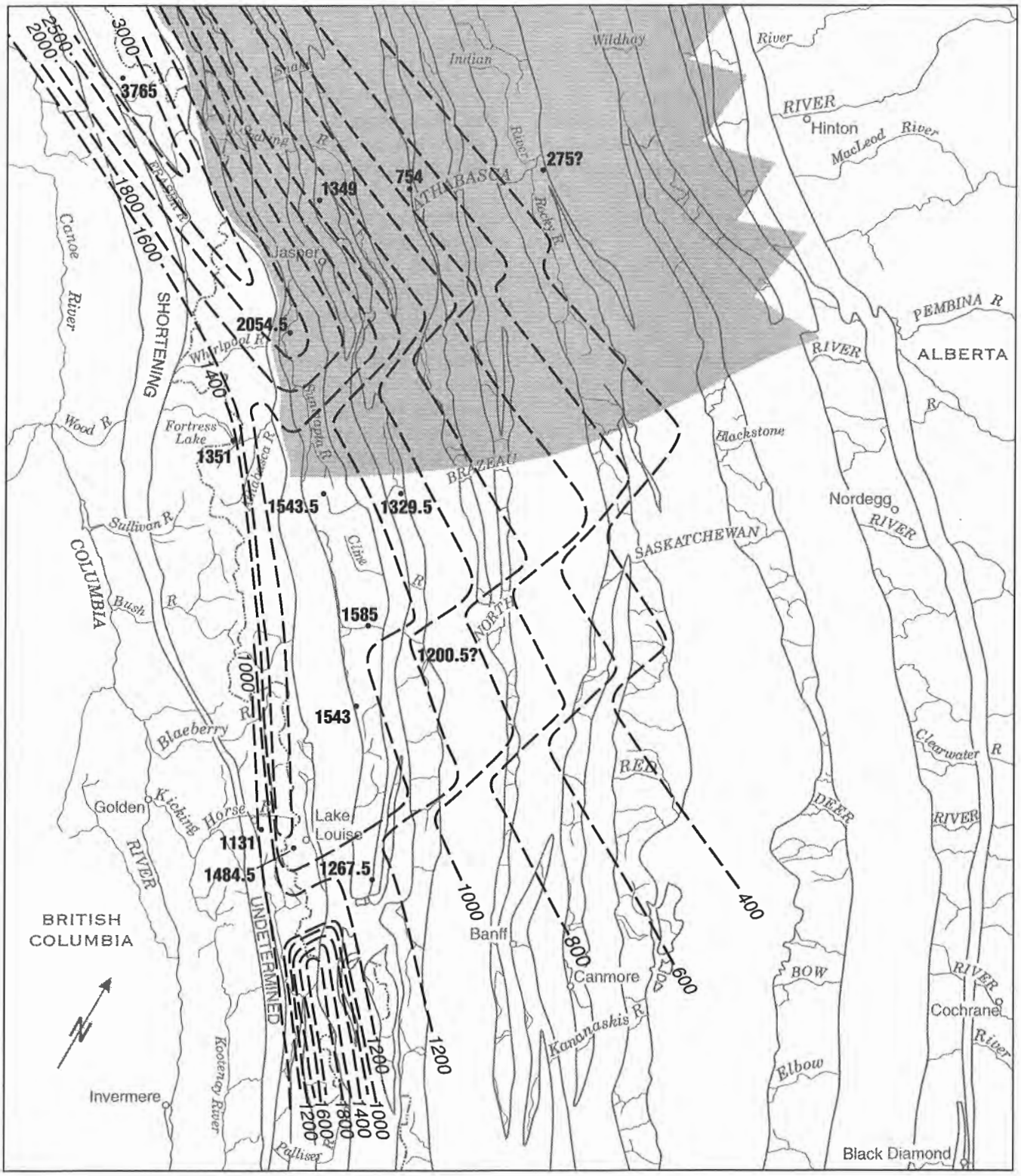
2. The tongue thins rapidly westward, from 795 ft at the type section to less than 600 ft (242.3 m to less than 182.9 m). Convergence of bedding, demonstrative of this thinning, is visible in views of the lower cliffs of Mount Stephen and Mount Field (Figs. 37, 39).

3. Talus blocks, debris flows, and allochthonous (platform derived) calcarenites are all more numerous near the Cathedral Escarpment than in the westernmost exposures of the tongue.

It should be noted that the Cathedral Escarpment is exposed for only 30 miles (50 km), from Hawk Creek to Emerald Lake. It typifies the western edge of the Cathedral Platform where that edge is exposed, but is not necessarily a regional feature. The presence of tongues of deeper water, ribbon-bedded lime mudstone lithofacies interrupting shallow-water, rim or near-rim facies at Mount Assiniboine (Section AC–103) and Chaba River (Section AC–143), and the great thickness of the ribbon-bedded lime mudstone lithofacies in the Chetang Formation (largely Cathedral equivalent) near Mount Robson (Sections AC–165, 166), suggest that, in these areas, the Cathedral platform edge may have been a ramp like that of the Eldon Formation rather than an escarpment.

The thickness of the Cathedral Formation at a given point in the platform region is mainly the result of interplay between the rate of subsidence during Cathedral time (best represented by the thickness of the Mount Whyte/Cathedral Grand Cycle, Fig. 49) and the degree to which Cathedral carbonates have changed northeastward to Mount Whyte mixed carbonate and detrital facies. An additional modification occurs along the rim, where the Narao Member of the Stephen Formation passes westward into rim carbonates that are included of necessity within the Cathedral Formation. The Cathedral is thickest in its most western exposures, just before its disappearance westward. The greatest known thickness is roughly 2 000 ft (610 m) at the Cathedral Escarpment on Mount Stephen. The Cathedral thins eastward (in part by passage of its uppermost strata into the Narao Member of the Stephen Formation) to 1 231.5 ft (375.4 m) at Ross Lake. The formation is 522 ft (159.1 m) thick at Ghost River, the only locality along the mountain front to provide a complete section.

The Ross Lake and Trinity Lakes members may be viewed as southwesterly pinching tongues of the Mount Whyte Formation. Their distribution is summarized in Figure 50. Note that while the pinchout of the Trinity Lakes Member lies northeast of that of the stratigraphically lower Ross Lake Member, the Trinity



Measured thickness, Mount Whyte-Catherdral Grand Cycle (feet) . . . . . 27.
Isopach of Mount Whyte-Cathedral Grand Cycle (interval 200 feet). . . . . .

Figure 49. *Isopach map of the Mount Whyte/Cathedral Grand Cycle and equivalent part of the Snake Indian Formation (shaded area). (Palinspastic restoration based on Fig. 15.)*

Lakes Member maintains its identity farther northeastward than does the Ross Lake. This relationship is another important demonstration that the boundary between lime mud deposition and terrigenous mud deposition followed the overall northeastward transgression of the Middle Cambrian shoreline. It is noteworthy that, while the Ross Lake Member shales may be said to pinch out against the Kicking Horse Rim (at least from Kicking Horse Pass to Mount Assiniboine), the Trinity Lakes Member pinches out well east of the rim.

Paleontology and age

In the Rocky Mountains, the base of the Cathedral Formation ranges from within the *Plagiura–Poliella* Zone to well up in the *Albertella* Zone. Northeastward convergence of the base of the Cathedral toward the Trinity Lakes Member suggests that the base must rise into the *Glossopleura* Zone in the subsurface of the Plains.

The top of the Cathedral Formation lies within the *Glossopleura* Zone. The formation is, therefore, early to medial Middle Cambrian.

Interpretation, Mount Whyte/Cathedral Grand Cycle

The Cathedral and Mount Whyte are intimately related and partly contemporaneous formations forming a complete Grand Cycle (Aitken, 1989). They represent contrasting but linked responses to a single series of events, and are therefore interpreted jointly.

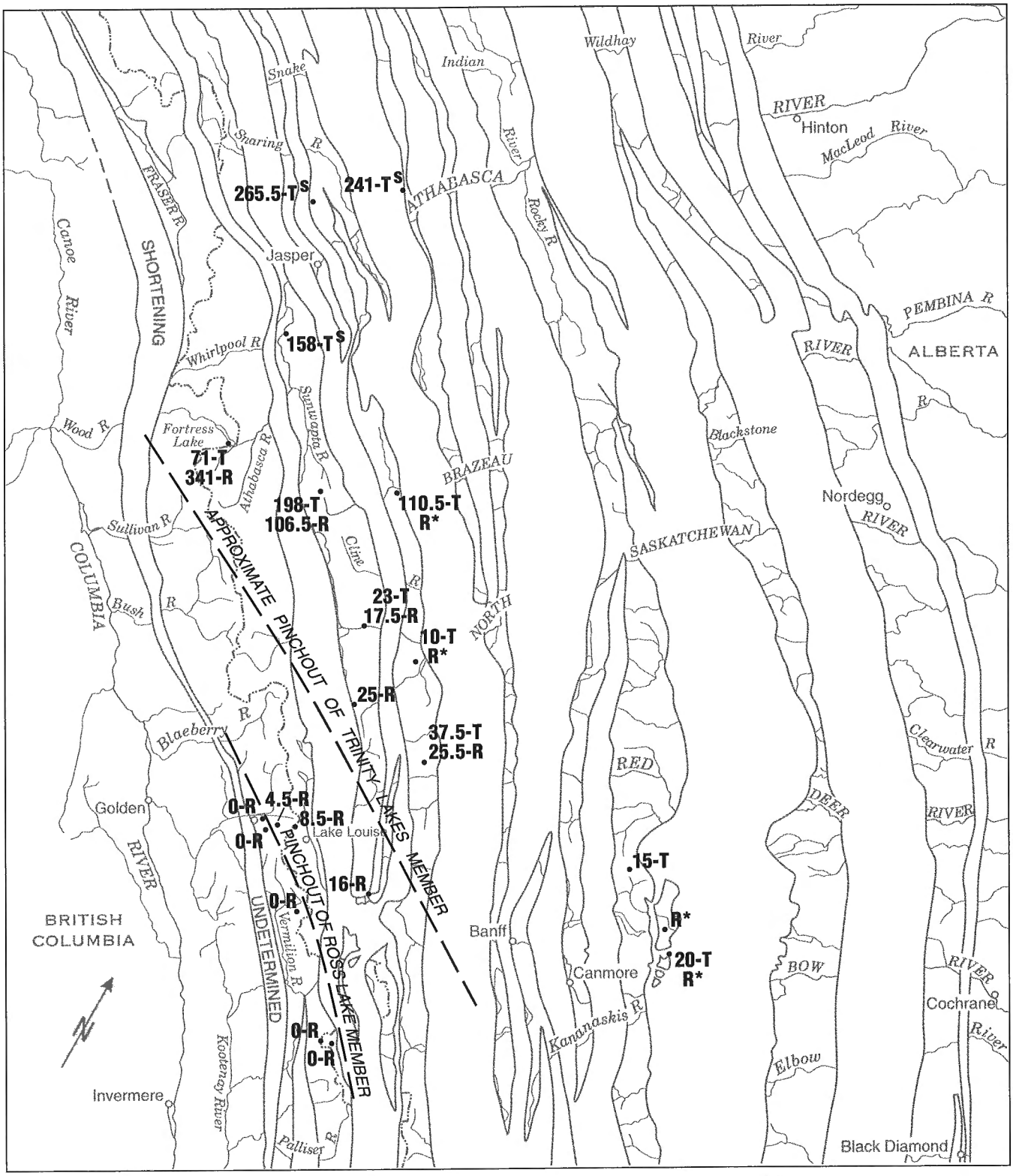
The earliest deposits of the cycle record a marine transgression, during which fine grained detrital sediments were laid down (Weed Member of the Mount Whyte) across an erosional surface developed on top of the Gog Group. Along the Kicking Horse Rim, the Mount Whyte Formation is thin and locally missing, evidence of a tectonically elevated rim that ponded muddy sediments on its inward side, thus permitting early establishment of carbonate sedimentation (the earliest Cathedral beds) along the rim.

The earliest Cathedral Formation sediments, deposited on an elevated rim flanking the open basin and, therefore, in an environment of high turbulent energy, were ooid grainstones. Deposition of the grainstones perpetuated or even accentuated the relief of the rim, and provided a foundation for the growth of a reef. The reef was at first the progradational embedded reef, flanked outboard by clinoform beds of carbonate debris, and subsequently developed into the nearly vertical Cathedral Escarpment, flanked outboard by siliciclastic muds (McIlreath, 1977). McIlreath's studies show that the reef was built largely by algae, *Epiphyton, Girvanella*, and renalcids, with contributions by blue-green algae (cyanobacteria). Submarine cementation also played a large role.

As the progradational embedded reef was growing upward and outward, maintaining its crest at or near sea level, carbonate strata, now the Takakkaw Tongue, were accumulating in progressively deeper water at the toe of the escarpment. Westward thinning of the tongue, and distinct changes in lithology westward, indicate that the tongue consists largely of carbonate particles that originated on the reef and associated peritidal complex. Subsequently, deposition of beds of reef and reef-flat derived carbonate debris in front of the reef diminished markedly, and the reef front developed into a nearly vertical wall, the Cathedral Escarpment, which was subsequently buried in siliciclastic muds of the Stephen Formation.

McIlreath (1977), building upon earlier studies by Wilson (1974) and Mesolella et al. (1970), produced a plausible model for growth of the Cathedral Escarpment, in which the nearly vertical growth of the reef front is attributed to equality between the rates of upward reef growth and eustatic rise or basin subsidence. His analysis perhaps should have given more emphasis to differential rates of carbonate sedimentation; peritidal organic deposition on the crest and front of the reef, and mixed organic and inorganic deposition on the peritidal reef flat, were undoubtedly much more rapid than deposition in the flanking subtidal environments. So long as the potential rate of peritidal deposition equalled or moderately exceeded the rate of subsidence, the reef could continue to build a nearly vertical wall facing the open basin. Tongues of peritidal facies extending eastward from the rim probably record episodes during which the potential rate of depositional upbuilding on the reef crest and reef flat was substantially faster than subsidence, resulting in progradation of peritidal over subtidal facies.

Parts of the expanding carbonate complex were at least intermittently emergent along the rim. The gypsum occurrences probably owe their origin to the isolation of small lagoons or pans by bars or tidal-creek levees, and the cupped surfaces at Mount Whymper record erosion of cemented sediment, probably during episodes of slightly lowered sea level. Reinterpretation of *Yoholaminites* as a cavity-filling tufa also supports intermittent emergence.



Measured thickness, Ross Lake Member (feet) **16-R**
Measure thickness, Trinity Lakes Member (feet) **20-T**
Ross Lake Member indistinguishable within Mount Whyte Formation . . . . . **R***
Trinity Lakes Member within Snake Indian Formation . . . . . **T^S**

Figure 50. *Map of measured thicknesses, Ross Lake and Trinity Lakes members of the Cathedral Formation. (Palinspastic restoration based on Fig. 15.)*

Asymmetry of the profile through the reef and associated shoal complex, with gradually deepening, carbonate-depositing environments platformward, and an escarpment descending into a deep-water, semi-starved environment on the side of the open basin, suggest that the net movement of seawater over the Cathedral Escarpment was prevailingly toward the inshore basin, carrying most of the carbonate particles created on the rim inward. A corollary is that, where platform carbonate lithosomes are bounded basinward by a ramp rather than an escarpment (e.g., the Eldon Formation), net movement of water may have been balanced or basinward.

While the peritidal carbonate complex on the rim built upward in response to relatively rising sea level, and expanded somewhat into the inshore basin, the belt of bioturbated silt that was to become the Weed Member continued to advance northeastward behind the transgressing shoreline. At the most easterly sections in the mountains, siltstone is interbedded with littoral or sublittoral sandstone. Between the belt of sublittoral silt and the inner edge of the carbonate shoal complex lay a quiet environment below fairweather wave base. There, sedimentation alternated between deposition of terrigenous mud and deposition of carbonate sediment, especially lime mud, giving rise to the Chephren Member. Carbonate muds accumulated when the energy regime was inadequate to transport terrigenous mud completely across the inshore basin. In the south, deposition appears to have been continuously subtidal; units of ooid and skeletal grainstone probably record localized high-energy conditions due to basin currents or microtopography. To the north, however, beds of algal stromatolites probably record shallowing, and mudcracked beds, temporary emergence.

With continued cratonward advance of the belt of detrital sediments in response to continued transgression, deposition of lime mud, now the Cathedral Formation, became continuous in the outer part of the inshore basin. Continued transgression caused the boundary between terrigenous and lime muds to migrate cratonward; carbonate sediments thus came to overlie detrital and mixed sediments, giving rise to a Grand Cycle. The Ross Lake and Trinity Lakes members record sharp pulses of increased terrigenous mud supply. The presence in the Front Ranges of some purple-red coloration in strata of the Trinity Lakes Member of the Snake Indian Formation (a consistent signal of approach to a shoreline in the lower Paleozoic of the region) might suggest that the shale tongues record progradational regressions. Within the Main Ranges, on the other hand, there is no evidence of shallowing during deposition of the shale tongues, but rather the contrary. The rocks, the unusual abundance of fossils, and the appearance of new faunas suggest deepening, interpreted here as a eustatic rise of sea level.

During the early part of the history recounted above, roughly through *Plagiura–Poliella* time, silty, calcareous, terrigenous muds that were to become the Naiset Formation were accumulating below wave base on a slope outboard of the rim. By *Albertella* time, these muds were covered by Cathedral carbonate sediments immediately west of the rim. Because carbonate sedimentation was already established on the rim in *Plagiura–Poliella* time, the Naiset muds cannot have been transported from the inshore basin across the rim to its outer slope. Either the Naiset muds had a source separate from that of the Mount Whyte muds, or mud from a single source followed different routes to its ultimate resting places.

The end of the Grand Cycle appears to have been nearly synchronous over nearly all of the platform region, and is marked by the greatest eastward expansion of peritidal lithofacies (cryptalgal laminite, pale fenestral lime mudstone, pale-pellet grainstone) at the top of the Cathedral Formation. Synchroneity applies along the Kicking Horse Rim to the extent that the contact equivalent to the base of the Stephen Formation can be recognized regionally, but, where peritidal dolomites equivalent to the Narao Member of the Stephen Formation have been included with the Cathedral along the rim, the appearance of argillaceous rocks, generally perceived as the initial deposits of the next cycle, marks a slightly later event.

Recommended sections

Completely exposed sections of the Cathedral Formation are widespread in the southern Rocky Mountains. Unfortunately, most of these sections present mountaineering difficulties so severe as to require special techniques and trained companions, for their safe study.

Ghost River

The section at Ghost River (AC–28) manifests regionally representative facies in a greatly thinned section.

Kicking Horse Pass roadcuts

The faulted section in the roadcuts at Kicking Horse Pass (Sections AC–122/123) is very important in illustrating the near-rim aspect of the Cathedral

Formation, but it must be understood that this section is atypical of the formation in a regional sense.

Mount Weed

The section at Mount Weed (AC-171), although faulted, provides a regionally typical view of the Cathedral Formation, with well developed Ross Lake and Trinity Lakes members.

Monarch Creek

The reef-flat facies of the Cathedral Formation is best preserved in the section on Mount Stephen above Monarch Creek; the exposures at the switchbacks on the Yoho Valley road are less satisfactory.

Ptarmigan Limestone

The "Ptarmigan Limestone" (Walcott, 1917a, b, 1928) was fully reviewed by Deiss (1939), who concluded that it was a formation of somewhat local development, equivalent to some lower part of the Cathedral Formation. The essential basis for its recognition (by both Walcott and Deiss) appears to have been the lithological criterion of (relict) limestone versus the (secondary) dolomite that makes up most of the Cathedral Formation in the general vicinity of Lake Louise. As demonstrated repeatedly in the present study, limestone/dolomite contacts generally do not conform to bedding, nor do they lie subparallel to the contacts of associated lithostratigraphic units. Accordingly, Rasetti's (1951, p. 65) decision not to recognize the "Ptarmigan Limestone" was correct; the formation serves no useful purpose, and should be treated as obsolete.

Stephen Formation

Definition

The Stephen Formation is recognized as a recessive weathering unit shale with beds of limestone that separates the thick, resistant carbonate rocks of the Cathedral Formation beneath from those of the Eldon Formation above (Figs. 5, 6, 28-31, 37, 39, 51, 52, 69, 70, frontispiece). In the northeastern part of the region studied, it can be recognized as the Stephen Member of the Snake Indian Formation.

Throughout the platform region; that is, the region northeast of the Kicking Horse Rim, the Stephen Formation ("platformal Stephen") is newly divided here into a lower unit, the Narao Member, consisting of limestone and minor shale, and an upper unit, the Waputik Member, in which limestone is normally subordinate to shale. Locally, along the rim, the Waputik Member constitutes the entire formation.

In the limited area of exposure west of the Cathedral escarpment, the basinal facies of the formation (i.e., the "thick Stephen" of Fritz, 1971, and McIlreath, 1977a, b) is here newly subdivided into a lower unit, the Amiskwi Member, consisting of shale with only minor amounts of limestone, and an upper unit, the Wapta Member, consisting of shale with numerous beds of limestone and minor siltstone and dolomite. The Wapta Member lithologically resembles the Waputik Member and is largely equivalent to it.

The Burgess Shale Member or lentil is famous for its unique, beautifully preserved fossils of soft-bodied animals (Walcott, 1911b, p. 51, footnote; Rasetti, 1951, p. 77-79; Fritz, 1971; Whittington, 1971, 1980, 1985; Collins and Rudkin, 1981; Conway Morris and Whittington, 1985). It is an unmappable body of rock distinguished only by its fossils. Accordingly, it is not given formal status here, but is regarded instead as a particular exposure of the Amiskwi Member of the "basinal" Stephen Formation.

The *Ogygopsis* shale member or lentil (Walcott, 1908c, p. 210; Rasetti, 1951, p. 75-77), like the Burgess Shale, is distinguished only by its fauna and is not mappable. It, too, is regarded here as a particular exposure of the Amiskwi Member of the "basinal" Stephen Formation.

Origin of names

The Stephen Formation was defined by Walcott (1908a) and is named after Mount Stephen, 10.5 km (6.5 miles) southwest of the type section. The Narao Member (new) is named after Narao Peak, 4.8 km (3 miles) south-southeast of the type section. The Waputik Member (new) is named after the Waputik Range, north of its type section. The Amiskwi Member (new) is named after the Amiskwi River, 10 km (6 miles) southwest of its type section. The Wapta Member (new) is named after Mount Wapta, 3.2 km (2 miles) north of its type section.

Type section

Rasetti (1951, p. 70-72) reviewed the problems surrounding Walcott's choice and confusing indication of a type section, initially on the "north and east sides of Mount Stephen" and later on the "northwest side

of Mount Stephen, above Field." Rasetti revealed his concept of the Stephen Formation in the following words (p. 71), "Moreover, the succession of strata that might be defined as the Stephen formation both in the eastern and western parts of Mount Stephen is not typical of that portion of the stratigraphic column in the area investigated." Geologists familiar with the stratigraphy of the southern Rocky Mountains would agree with Rasetti, and without known exception have treated the platformal facies of the Stephen Formation – as seen, for instance, in the vicinity of Lake Louise, Mount Eisenhower, and Bow Lake – as the "normal" Stephen, and have treated the much thicker equivalent strata ("basinal Stephen" of this report), seen in a limited area centered on the western slopes of Mount Stephen, as anomalous. Moreover, although a complete section of the "basinal Stephen" can indeed be measured on Mount Stephen along a line just east of the Fossil Gully Fault, the task is both difficult and dangerous. Rasetti (ibid.) was justified, therefore, in recommending the section (AC–4 of this report; Fig. 30) described by Deiss (1940), on the south slope of Mount Bosworth, as the type section, despite the fact that such a change of locale might be taken to violate modern stratigraphic practice. Deiss's practice and Rasetti's recommendation are formally adopted here. The type section also serves as the type sections of the Narao and Waputik members.

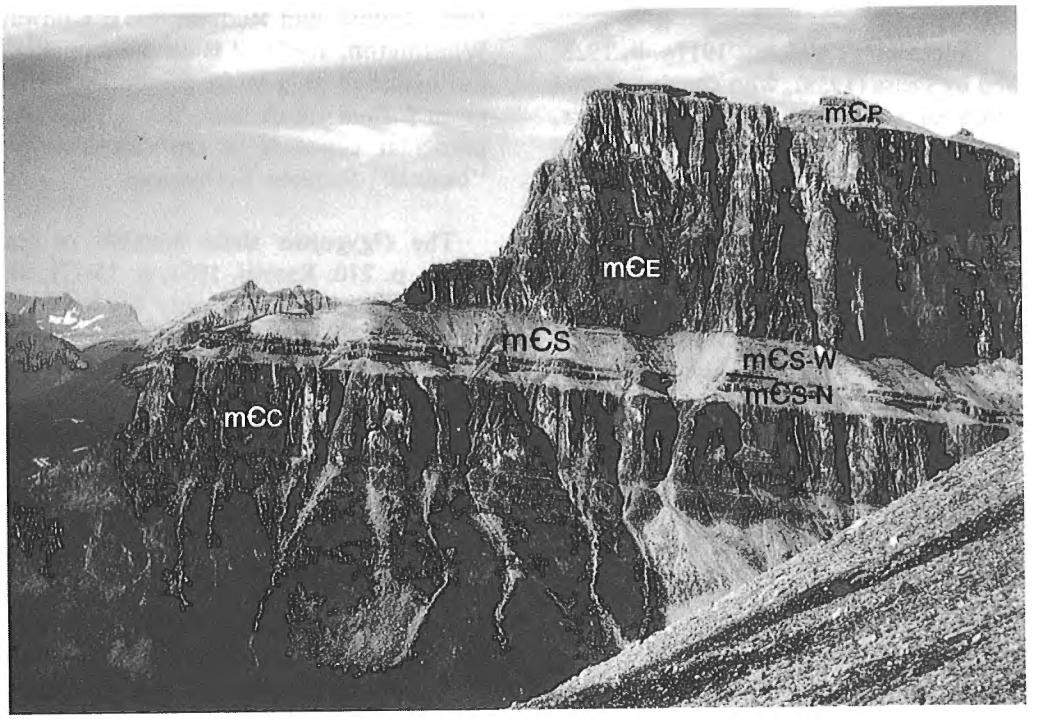


Figure 51. *Middle Cambrian section at Castle Mountain, viewed from Helena Ridge.* m€C–*Cathedral Formation;* m€S–*Stephen Formation;* m€S-N–*Narao Member;* m€S-W–*Waputik Member;* m€E–*Eldon Formation;* m€P–*Pika Formation. ISPG photo 1577-1.*

Type section of the Stephen Formation and of its Narao and Waputik members

Section AC–4

(lat. 51°27′30″N, long. 116°18′45″W)

The section was measured near timberline on the southeast slopes of Mount Bosworth, overlooking the highway. It was measured on both sides of the first gully southwest of the gully containing the normal fault that cuts the eastern nose of the mountain (Figs. 30, 31). The Narao Member is better exposed east of the gully, and the Waputik Member west of the gully; it is the better exposures of each member that are described here.

ELDON FORMATION

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	At this locality, the basal Eldon Formation is only moderately resistant; resistance increases upward.		
	Section continues upward.		
3	**Limestone**: parted lime mudstone	not measured	
2	**Limestone**: parted lime mudstone; bedding is irregular, almost nodular in places because of intense burrowing; weathered surface has scoriaceous appearance	29.5 (9)	36.5 (11.1)
1	**Limestone**: at the base, a 20 cm thick bed of ooid grainstone, overlain by limestone (as Unit 15 of the Stephen Formation).	7 (2.1)	7 (2.1)
	Contact is a bedding plane.		

STEPHEN FORMATION
(336.5 ft/102.6 m)

Waputik Member
(175 ft/56.4 m)
(Units 7 to 16)

The Waputik Member is recessive weathering; it is only locally well exposed, forming a ledgy outcrop.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
16	**Shale** (slate): greenish grey, weathering greenish grey, slightly calcareous	11 (3.4)	336.5 (102.6)
15	**Limestone**: burrow-mottled lime mudstone, with numerous layers of oncoid floatstone/rudstone; crudely thin bedded; weathered surface appears scoriaceous, with dark orange dolomite mottling	10 (3)	325.5 (99.2)
14	**Shale** (slate): as below. A 10 cm thick bed of rudstone, flat pebbles in a skeletal matrix, occurs 7.5 ft (2.3 m) above the base	24.5 (7.5)	315.5 (96.2)
13	**Limestone**: oncoid-skeletal grainstone/packstone, as in Unit 12, on a base of flat-pebble rudstone; a massive, resistant bed	1.5 (0.5)	291 (88.7)
12	Cycle: as Unit 10, with a few beds of shale throughout. A 5 cm thick bed of limestone, with small oncoids in a matrix of skeletal grainstone, occurs 10 ft (3 m) above the base	26.5 (8.1)	289.5 (88.2)
11	**Limestone**: a single massive bed; the lower half is ooid grainstone, partly coarse grained, very dolomitic; the upper half is oncoid packstone	2.5 (0.8)	303 (92.4)
10	**Shale** and **limestone** (small-scale cycle) At the base, shale (slate), greyish green, weathering grey-green and rusty, calcareous, with lenses and nodules of lime mudstone, grading rapidly upward to parted lime mudstone (as below); rare very thin beds of rudstone (as in Unit 8)	22 (6.7)	260.5 (79.4)
9	**Limestone** and **mudstone** Limestone: parted lime mudstone with prominent partings of mudstone. A few thin and medium beds of mudstone (as below)	27.5 (8.4)	238.5 (72.7)
8	**Mudstone** (slate) and **limestone** Mudstone: brownish grey, calcareous, with very minor, nodular thin beds and lenses of skeletal wackestone and a few persistent thin beds of lime mudstone. Beds of coarse flat-pebble rudstone (rounded flat pebbles) with a skeletal matrix occur at 16.5, 24, and 36 ft (5, 7.3, and 11 m) above the base	43 (13.1)	211 (64.3)
7	Covered	16.5 (5)	168 (51.2)
	In the section east of the gully, the basal 12 ft (3.7 m) are shale: brown-grey, brown weathering, calcareous, with weak slaty cleavage, and 10 per cent limestone: mainly skeletal (trilobite) wackestone/packstone, in nodular thin beds and lenses up to 15 cm thick.		
	The basal contact of the unit and the member is a bedding plane.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Narao Member (151.5 ft/46.2 m) (Units 1 to 6)		
	The Narao Member forms a modest cliff above its recessive weathering base.		
6	**Limestone**: pale grey, weathers pale grey; thrombolitic, with scattered oncoids; massive	12.5 (3.8)	151.5 (46.2)
5	**Limestone**: cryptalgal laminite; dolomitic. Bedding-plane slabs show a mat of blister-like stromatolites, 3 to 4 cm in diameter. Rare thin beds of fenestral lime mudstone and minor flakestone	28 (8.5)	139 (42.4)
4	**Limestone** and **shale** At the base, shale: dark grey, platy, with a thin bed of microcrystalline dolomite. This grades upward, 2 ft (0.6 m) above the base, to parted lime mudstone with a few laminae of skeletal packstone/wackestone. This is the basal unit of the second cycle	18.5 (5.6)	111 (33.8)
	Upper contact of Unit 3 is abrupt.		
3	**Limestone**: cryptalgal laminite (finely interlaminated calcitic and dolomitic laminae); many small blister- and dome-shaped stromatolites; weathers grey and yellow, slightly more resistant than underlying units. Stromatolites and layers of flakestone increase upward; no desiccation cracks. A few layers are completely dolomitized	19.5 (5.9)	92.5 (28.2)
2	**Limestone** and **mudstone** At the base, mudstone: pale brown, very calcareous, massive, with inarticulate brachiopods. Upward increase in laminae and nodules leads to parted lime mudstone facies (with thick mudstone partings), 2 ft (0.6 m) above the base and continuing to the top. Ripple crosslamination and ripple cross-sections are widespread, indicating calcisiltite. A 5 cm thick bed of rudstone, as in Unit 1, occurs 3.5 ft (1.1 m) above the base. This is the basal unit of the first cycle	49 (14.9)	73 (22.2)
1	**Limestone**: parted lime mudstone; in irregular to lenticular, very thin beds, with prominent, orange weathering dolomite partings. Bedding planes are strongly figured with feeding traces and burrows. At the top, a 10 cm thick bed of flat-pebble rudstone with skeletal matrix.		
	Gradational contact at the top; base is poorly exposed and apparently planar.	24 (7.3)	24 (7.3)

CATHEDRAL FORMATION

The Cathedral Formation forms moderate cliffs, somewhat "broken-back" at the top. The uppermost beds comprise dolomite: ex-parted lime mudstone, mottled dull yellow-white and grey, regularly thin bedded, weathering yellow-grey.

The type section of the Amiskwi and Wapta members is designated here as the section immediately east of the main Fossil Gully fault on Mount Field (composite section AC–161/162 in Appendix B of this report, see Figure 39). The type section is less than ideal, because it is impracticable to avoid all the minor faults associated with the Fossil Gully fault. Nevertheless, correlation across these faults is reasonably straightforward. The section is chosen over the unfaulted section on Mount Stephen because it is easier and less hazardous of access (when approached from above, via Burgess Pass), and because the "shallow water" characteristics of the Wapta Member are more strongly expressed on Mount Field.

Type section of the Amiskwi and Wapta members of the Stephen Formation on Mount Field

Sections AC-161/162

(lat. 51°25′28″N, long. 116°27′57″W)

ELDON FORMATION

The Eldon Formation forms the pale coloured upper face and summit of Mount Field.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
3	**Dolomite**: as below, but pale grey mottled with dark grey (ex-burrow-mottled lime mudstone). Stromatactoid dolomite is widespread in pockets and indistinctly bounded lenses. At about 53 ft (16.2 m) above the base, the unit grades upward to dolomite (as Unit 2). From 73 ft (22.3 m) above the base upward, relict pellets are visible	110 (33.5)	435.5 (132.7)
2	**Dolomite**: as below, but bedding is distinct, and is shown in part by aligned mottlings of dark grey, very fine crystalline dolomite (transition from ex-parted to ex-burrow-mottled lime mudstone). Subunits of stromatactoid dolomite occur at intervals	77 (23.5)	325.5 (99.2)
1	**Dolomite**: grey to very pale grey, fine and very fine crystalline, with partings and laminae of dark grey, very fine crystalline dolomite; seen close-to, weathering is dull greyish yellow, with dark grey stripes but, at a distance, the overall effect is greyish yellow. Subunits with stromatactoid structure occur intermittently in the interval 35 to 150 ft (10.7 to 45.7 m) above the base.	248.5 (75.7)	248.5 (75.7)
	Conformable contact.		

STEPHEN FORMATION
(911.5 ft/277.8 m)

The Stephen Formation, here of the basinal facies, supports brown weathered slopes, somewhat recessive weathering near the base, but steepening upward into ledgy cliffs.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Wapta Member (341.5 ft/104.1 m) (Type Section, Units 12 to 27)		
27	**Slate**: greenish grey, weathering dull green, noncalcareous	9.5 (2.9)	911.5 (277.9)
26	**Limestone**: skeletal wackestone; very fine grained, in very thin, nodular beds and nodules, with partings of grey, dolomitic, slightly silty shale		
	This unit changes to dolomite near the Fossil Gully fault	17 (5.2)	902 (275)
25	**Shale**: pale greenish grey, weathers dull, deep green and brown; noncalcareous, very thin bedded, with siltstone interbeds	19 (5.8)	885 (269.8)
24	**Limestone** and **slate** Fifty per cent nodules of grey, microcrystalline limestone in a matrix of slate (as below). The limestone nodules change to orange weathering dolomite near the fault	3.5 (1.1)	866 (264)
23	**Shale**: pale greenish grey, weathers pale brown, calcareous, largely silty, well laminated, lichenous, burrows common. A one foot (30 cm) thick bed of limestone (skeletal wackestone), strongly mottled with silty dolomite, has its base 10 ft (3 m) below the top of the unit. Bedding surfaces are micaceous. Weathers bluish green-grey	64.5 (19.7)	862.5 (263)
22	**Dolomite**: grey, weathering dull orange, fine equicrystalline, traces of ex-particulate texture	2 (.6)	798 (243.3)
21	**Slate**: pale greenish grey, calcareous, partly silty; slim lenses of grey, microcrystalline limestone are common (these change to dolomite near the Fossil Gully fault)		
	Unit grades upward to interlaminated limestone and dolomite, partly silty, as below.	22 (6.7)	796 (242.7)
20	**Limestone** and **slate** Lower (40 cm thick) and upper (60 cm thick) beds of ooid and ooid-skeletal grainstone/packstone (the upper bed carrying a few oncoids) are separated by slate: grey, weathering olive-brown, calcareous, partly silty	7.5 (2.3)	774 (236)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
19	**Dolomite** and **limestone** (interlaminated) As Unit 16; largely silty; grains of quartz silt outline crosslamination in some beds	42.5 (13)	766.5 (233.7)
18	**Slate**: grey, weathering dull greyish green, calcareous	2 (0.6)	724 (220.8)
17	**Limestone** and **slate** Nodules of grey, microcrystalline limestone (locally dolomitized) in slate: as above	6 (1.8)	722 (220.1)
16	**Dolomite** (75%) and **limestone** (25%) (thinly interbedded and interlaminated) Dolomite: grey, orange weathering, microcrystalline, partly silty. Limestone: grey, grey weathering, microcrystalline; ribbon-bedded lime mudstone facies, unusually thinly bedded.		
	Forty-three feet (13.1 m) above the base, a 25 cm thick packet of beds is involved in a slump structure.	56 (17.1)	716 (218.3)
	At this point, a fault subsidiary to the main Fossil Gully fault is crossed. The section is "tied" on a distinctive, 15 to 30 cm thick bed of flat-pebble rudstone/floatstone, overlain by penecontemporaneously slumped beds, which lies 12 ft (3.7 m) below the top of Unit 16.		
15	**Slate**: grey, weathering pale brown, calcareous, platy, non-silty. Forty feet (12.2 m) above the base, a 20 cm thick bed of limestone: as Unit 12, with scattered pebbles	45 (13.7)	660 (201.2)
14	**Limestone**: as below; with scattered, small (3-4 mm) oncoids	2.5 (0.8)	615 (187.5)
13	**Slate**: grey, weathering banded grey and pale brown, calcareous, micaceous, silty, well laminated. Thin, lenticular beds of microcrystalline limestone are common in the uppermost 3 ft (1 m)	30.5 (9.3)	612.5 (187.1)
12	**Limestone**: trilobite packstone/grainstone; nodular thin bedded, flaggy, to nodular, massive, with partings and mottlings of orange weathering, microcrystalline dolomite. Very minor interbeds of slate as below. The basal, 1 ft (30 cm) thick, bed is trilobite grainstone with dolomite blotches	12 (3.7)	582 (177.5)
	At this point, the line of section crosses a cluster of faults of the Fossil Gully system. The upward line is offset eastward, and the Unit 11/Unit 12 contact correlates across the faults.		
	Amiskwi Member (570 ft/173.7 m) (Type Section, Units 1 to 11)		
11	**Shale**: much as below, but dolomitic, "microcrystalline-looking", brown weathering	91 (27.7)	570 (173.7)
	Fossils in loose material decrease in number from Unit 10 upward into Unit 11. Laminae of trilobite coquina and rare thin lenses of skeletal grainstone/packstone reappear 70 ft (21.3 m) above the base, and continue upward		
	Gradational contact.		
10	**Shale**: brown, and brownish grey, weathering dark grey and pale brown, very calcareous, platy; widely spaced siltstone laminae; silty zones, several feet thick, occur at intervals. Trilobite fragments occur sparsely throughout the unit. The shale grades upward to dark grey and bluish grey, calcareous, fissile shale (strong lithic resemblance to the Burgess Shale). Well preserved *Pagetia* spp. are common. The lowest-noted gastropods and hyolithids occur 111 ft (33.8 m) above the base	143 (43.6)	479 (146)
9	**Limestone**: lime mudstone; dark brownish grey, weathers dark grey with yellow laminae (ribbon-bedded lime mudstone); thin bedded, laminated, dolomitic, massive	3.5 (1.1)	336 (102.4)
8	**Shale**: very calcareous, approaching argillaceous limestone; dark brown, weathering very dark grey, locally pale brown; sooty, platy, and richly fossiliferous at several levels (trilobites and brachiopods)	58.5 (17.8)	332.5 (101.4)
7	Covered: recessive weathering	30 (9.1)	274 (83.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Shale**: dark brownish grey, weathering very pale brown, very calcareous, sooty, conchoidal fracture. Unit is nearly barren of fossils in the lower half; the upper half is fossiliferous, with well preserved *Pagetia* spp.	20 (6.1)	244 (74.4)
5	Very poorly exposed **Shale**: as above	67-72 (22)	224 (68.3)
	"Boundary limestone" (informal) (Units 3, 4)		
4	**Limestone**: a lenticular, massive unit, with dolomite mottling and a hummocky upper surface. Overall pale grey "wash" conceals the fragmental character; only local, water washed exposures allow inspection of the fabric, which is coarse, comprising angular fragments of limestone in a dolomitic lime mudstone matrix. The unit is a debris-flow breccia, or a complex of debris flows	3.5-8.5 (1.1)	152 (46.3)
3	**Limestone**: lime mudstone and pellet grainstone; grey, orange to yellow weathering, thin bedded (1-8 cm), laminated and locally low-angle crosslaminated; prominent partings of dolomite: brown, microcrystalline	63.5 (19.4)	148.5 (45.3)
2	**Shale**: grey, weathering dull green, partly greenish grey; minor brown weathering zones; calcareous, partly silty	45 (13.7)	85 (25.9)
	The thickness assigned to Units 1 and 2 is imprecise, and probably exaggerated because of crumpling and minor faulting.		
1	**Shale**: grey and brownish grey, calcareous, platy, partly silty; weathers mainly pale brown, but the silty, dolomitic beds weather brownish orange; the proportion of silty beds increases upward.	40 (12.2)	40 (12.2)
	Abrupt, concordant contact.		
	CATHEDRAL FORMATION		
	Takakkaw Tongue (uppermost 105 ft/32 m only)		
	Limestone: ribbon-bedded lime mudstone; moderately resistant, but less so than some underlying units of this formation	105 (32)	105 (32)

"Platformal Stephen"

The Stephen Formation of the platform region is divisible into two members, the Narao below and the Waputik above (Figs. 51, 52).

Narao Member

The Narao Member, 151.5 ft (49.2 m) thick at the type section, is dominated by limestone of the parted lime mudstone lithofacies, a part of which was deposited as calcisiltite, as judged by widespread crosslamination. Feeding burrows are prominent and ripple marks common. A few thin beds of flat-pebble rudstone or equant-pebble rudstone with skeletal matrix interrupt the parted lime mudstones in most sections. Rare laminae, lenses and very thin beds of coquina, composed entirely of cranidia and pygidia of the relatively large trilobite *Glossopleura*, are highly characteristic. A few oncoids occur locally in lime mudstone. Grey, brownish or greenish grey shales or mudstones form a minor part of the Narao Member. Normally, these detrital strata occur as only two units, each less than 10 ft (3 m) thick.

The abrupt bases of the units of shale or mudstone are seen to mark the beginning of small-scale asymmetric cycles comparable to those described earlier for the Trinity Lakes Member of the Cathedral Formation. The detrital unit grades upward into parted lime mudstone via an interval of thin beds or lenses of lime mudstone in shale or mudstone. Parted lime mudstone, with minor thin beds and lenses of various "particulate" limestones, makes up the bulk of the cycle. Are the two cycles at the type section a version of the shallowing-upward cycles that are so common in carbonate successions worldwide, or merely "clearing-upward" cycles; that is, cycles of an upward-diminishing supply of terrigenous mud? At the type section, the cycles themselves provide the answer to this puzzle since each terminates with a unit of cryptalgal laminite, the upper one capped with thrombolitic limestone. Upward shallowing is clearly expressed.

In the vicinity of the type section, the Narao Member consists mainly of two shallowing-upward cycles, as described, overlying parted lime mudstone that is gradational into the underlying, massive, Cathedral Formation lime mudstones (or derived dolomite). Along the Bow River transect, east to the mountain front and northward at least to North Saskatchewan River, the member likewise contains two, and only two cycles. Eastward along the North Saskatchewan transect the two cycles persist at least to

Mount Loudon, but, at Windy Point, they are not recognizable. At localities north of North Saskatchewan River, resolution of the Narao into two cycles (as far as determined from field notes and photographs) is doubtful. Strangely, the limitation of the member to two cycles was not appreciated until fieldwork was finished; the full extent of the two, obviously isochronous, cycles is an important question worth further study.

The Narao Member is expressed topographically as a stepped or ledgy interval, less resistant than the Cathedral below but more resistant than the Waputik Member above. In the region where it comprises two clearly expressed cycles, its topographic "signature" is unmistakable (Figs. 51, 52).

Significant changes take place in the Narao Member on the east flank of the Kicking Horse Rim; for instance, in the roadcuts in Kicking Horse Pass and at Mount Whymper (Section AC–53). At these localities, cryptalgal laminite and fenestral limestone take the place of much of the parted lime mudstone seen elsewhere. This westward change is complete in the "Chalet Gully" section on Mount Field, which is effectively on the crest of the rim. There (Fig. 53), the uppermost 127.5 ft (38.9 m) of the dolomites mapped as Cathedral are as follows:

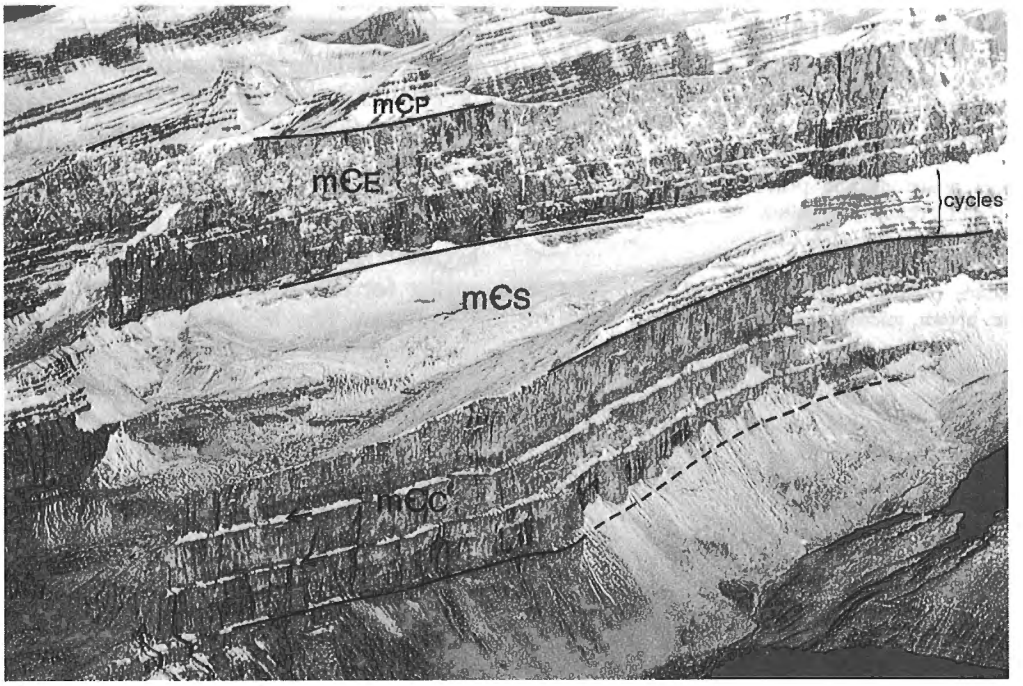


Figure 52. *Middle Cambrian section updip from Section AC–41 (Banff Park Boundary, North Saskatchewan River). (Low-level, oblique air photograph; view northwestward.)* m€C*–Cathedral Formation;* m€S*–Stephen Formation;* m€E*–Eldon Formation;* m€P*–Pika Formation. Snow on the ledges overlying recessive weathering units accentuates details of the Ross Lake and Trinity Lakes members (arrows) of the Cathedral Formation; the two relatively thick, shallowing-upward cycles of the Narao Member; and the numerous, smaller-scale cycles of the Waputik Member of the Stephen Formation. ISPG photo 1518-55.*

Figure 53. *Transition from the Stephen Formation (Narao Member) to equivalent Cathedral Formation strata at "Chalet Gully", Mount Field. The Cathedral/Stephen contact was placed by Fritz (1971), McIlreath (1977), and others at the base of the shales at "A" (i.e., the base of the Waputik Member). At "B" (figure for scale), the thin bedded, dark grey, flaggy dolomite overlying nearly white, massive dolomite corresponds to the base of the Narao Member. ISPG photo 1499-53.*

STEPHEN FORMATION

Waputik Member

Contact covered.

CATHEDRAL FORMATION

Narao Member equivalent

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Dolomite**: as Unit 3 (top of second cycle)	6.5 (2)	58.5 (17.8)
5	**Dolomite**: cryptalgal laminite; laminated dark and pale grey	2 (0.6)	52 (15.8)
4	**Dolomite**: medium grey, medium grey weathering, fine and medium equicrystalline, thin bedded, flaggy (ex-parted lime mudstone), traces of lamination. One 2-inch (5 cm) thick bed of ex-oolite	8 (2.4)	50 (15.2)
3	**Dolomite**: white, coarse crystalline, with relics of thin beds and laminae in grey, fine crystalline dolomite (top of the first cycle)	10 (3)	42 (12.8)
	Contact crosses bedding.		
2	**Dolomite**: cryptalgal laminite; pale grey, weathering pale grey, micro-crystalline	5 (1.5)	32 (9.8)
1	**Dolomite**: dark grey, fine equi-crystalline, thin bedded, flaggy (ex-parted lime mudstone). Unit weathers much darker than the underlying strata (see Fig. 51).	27 (8.2)	27 (8.2)
	Abrupt, concordant contact.		

CATHEDRAL FORMATION

1	**Dolomite**: crudely thin bedded in grey and coarser white beds; fine to coarse crystalline, with local mega-crystalline pods; completely massive, weathering brown-grey. Local brecciation due to west-side-down fault immediately to the west. Top 1.5 ft (0.5 m) is strongly burrow mottled.	69 (2.1)	

At Mounts Wedgewood and Eon (near Mount Assiniboine; Sections AC–102, AC–103) where, as at Mounts Stephen and Field, the Waputik Member makes up the entire Stephen Formation, the uppermost 140 ft (42.7 m) of the underlying Cathedral Formation is characterized by cryptalgal laminite, fenestral lime mudstone and oolite, arranged in two shallowing-upward cycles. These beds are equivalent to the Narao Member and may be treated as the Narao Member of the Cathedral Formation.

Waputik Member

The Waputik Member, 185 ft (56.4 m) thick at the type section, is characterized by recessive weathering and by a shale content distinctly higher than that of the Narao Member, though not everywhere exceeding one half. The shale is largely green and (especially eastward) deep green, but greenish grey, grey, and brownish grey colours also occur. In shoreward localities to the northeast, minor purple-red intervals occur. Laminae and lenses of quartz siltstone are associated with the shales, and are increasingly prominent northeastward.

The Waputik Member can be divided entirely into shallowing- and clearing-upward cycles analogous to, but not identical with, the small-scale cycles of the Narao Member. The Waputik cycles differ from their Narao analogues in the following ways:

1. The basal, detrital units are much thicker (up to 43 ft/13.1 m), and form a larger proportion (locally more than half) of the cycle. The thickness and proportion of the detrital units decrease upward in the member.

2. Beds of ooid and skeletal grainstone – the former rare and the latter thin and inconspicuous in the Narao Member – are fairly common in the Waputik. Although such beds mark the end of some cycles they are by no means limited to the end and may occur at any level, interrupting shale or parted limestone.

3. Beds of rudstone with embayed pebbles and skeletal matrix, and knobby tops of grainstone beds – both considered to represent submarine hardgrounds – are common and, like the grainstones, not limited to the ends of cycles.

4. Oncoids occur at several levels, in oncoid wackestones or oncoid rudstone/packstones with skeletal matrix.

5. Stromatolites and thrombolites, unknown on the Bow River transect, first appear along North Saskatchewan River and increase in prominence northward. Cryptalgal structures commonly mark the tops of cycles, but are not limited to such a position.

The contact between the Narao and Waputik members is placed at the level at which shale content increases abruptly upward. So far as presently known, the contact approximates the boundary between the *Glossopleura* and *Bathyuriscus–Elrathina* zones.

"Basinal Stephen"

The Stephen Formation of the basinal region is divided into two members, the Amiskwi Member below and the Wapta Member above.

Amiskwi Member

The Amiskwi Member, 570 ft (173.7 m) thick at the type section, consists mainly of grey, brownish grey and brown, less commonly black, shales and subordinate massive mudstones that are largely calcareous and generally silty. Some intervals have a sooty aspect. Graded laminae are widespread. Slide surfaces and penecontemporaneous overfolds are fairly common. While some intervals of shale are virtually barren of macrofossils, others are crowded with trilobites, small hyolithids, inarticulate brachiopods, and conical gastropods. Fossils of soft-bodied animals, notably worms, the crustacean *Canadaspis*, and the large arthropod *Anomalocaris* are sparsely but widely distributed. The famous Burgess Shale (see Whittington, 1971, 1980, 1985) is part of the Amiskwi Member, as is the interval 70 ft (21.3 m) higher above the Walcott quarry that has also yielded exceptional fossils of soft-bodied animals.

Most of the Amiskwi Member contains only insignificant thin beds and laminae of carbonate rock, mainly lime mudstone. The exception is the "boundary limestone" (Fritz, 1971; McIlreath, 1977a, b), a westward thinning wedge of limestone that adjoins the Cathedral Escarpment (Fig. 54). The "boundary limestone" consists mostly of thin bedded lime mudstone and irregularly thin to medium bedded wackestone, packstone, and grainstone; the former predominant in the thinner, distal part of the wedge

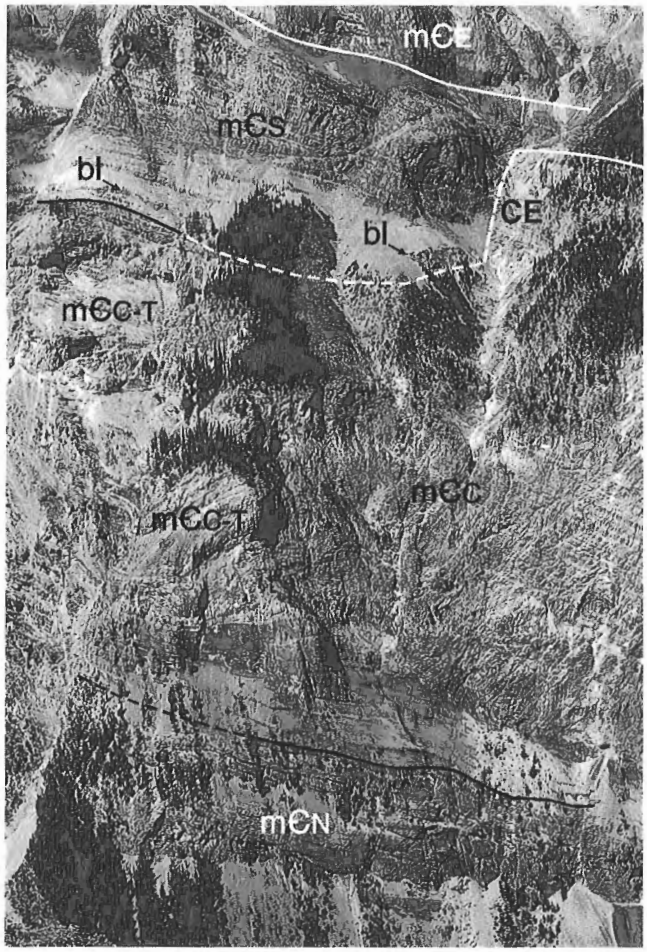


Figure 54. *Geological relationships near the Cathedral Escarpment, south face of Mount Field.* m€N*–Naiset Formation;* m€C*–Cathedral Formation, reef-flat facies (note rhythmic bedding);* m€C-T*–Takakkaw Tongue of the Cathedral Formation, slope facies (note the westward convergence of bedding);* m€S*–Stephen Formation;* bl*–outcrops of "boundary limestone" (note the westward thinning);* m€E*–Eldon Formation;* CE*–Cathedral Escarpment. In this view, the basal, progradational reef, which was the source of the coarse debris in the Takakkaw Tongue, can be visualized between the rhythmically parallel-bedded dolomite on the right and the clinoform beds on the left (west). ISPG photo 1499-4.*

and the latter in the proximal part. The type section contains a lenticular bed of debris-flow breccia. McIlreath (op. cit.) demonstrated that the peloids, skeletal grains, ooids and oncoids of the coarser beds were derived from the shallow platform to the east, and implied that the shallow platform was also the probable source of the lime mud. At the type section of the Amiskwi Member, the "boundary limestone" occupies the 73 ft (22.6 m) thick interval from 85 to 158 ft (25.9 to 48.2 m) above the base. It is locally as thick as 330 ft (100.6 m) (McIlreath, op. cit.).

The trilobite faunas of the Amiskwi Member are characterized by a number of genera unknown in the "platformal Stephen"; for example, *Pagetia, Ogygopsis,* and the agnostids *Ptychagnostus* and *Peronopsis*. These taxa are characteristic of basins that had unrestricted connections with the open oceans (Palmer, 1973).

Wapta Member

The Wapta Member, 341.5 ft (104.1 m) thick at its type section, consists of calcareous and noncalcareous shale that is mainly greenish grey and partly silty, alternating with beds and units, up to 50 ft (15 m) thick, of various carbonate rocks. Most characteristic of the carbonates are skeletal, oncoid and, less commonly, ooid and intraclast grainstone, packstone, and wackestone, either in isolated medium beds or thick units with irregular to nodular thin and medium bedding. Also prominent are units of thin bedded pellet grainstone and calcisiltite that are generally rich in quartz silt and display ripple crosslamination. The limestones are partly dolomitized at and near the type section of the member. Quartz siltstone is interbedded with shale near the top of the type section. Feeding burrows, unknown in the Amiskwi Member, appear in silty shale in the upper half of the Wapta Member. A few zones with slump structures are present, but are not so prominent as in the Amiskwi.

In contrast with the Amiskwi Member, the Wapta Member contains trilobites that are not essentially different from those of the Wapta Member of the "platform Stephen".

The base of the Wapta Member is drawn at the base of the lowest grainstone or packstone bed that is 10 cm or more thick, or the lowest unit of thin bedded lime mudstone 30 cm or more thick - whichever occurs lower.

The Amiskwi and Wapta members embody the concepts of the "deep-water" and "shallow-water" portions, respectively, of the basinal ("thick") Stephen, as expressed by McIlreath (1977).

Contacts

Basal contact

The basal contact of the "basinal Stephen" is conformable, although abrupt. It is marked by the appearance of shale with subordinate thin beds of lime mudstone above ribbon-bedded lime mudstone of the Takakkaw Tongue of the Cathedral Formation. At Fossil Gully on Mount Stephen, the contact is a gravity-slide surface. The rocks juxtaposed at the contact are interpreted as being of deep-water origin, and there is no physical evidence of erosion. The *Glossopleura* Zone probably straddles the contact (Fritz, 1971, p. 1163-64).

All previous authors who have written in detail about the Cathedral and Stephen formations have stated that the Cathedral/Stephen contact, in what is here termed the "platform region", is unconformable, either regionally or locally. These statements merit re-examination for two reasons: first, that different evidence has been cited by different authors; and second, that, except for Rasetti, none have distinguished between possibly local unconformity at the crest of the Kicking Horse Rim and regional unconformity.

Deiss (1940, p. 779) inferred a hiatus at the base of the Stephen in the platform region on the basis that the *Ogygopsis klotzi* faunule is known only from the "basinal" Stephen. Rasetti (1951, p. 69) concluded that, "An unconformity must be present between the Cathedral and the Stephen where the latter does not include beds of the *Glossopleura* Zone." Fritz (1971, p. 1169), referring to sections at the crest of the rim, inferred an unconformity on the basis that, of the four faunules of the *Bathyuriscus–Elrathina* Zone recognized by him in the "basinal" Stephen, only the uppermost (*Ehmaniella burgessensis* faunule) is present. His reasoning would suggest that the contact is unconformable throughout the platform region. McIlreath (1977, p. 194) accepted the published paleontological arguments.

The arguments relating to the absence of *Glossopleura* at sections on the rim are invalidated by the demonstration (above; see also "Cathedral Formation") that the *Glossopleura*-bearing Narao Member passes westward into barren, largely cryptalgalaminate dolomites at the rim, these being included with the Cathedral Formation there (Figs. 40, 53). Because the contact between the *Glossopleura* and *Bathyuriscus–Elrathina* zones approximates the contact between the Narao and Waputik members, the remaining paleontological argument relates, not to a possible unconformity at the regionally gradational base of the Stephen Formation, as described below, but to a possible unconformity at the base of the Waputik Member. Rasetti (1951, p. 108) inferred a probable unconformity at this level, because, "The *Ehmania* or *Bolaspis–Glyphaspis* fauna that is believed to occupy this time interval in Montana, Wyoming, and Utah does not seem to be represented in the Canadian Rockies." The lower three *Bathyuriscus–Elrathina* Zone faunules of the "basinal Stephen", which are missing at the rim and throughout the platform, are strictly local (so far as is presently known), and are largely characterized by taxa of known deep-water or outer-detrital associations, which probably did not inhabit shallow platform seas. Significantly, as recognized by Fritz (1971, p. 1168), the *Ehmaniella burgessensis* faunule characterizes both the "shallow-water" part (Wapta Member) of the "basinal" Stephen and the lithologically similar Waputik Member of the platform, a further suggestion that the other *Bathyuriscus–Elrathina* faunules listed by Fritz are facies controlled. In my opinion, the paleontological arguments for a sub-Waputik disconformity are persuasive, but not yet conclusive.

No physical evidence of erosion at the Narao/Waputik contact has been observed on any of my many traverses across the boundary between the members. Furthermore, the persistence of the two Narao Member cycles over a region extending eastward to the mountain front is evidence against a break of any magnitude.

Throughout the platform region, the *Glossopleura* Zone straddles the Stephen/Cathedral contact and, hence, paleontological evidence of a disconformity is lacking.

The evidence from lithostratigraphy supports a conformable and gradational contact. As the contact is approached from below, the dominant, thick beds of burrow-mottled lime mudstone become thinner, and grade upward to parted lime mudstone. The contact (generally indefinite within a zone a few feet thick) is drawn at the base of the parted lime mudstones. The lowest shale bed in the Stephen Formation is generally a few to tens of feet above the base; only locally is it basal. In the western part of the platform, where the top of the Cathedral Formation is cryptalgal laminite, the contact is drawn at the change from cryptalgal laminite to parted lime mudstone. At a number of localities, the contact marks a change from dolomite below to limestone above. This phenomenon merely records the relative susceptibilities of the parted and

mottled lime mudstones to dolomitization; it is not a criterion for placing the contact. At a few localities, the basal beds of the Stephen also are dolomitized.

Upper contact

Walcott (1908a, 1928) did not specify criteria for recognizing the Stephen/Eldon contact, and was inconsistent in his placement of it. Perhaps because he placed 315 ft (96 m) of limestone that overlies the highest Stephen shale at Mount Bosworth in the Stephen (1928, p. 312), Deiss (1939, 1940) and Rasetti (1951) generally placed the top of the Stephen at the conspicuous contact where pale dolomite overlies nearly black weathering, thin bedded limestone. Neither author referred to the fact that Walcott rarely distinguished dolomite from limestone. Rasetti (1951, p. 74, 75) recognized that the limestone/dolomite contact does not follow bedding, and mentioned that it would be preferable to place the contact at the top of the highest shale, as subsequent authors have done. The spectacular contact between nearly black limestone and pale dolomite is indeed a useful "signature" for the basal Eldon in many areas, but it records post-depositional processes, rather than sedimentation, and is not consistent in its stratigraphic level.

Defined as the top of the highest shale, the Stephen/Eldon contact is gradational, by interbedding. The correlation diagrams presented here (Figs. 55-58) and, especially, the data from the subsurface of the Plains area to the east (Pugh, 1971), strongly imply that the contact is diachronous and younger to the northeast.

Distribution and thickness

The formation is identifiable, either as Stephen Formation or as the Stephen Member of the Snake Indian Formation, throughout the region studied. In the west, the "basinal Stephen" has limited exposure west of the Kicking Horse Rim, before the westward dip carries it from view. In the north, the Stephen Member of the Snake Indian Formation is recognizable at least to Mount Henry, north of Jasper. In the Mount Robson district, the Tatei Formation is the approximate equivalent of the Stephen. Eastward, the Stephen is traceable far to the east, in the subsurface of the Plains, until shaleout of the underlying carbonates of the Cathedral Formation renders the Stephen unrecognizable, as it passes into part of the Earlie Formation (Aitken, 1968; Pugh, 1971). Southward, most of the Middle Cambrian, including the Stephen, plunges from view south of Mount Assiniboine. Where it reappears, the Stephen equivalent is probably the thin, recessive weathering unit of calcareous, silty dolomite at the base of the Windsor Mountain Formation (Norris and Price, 1966), but this speculation lacks rigorous faunal confirmation.

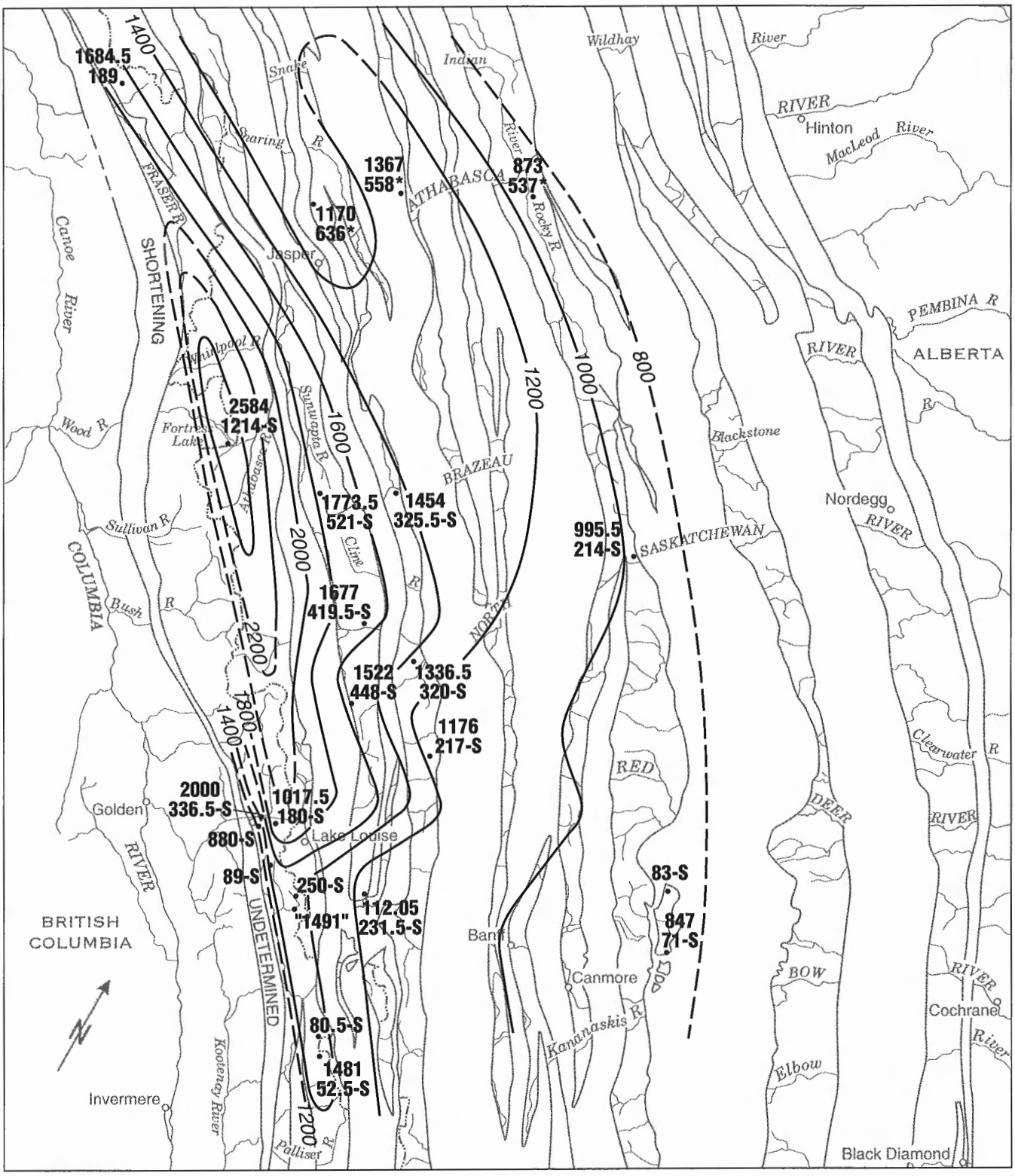
Thickness of the Stephen (whether formation or member) in the platform region records the interplay of two nearly independent variables: first, rate of subsidence, an indication of which is given by the thickness of a given chronostratigraphic interval; and second, the duration of the time during which terrigenous mud continued to reach the point in question.

The first variable is best represented by the thickness of the Stephen/Eldon Grand Cycle, bounded by nearly isochronous surfaces. The second variable, duration of terrigenous mud supply, is illustrated by the ratio of Stephen thickness to the thickness of the Stephen/Eldon cycle, which, in the south, shows values of one sixth and less, increasing northward to values exceeding one half (Fig. 59). The isopach map (Fig. 59) combined with the correlation panels (Figs. 55-58) demonstrate that the source of detritus lay in the north, and that the southward or southwestward limit of terrigenous mud deposition retreated cyclically northward or northeastward throughout Stephen time.

The Stephen is 336.5 ft (102.6 m) thick at the type section. The maximum measured thickness is 1214 ft (370 m) at Chaba River (Section AC-143). The formation is as thin as 52.5 ft (16 m) near its southward plunge from view near Mount Assiniboine, where the Narao Member has merged with the upper Cathedral Formation. It is as thin as 71 ft (21.6 m) along the southern mountain front, where both Narao and Waputik members are present.

Upon crossing the Cathedral Escarpment, which marks the western limit of the platform, the Stephen thickens abruptly, forming a sort of casting of the terminal surface of the underlying Cathedral Formation. Discrepancies in the thicknesses reported below result from differences in the routes of measurement and the difficulties of stratigraphic measurement in alpine terrain:

Measured by	Mount Field	Mount Stephen
Fritz (1971)	—	1030 ft (313.9 m)
McIlreath (1977)	989 ft (301.4 m)	1145 ft (349 m)
Aitken (this report)	906.5 ft (276.3 m)	924 ft (281.6 m)



Measured thickness, Stephen-Eldon Grand Cycle (feet) . . . . . **847**•
Measured thickness, Stephen Formation (feet). . . . . **71-S**•
Measured thickness, Stephen equivalent in Snake Indian Formation (feet) . . . . . **636***•
Isopach of Stephen-Eldon Grand Cycle (interval 200 ft) . . . . . ⌒

Figure 59. *Isopach map of the Stephen/Eldon Grand Cycle, and measured thicknesses of the Stephen Formation (Member). (Palinspastic restoration based on Fig. 15.)*

Paleontology and age

The Stephen Formation of both the platform and basinal regions comprises the upper part of the *Glossopleura* Zone and the basal part of the *Bathyuriscus–Elrathina* Zone. It is thus medial Middle Cambrian.

Interpretation

Paleogeographic and sedimentological interpretation of the Stephen/Eldon Grand Cycle is discussed below, under "Eldon Formation".

Recommended sections

In addition to the type section of the formation, and the contiguous type sections of the Amiskwi and Wapta members, the following reasonably accessible sections provide an overview of different aspects of the Stephen Formation.

Kicking Horse Pass Roadcuts

The Stephen Formation is well exposed in the Highway 1 roadcuts immediately downgrade from Sherbrooke Creek (Section AC–123). Here, the Narao Member consists largely of cryptalgal laminite, presaging its passage into cryptalgal dolomite of the uppermost Cathedral Formation four kilometres to the west. The base of the Stephen is marked by an abrupt contact between limestone and underlying dolomite, and is atypical on all counts.

Park Boundary, North Saskatchewan River

This is a well exposed section (Section AC–41). Cyclicity is well developed in both the Narao and Waputik members.

Beauty Creek

This section (AC–48) is thick and well exposed. Cyclicity is well developed, and algal stromatolites are fairly prominent in the Waputik Member.

Ghost River (Orient Point)

This section (AC–28) reveals the pronounced eastward thinning of the Stephen Formation. Both platform members are recognizable. Deep green shale, characteristic of the Stephen of the Plains subsurface, is exposed.

Snake Indian Formation

Definition

The Snake Indian Formation, equivalent to the combined Mount Whyte, Cathedral and Stephen formations, consists of an alternation of thick, recessive weathering shale units with subordinate thick units of cliff forming limestone and dolomite (Figs. 60–63). In eastern sections, it rests upon quartzose sandstones of the Gog Group, and may include thin equivalents of the Peyto Formation in its base. To the west, it overlies cliff forming, Lower Cambrian carbonate rocks of the Peyto/Hota.

The Weed Member (of the Mount Whyte Formation), the Trinity Lakes Member (of the Cathedral Formation), and the Stephen Member may be recognized as members of the Snake Indian Formation.

The name Snake Indian Formation was introduced for two reasons: first, to emphasize through a change in nomenclature that facies seen along the Bow Valley have changed significantly in the Jasper region; and second, because in reconnaissance mapping the recognition and tracing of the upper and lower boundaries of the equivalents of the Cathedral Formation are difficult in the Jasper region. The Snake Indian Formation was previously known as "Map-unit 3" of Mountjoy (1962, 1964).

Origin of name

The formation was named by Mountjoy and Aitken (1978), after the Snake Indian River, a few miles northeast of the type section, in Jasper National Park.

Type section

The type section (Fig. 60) is on Chetamon Mountain, 21 km north of Jasper. The section at Whitecap Mountain, 8 km along strike to the northwest of the type section, was designated a reference section by the authors of the formation.

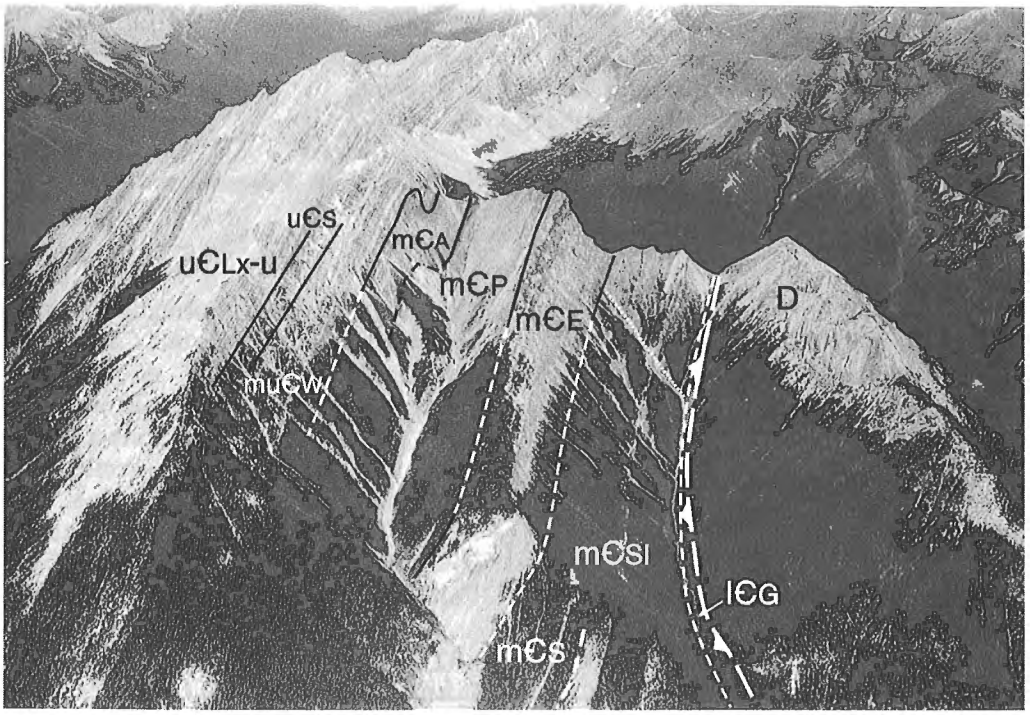


Figure 60. *Type section (dotted line) of the Snake Indian Formation at Chetamon Mountain. (Low-level, oblique air photograph.)* lЄG*–sandstones of the Gog Group;* mЄsI*–Snake Indian Formation;* mЄs*–Stephen Member;* mЄE*–Eldon Formation;* mЄP*–Pika Formation;* mЄA*–Arctomys Formation;* muЄw*–Waterfowl Formation;* uЄs*–Sullivan Formation;* uЄLx-u*–Lynx Group (upper division);* D*–Devonian strata (beneath the Chetamon Thrust). ISPG photo 1518-23.*

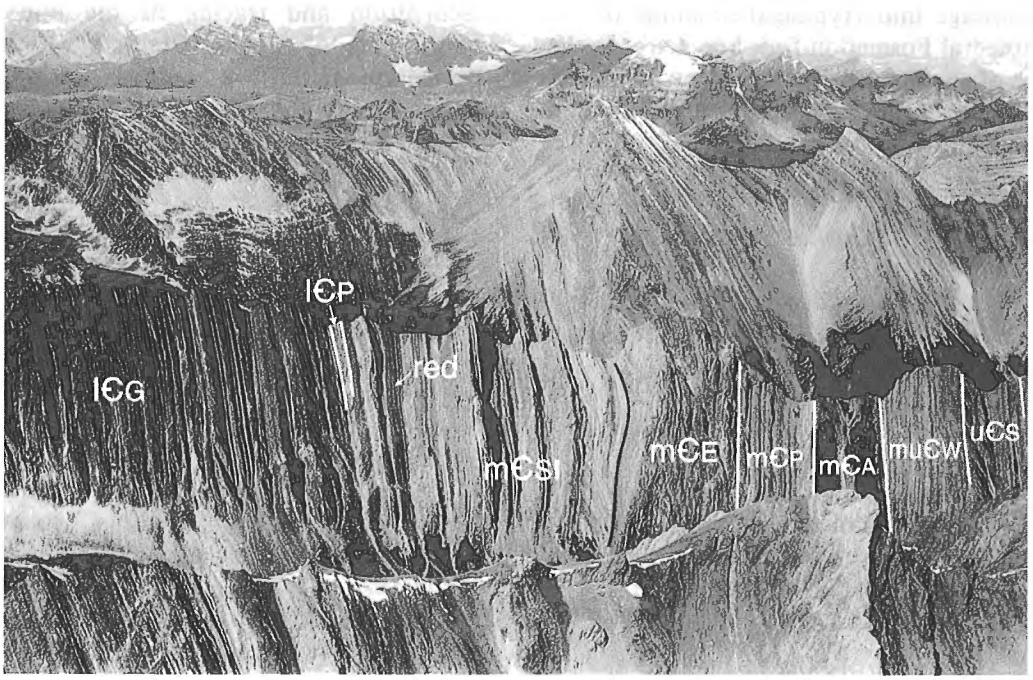


Figure 61. *Snake Indian Formation at Section AC–164, near Mount Henry. (Low-level, oblique air photograph; view northwestward.)* lЄG*–sandstones of the Gog Group;* lЄP*–Peyto Formation;* mЄsI*–Snake Indian Formation;* mЄE*–Eldon Formation;* mЄP*–Pika Formation;* mЄA*–Arctomys Formation;* muЄw*–Waterfowl Formation;* uЄs*–Sullivan Formation. ISPG photo 1518-29.*

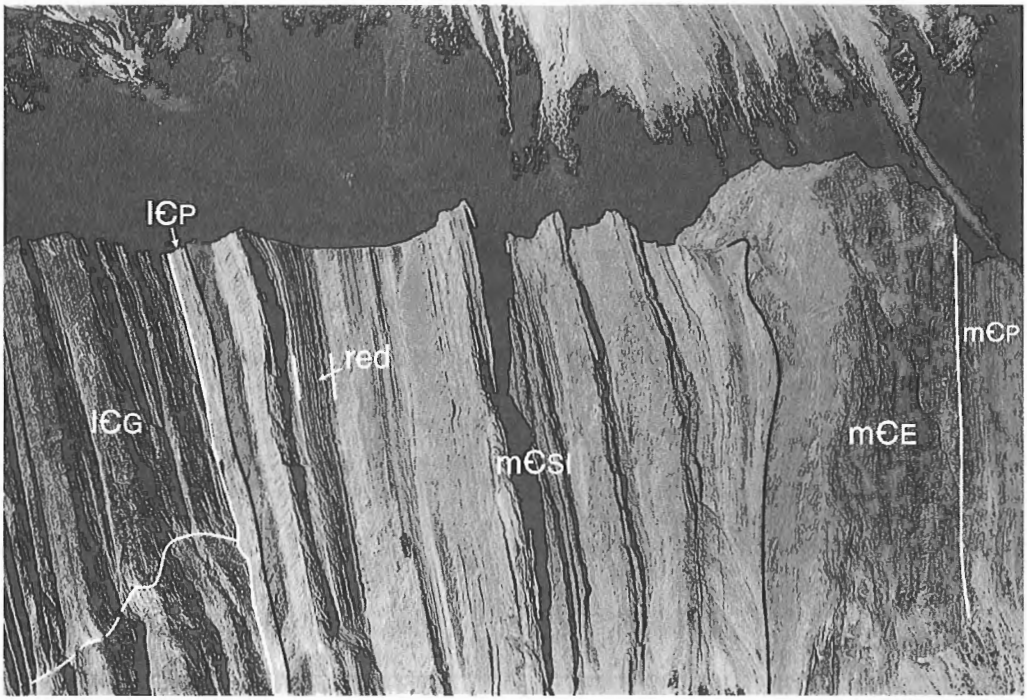


Figure 62. *A close-up view of part of the Snake Indian Formation section illustrated in Figure 61. Annotation as for Figure 61. ISPG photo 1518-27.*

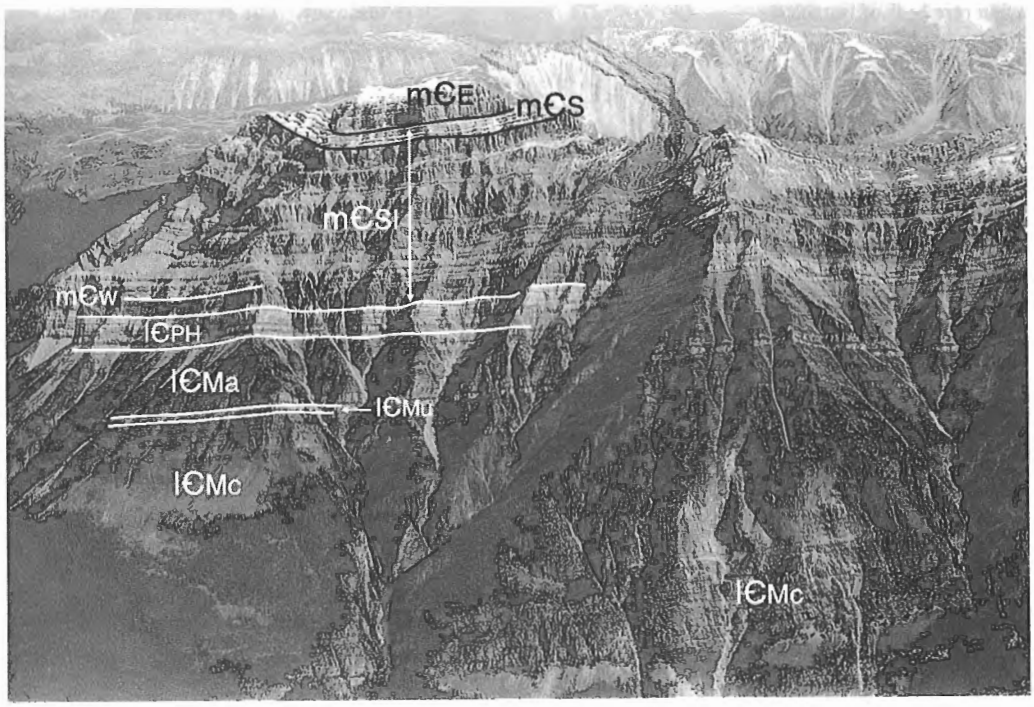


Figure 63. *The Cambrian section at Mount Kerkeslin. (Low level, oblique air photograph; view northeastward.)* lЄMc*–McNaughton Formation;* lЄMu*–Mural Formation;* lЄMa*–Mahto Formation;* lЄPH*–Peyto/Hota Formation;* mЄSI*–Snake Indian Formation (*mЄW*–Weed Member,* mЄS*–Stephen Member);* mЄE*–Eldon Formation. ISPG photo 1518-38.*

Section AC-89

Type section of the Snake Indian Formation at Chetamon Mountain

(lat. 53°02′30″N, long. 118°09′40″W)

(For access see Appendix C)

Adapted from Mountjoy and Aitken (1978, p. 355-360), expanded and recast into the lithological terms of this report.

ELDON FORMATION
(850 ft/259 m)

The Eldon Formation forms an imposing, unbroken cliff of limestone – mainly burrow-mottled lime mudstone, with minor dark-pellet and intraclast grainstone and pale-pellet grainstone. A zone of dolomitization rises across this cliff and provides a climbable route for measurement, but, in general, the formation is undolomitized.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
3	**Limestone**: as below; with 20 per cent thin and medium beds of dark-pellet grainstone and rare beds of intraclast grain/rudstone	48 (14.6)	277 (84.4)
2	**Limestone**: mainly parted lime mudstone; non-flaggy. Thirty feet (9.1 m) above the base, medium beds and, higher, thick beds of burrow-mottled lime mudstone appear	137 (41.8)	229 (69.8)
1	**Limestone**: parted lime mudstone; flaggy. Gradational top of unit marked by increasing resistance.	92 (28)	92 (28)
	Conformable contact.		

SNAKE INDIAN FORMATION
(1416 ft/431.6 m)
(Type section)

Stephen Member
(Units 48 to 62)

(Comprises the "third recessive", "upper limestone", and "fourth recessive" members of Mountjoy and Aitken, 1978.)

(Fourth recessive unit)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
62	Poorly exposed **Shale:** greenish grey; rare thin beds of skeletal grainstone/packstone	107 (32.6)	1416 (431.6)
61	Poorly exposed **Shale:** abundant thin beds of calcareous silstone; feeding traces	40 (12.2)	1309 (399)
		3 (1)	1269 (386.8)
60	**Limestone**: parted lime mudstone		
59	Covered: recessive weathering Along strike, **shale**: grey-green to olive, with 40 per cent limestone: parted lime mudstone and minor rudstone	124 (37.8)	1266 (385.9)
	GSC loc. 57618 (talus) *Ehmaniella*? sp. *Spencella* sp.		
58	Poorly exposed: recessive weathering **Limestone**: parted lime mudstone	2.5 (0.8)	1142 (348.1)

(Upper limestone unit)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
57	**Limestone**: parted lime mudstone; argillaceous, flaggy, weakly cliff forming; grades upward to non-argillaceous, parted lime mudstone	15.5 (4.7)	1139.5 (347.3)
56	Covered	9.5 (2.9)	1124 (342.6)
55	**Limestone**: oncoid packstone (rudstone), minor coarse ooid packstone	3.5 (1.1)	1114.5 (339.7)
54	**Limestone**: parted lime mudstone; flaggy, cliff forming	81.5 (24.8)	1111 (338.6)
53	**Limestone**: parted lime mudstone; lenticular to nodular bedded, recessive weathering; rare massive medium beds of oncoid floatstone (intraclast-skeletal packstone matrix). Near the base, minor brown calcareous shale and 25 cm and 45 cm thick beds of oncoid floatstone	36.5 (11.1)	1029.5 (313.8)

(Third recessive unit)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
52	Partly covered **Shale:** green, brown weathering; lenses of lime mudstone increasingly common upward	31 (9.5)	993 (302.7)
51	**Limestone**: lime mudstone with scattered oncoids; weathers pale grey, resistant	6 (1.8)	962 (293.2)
50	**Shale**: green, waxy, with some thin limestone beds; partly oncoidal in upper part	56.5 (17.2)	956 (291.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC locs. 42593, 90924 (30 ft/9.1 m above base) *Glossopleura boccar*? (Walcott), 1916 *Glossopleura* sp. *Micromitra* sp. *Zacanthoides* sp.		
49	**Limestone**: rudstone	0.5 (0.2)	899.5 (274.2)
48	Covered	4 (1.2)	899 (274)
	(Middle limestone unit)		
47	**Limestone**: parted lime mudstone; flaggy; uppermost 10 cm thick bed is ooid grainstone	25 (7.6)	895 (272.8)
46	**Limestone**: burrow-mottled lime mudstone, grading in part to parted lime mudstone; beds of oncoid floatstone/packstone 37 to 40 ft (11.3 to 13.4 m) and 68 ft (20.7 m) above base. Massive, strongly cliff forming	83 (25.3)	870 (265.2)
	Trinity Lakes Member **(Second recessive unit)** (Units 34-45)		
45	**Shale**: partly purple in upper half; several zones contain very thin beds of siltstone: grey, calcareous, laminated, brown weathering; minor limestone: as below; partly laminated, partly burrowed. Minor flat-pebble rudstone and trilobite packstone/wackestone, about 25 ft (7.6 m) below the top	84 (25.7)	787 (239.9)
44	**Limestone**: mainly parted lime mudstone; upper 10 cm and basal metre are ooid packstone with trilobite fragments	10 (3)	703 (214.2)
43	**Shale**: green; interbedded with thin, lenticular beds of limestone (skeletal grainstone/packstone); burrowed	10 (3)	693 (211.2)
42	**Limestone**: parted lime mudstone; coarsely laminated to thin bedded, scattered trilobite fragments	5 (1.5)	683 (208.2)
41	**Shale**: green; with irregular nodules and lenses of microcrystalline limestone	10 (3)	678 (206.7)
40	Covered	11 (3.4)	668 (203.7)
39	**Limestone**: parted lime mudstone; coarsely laminated and very thin bedded; upper 5 ft (1.5 m) consist of glauconitic oncoid and ooid packstone, with a spectacular bed of oncoids (2.5 cm in diameter, and commonly with hyolithid nucleii) on top	30 (9.2)	657 (200.3)
38	**Shale**: pale green to brown, finely laminated, with nodular layers of silty, microcrystalline, dolomitic limestone; intensely burrowed at base	28 (8.5)	627 (191.1)
37	**Limestone**: skeletal ooid grainstone/ packstone; thin bedded	1 (0.3)	599 (182.6)
36	**Shale**: green, silty, recessive weathering	10 (3)	598 (182.3)
35	**Limestone**: parted lime mudstone; abundant trilobite fragments	1 (0.3)	588 (179.3)
34	**Shale**: green to olive-green, slightly silty, recessive weathering, basal part covered	15 (4.7)	587 (179)
	(Lower limestone unit)		
33	**Limestone**: trilobite wackestone and coquina; nodular, thin bedded, top mammillate	1 (0.3)	572 (174.3)
32	**Limestone**: lime mudstone; finely laminated, fenestral (cryptalgal laminite), slightly mottled, massive, cliff forming. Upper 15 cm comprise a bed of algal stromatolites with polygonal cracks on the upper surface	38 (11.6)	571 (174)
31	**Limestone**: lime mudstone (and ?pale-pellet grainstone); pale to dark grey, fenestral, cliff forming	30 (9.1)	533 (162.4)
30	**Limestone**: alternating burrow-mottled and parted lime mudstone; scattered oncoids and minor ooid packstone 30 to 35 ft (9.1 to 10.7 m) above base; cliff forming	94 (28.6)	503 (153.3)
	(First recessive unit)		
29	Partly covered **Mudstone:** greenish grey with a few nodules and thin beds of grey, microcrystalline limestone	3 (7)	409 (124.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
28	**Limestone** and **shale** Limestone: burrow-mottled lime mudstone, interrupted by three units consisting of green shale with minor beds of pebbly skeletal grainstone, glauconitic	32 (9.8)	386 (117.7)
27	**Mudstone**: olive-green, calcareous, chippy; with widely spaced lenses of limestone (skeletal grainstone/ packstone)	29 (8.8)	354 (107.9)
26	**Limestone**: oncoid packstone; argillaceous	1 (0.3)	325 (99.1)
25	**Mudstone**: dark red; varve-like bedding; recessive weathering	28 (8.6)	324 (98.8)
24	**Shale**: dark green	6 (1.8)	296 (90.2)
	GSC loc. 90922 (middle of unit) *Albertella helena* Walcott, 1908 *Albertella levis*? Walcott, 1917		
23	**Mudstone**: khaki to pale green, calcareous, chippy, abundant burrows, varve-like bedding. Rare thin beds of muddy, skeletal packstone	36 (11)	290 (88.4)
	GSC loc. 90923 (talus) *Albertella levis*? Walcott, 1917		
22	**Limestone**: fine skeletal grainstone; partly oolitic, resistant. Top 15 cm contains abundant oncoids up to 3.8 cm in diameter	2 (0.6)	254 (77.4)
21	**Limestone**: parted lime mudstone; grading to nodules of micro-crystalline limestone in olive to khaki calcareous mudstone. A few 15 to 30 cm thick beds of skeletal ooid packstone	24 (7.3)	252 (76.8)
	GSC loc. 90921 *Paralbertella bosworthi* Walcott, 1917		
	GSC locs. 57670, 67673 (lower half of unit) *Albertella levis* Walcott, 1917 *Paralbertella* sp. *Mexicella* sp.		
20	**Limestone**: slightly skeletal ooid grainstone/packstone, partly oncoid and intraclast rudstone, glauconitic	1 (0.3)	228 (69.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Weed Member **(Green quartz siltstone member)** (Units 6 to 19)		
19	**Mudstone**: silty, green, red in basal 3 ft (1 m); in part, argillaceous siltstone, partly finely laminated, partly burrowed, calcareous at top	22 (6.7)	227 (69.2)
	GSC loc. 90934 (top 1 ft/0.3 m) *Paralbertella* sp.		
18	**Siltstone**: dolomitic, pale greenish grey; abundant, well preserved burrows and feeding traces	1 (0.3)	205 (62.5)
17	**Mudstone**: red and green; silt lenses (flaser), some mudcracks	4 (1.2)	204 (62.2)
16	**Siltstone**: dolomitic, pale green, finely laminated and crosslaminated; forms a prominent, pale yellow weathering rib	2 (0.6)	200 (61)
15	**Mudstone**: dark red; interbedded with siltstone; ripple marks	11 (3.4)	198 (60.4)
14	**Shale** and **siltstone** (thinly interbedded) Shale: silty. Siltstone: pale green; recessive weathering	4 (1.2)	187 (57)
13	**Limestone**: skeletal ooid grainstone/ packstone; dolomitic, weathers yellow-grey, moderately resistant	0.5 (0.2)	183 (55.8)
	GSC loc. 90920 *Paralbertella* sp.		
12	**Siltstone**: calcareous, finely laminated, pale green; interbedded with silty green shale; abundant mudcracks, some ripple marks	2.5 (0.7)	182.5 (55.6)
11	**Siltstone** and **sandstone** Pale green, calcareous, partly finely laminated, partly highly burrowed	2 (0.6)	180 (54.9)
10	Covered	7 (2.1)	178 (54.3)
9	**Sandstone**: fine grained, quartzose, calcareous, finely laminated, weathers pale yellow	1 (0.3)	171 (52.1)
8	**Shale**: silty, dark red	3 (0.9)	170 (51.8)
7	**Shale**: green, silty	3 (0.9)	167 (50.9)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Siltstone**: pale green, calcareous, partly finely laminated, partly burrowed, with feeding traces; minor very thin interbeds of microcrystalline limestone: dolomitic, and dolomite: pale yellow; ripple marks	4 (1.2)	164 (50)
	(Basal red member) (?Peyto Formation) (Units 1-5)		
5	**Limestone**: dark grey skeletal wackestone; silty, dolomitic, nodular thin bedded, mainly altered to dolomite: grey, very fine crystalline	4.5 (1.4)	160 (48.8)
4	**Mudstone** and **shale** Mudstone: very dolomitic. Shale: purple to red, some green. Minor dolomite: greenish grey, microcrystalline, silty, thin and medium bedded; thin beds of siltstone at the top; mudcracks and oscillation ripple marks at several levels; thin breccias, rare sandy beds	97.5 (29.7)	155.5 (47.4)
3	**Limestone**: red, microcrystalline, argillaceous, thin and very thin bedded, ripple marks, tepee structures; prominent thin layers of flakestone	20.5 (6.3)	58 (17.7)
2	**Mudstone**: red, calcareous	13 (3.9)	37.5 (11.4)
1	**Dolomite**: grey, pale red, microcrystalline, silty, laminated, and nodular, partly burrowed; partings of green and purple shale; minor flakestone; mudcracks prominent.	24.5 (7.5)	24.5 (7.5)
	Abrupt contact.		
	GOG GROUP		
	Sandstone: quartzose, red to pale grey, fine to medium grained, pale grey carbonate cement, weathers pale brown in 1 to 3 ft thick (0.3 to 1 m) beds; moderately resistant.		

At the type section, the Snake Indian Formation was divided into nine informal members by Mountjoy and Aitken (1978). Each of these members would be mappable at a scale of 1:50 000.

Basal red member

According to Mountjoy and Aitken (op. cit., p. 345), "The basal red member is 160 feet (48.8 m) thick and comprises red and purple mudstone and shale with local green alteration, interrupted by grey and red, silty, thin-bedded dolomite and limestone and red micritic limestone. The red clastic units contain mud-cracks and ripple-marks, the grey carbonates are in part cryptalgal laminites, and the red limestone contains small-scale ripple-marks and teepee [sic] structures. The member is in abrupt contact with underlying quartz sandstones of the Gog Group." These lithic characteristics, and its position beneath the Weed Member, strongly suggest that the Basal red member is equivalent to the Peyto Formation. Paleontological confirmation of this correlation is lacking.

Green quartz siltstone member

The Green quartz siltstone member, 67 ft (20.4 m) thick at the type section, is recognized as the continuation of the Weed Member of the Mount Whyte Formation, and may legitimately be treated as the Weed Member of the Snake Indian. It is younger (*Albertella* Zone) at Chetamon Mountain than at any other known locality.

First recessive member

The First recessive member, 182 ft (55.5 m) thick at the type section, may be recognized as a fusion of the Chephren Member of the Mount Whyte Formation and the Ross Lake Member of the Cathedral Formation, the limestones that intervene between these members to the south, southeast, and southwest having largely changed facies to shales. It is a shaly interval displaying the overall characteristics of the formal members named above.

Lower limestone member

The Lower limestone member, 163 ft (49.7 m) thick at the type section, is the lowest unit of the type Snake Indian Formation to display the lithic characteristics of the Cathedral Formation. It is a cliff forming unit, corresponding to the unnamed carbonate member of the Cathedral that intervenes between the Ross Lake and Trinity Lakes members.

Second recessive member

The Second recessive member of the type Snake Indian Formation corresponds to the Trinity Lakes Member of the Cathedral Formation, and the name Trinity Lakes may appropriately be applied to it. It is 215 ft (65.5 m) thick at the type section.

Middle limestone member

The Middle limestone member, 108 ft (33 m) thick at the type section, is the second cliff forming member of the Snake Indian Formation to have the lithic characteristics of the Cathedral Formation. It corresponds to the upper Cathedral; that is, the unnamed carbonate member intervening between the Trinity Lakes Member and the base of the Stephen Formation.

Third recessive and upper limestone members

The Third recessive member, 98 ft (29.9 m) thick, and the Upper limestone member, 146.5 ft (44.7 m) thick, correspond jointly to the Narao Member of the Stephen Formation. The Third recessive member has a much higher shale: limestone ratio than its equivalent in the Bow Valley transect, but the Upper limestone member, dominated by the parted lime mudstone lithofacies, is little changed from its equivalent there. Interestingly, the Narao Member, seen as two shallowing-upward cycles in the southern part of the region studied, is more naturally perceived near Jasper as a single shallowing-upward cycle of larger scale.

Fourth recessive member

The Fourth recessive member, 276.5 ft (84.3 m) thick at the type section, corresponds in position and faunal content to the Waputik Member of the Stephen Formation. It is lithologically similar to the Waputik, but with a higher shale:limestone ratio.

Stephen Member

In future geological mapping, more detailed than that published to date, a choice will have to be made between mapping the Narao and Waputik members of the Snake Indian Formation and mapping a Stephen Member that comprises both. The latter choice is recommended as providing a more comprehensible link with the Bow Valley succession.

Contacts

Regionally, the Snake Indian Formation overlies the Peyto/Hota Formation at the sub-Middle Cambrian unconformity. At the type section, if correlation of the Basal red member with the Peyto Formation is correct, the base is conformable with the quartzose sandstones of the Gog Group, and the formation straddles the sub-Middle Cambrian unconformity there.

The contact with the overlying Eldon/Titkana is conformable and gradational.

Distribution and thickness

The distribution of the Snake Indian Formation is sketched in Figures 49 and 59. The Snake Indian is a formation of the frontal thrust sheets of the Rocky Mountains, northwest of a line passing just north of Mount Athabasca and Beauty Creek. It may be recognizable to the northwest as far as Pine Pass (Slind and Perkins, 1967).

The formation is 800 to 2 000 ft (244 to 610 m) thick. In common with other Cambrian formations of the platform region, it thins northeastward across the tectonic strike. The correlation panel of Slind and Perkins (op. cit.) shows northwestward thinning along the tectonic strike.

Interpretation

The Snake Indian Formation presents a proximal aspect of the succession Mount Whyte/Cathedral/ Stephen, in the sense that it was deposited closer to the source of siliciclastic sediment, which according to all evidence lay somewhere north of Pine Pass. In view of the fact that the Snake Indian contains intervals assignable without difficulty to the Mount Whyte and

Stephen formations, it is mainly the partial shaleout of the Cathedral Formation (through expansion of the Ross Lake and Trinity Lakes shale tongues), plus thickening of the Mount Whyte at the expense of the Cathedral, that changes the succession from the carbonate-dominated aspect of the upper Bow Valley to the shaly aspect of the Jasper region.

Chetang and Tatei formations

The Chetang and Tatei formations (Walcott, 1913, 1928) are encountered only at the northwestern extremity of the present study area. For this reason, and because of the inadequate original definitions and the paucity of subsequent work, my understanding of these two formations is incomplete. They are shown, as the combined Chetang–Tatei, only in the Cinnamon Peak/Whitehorn section near Mount Robson (Sections AC–165/166). They are combined, for present purposes, because of serious questions as to the criteria upon which a Chetang–Tatei contact should be based; in this, the precedent of Slind and Perkins (1967) is followed.

Original work on the complete Chetang and Tatei formations, which postdates that of Walcott (1913) and Burling (1923), consists only of the brief summary of Slind and Perkins (1967) and Mountjoy's (1980) map. Fritz and Mountjoy (1975) did not extend their extremely useful redescription of Cambrian formations of the Mount Robson area above the lower Chetang.

The base of the Chetang Formation, being the upper boundary of the carbonate rocks of the Hota Formation, is clear and, indeed, the Weed Member (of the Mount Whyte and Snake Indian formations) is well developed as the basal unit. On the other hand, as noted early on by Burling (1923), the lower, as well as the upper, boundary of the Tatei Formation, as conceived by Walcott, is uncertain and, therefore, the Chetang/Tatei contact was not defined. The top of the Tatei Formation, by original definition and according to Mountjoy's (1980) map, must be the base of the Titkana/Eldon. This implies that some sort of mappable, recessive weathering and presumably shaly unit must mark the top of the Tatei, to delimit it from the unbroken limestone cliff of the Titkana–Eldon above. Neither Walcott's nor Burling's descriptions mention such a unit, both emphasizing that the Tatei Formation consists of cliff forming limestone. Such a ledge forming unit, 190 ft (58 m) thick, and having the lithic characteristics and small-scale cyclicity characteristic of the Waputik Member of the Stephen Formation, but yielding no fossils, is indeed present in the southwest-facing cliffs of Whitehorn Mountain, beneath the "monolithic" Eldon Formation. The problem of criteria for a Chetang/Tatei contact remains. Again, because no satisfactory formation boundary could be drawn within any of the cliff forming units of the Chetang–Tatei, the contact must be drawn at one of the recessive weathering, shaly units; such shaly units are 6 to 8 in number, according to judgement, and the literature provides no guidance as to which one marks the contact.

Mountjoy (1980) mapped the Tatei as a unit in the order of 1 000 ft (300 m) thick on the eastern limb of the Mount Robson Syncline, and over 1 500 ft (460 m) on the western limb. He did not provide criteria for recognizing the boundaries of the formation.

Burling (1923) reported "several lots" of fossils from the Tatei but did not describe their content. No-one else has provided fossil lists. My own attempts to collect fossils from beds in which a skeletal content was apparent were foiled by the reluctance of the trilobite material to split cleanly from the matrix.

Eldon Formation

Definition

The Eldon Formation, as restricted by Deiss (1939), is recognized as the upper of the two great, Middle Cambrian, cliff forming, carbonate formations of the southern Rocky Mountains (Figs. 7, 17, 25, 28-30, 32, 51, 52, 55-58, 60, 69, 70, frontispiece). It is bounded by the recessive weathering Stephen and Snake Indian formations below, and the recessive weathering lower Pika Formation above.

The Eldon Formation is undivided, except in a few places along the Kicking Horse Rim, where the Field Member (new), a westward-rooted tongue of dark, outer-detrital strata, penetrates the normal pale dolomites of the Eldon (Fig. 39).

Origin of names

The Eldon Formation was named by Walcott (1908a) after "Eldon Switch, on the Canadian Pacific Railway." Eldon still exists as a siding and section-house on Highway 1A, 6 miles (9.7 km) west of the junction with Highway 93 and overlooked by Castle Mountain. Its position is shown on topographic

maps of suitable scale. The Field Member is named after its type section on Mount Field, above the town of Field, British Columbia.

Type section

It is plain that Walcott (1908a, c, 1928) intended some part of the Castle Mountain massif as the type section for the Eldon Formation. His measured section "... began at the southwest base [of Castle Mountain] and extended around the point of the mountain into the large amphitheatre on the northeast side [that contains Rockbound Lake] and hence to the summit of Stuart Knob" (Walcott, 1928, p. 274). The Eldon as originally defined included strata later differentiated as the Pika Formation by Deiss (1939). The Cathedral and Eldon cliffs of Castle Mountain proper are a serious mountaineering proposition. Like Deiss, I chose Helena Ridge, across Rockbound Lake from Eisenhower Peak, as providing good exposures and a practicable route of measurement. Walcott may in fact have made the same choice for the upper part of his section, inasmuch as he ended at Stuart Knob. Helena Ridge is on the right in Walcott's (1908c) Plate 20, figure 1, and in his (1928) Plate 40, figure 1 (the same photograph).

Deiss (1939, p. 1007) stated that, for reasons given above, "the type section of the Eldon dolomite ... is changed to Helena Ridge", but this was not necessarily a change. At the type section on Helena Ridge, the Eldon and its upper and lower contacts are well exposed. On the other hand, at this locality the Eldon consists almost entirely of dolomite, much of it rather coarsely crystalline and difficult to interpret, and the formation is broken by a west-side-down fault with an estimated throw of 300 to 400 ft (91 to 122 m), for which I was able to obtain only an approximate solution. Accordingly, the Mount Bosworth section (AC–3) and the Ghost River (Orient Point) section (AC–28) are here recognized as reference sections; the latter because it consists largely of undolomitized limestone.

The type section of the Field Member (new) is designated as that on the peak of Mount Field, overlooking Burgess Pass (Section AC–162).

Type section of the Eldon Formation at Castle Mountain (Helena Ridge)

Section AC–24

(lat. 51°18′52″N, long. 115°54′08″W)

PIKA FORMATION
(Type section)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
9	**Limestone**: burrow-mottled lime mudstone. At the top, 0.3 ft (10 cm) of intraclast grainstone/packstone	3 (0.9)	86 (26.2)
	GSC loc. 52569 (2.5 to 3 ft/0.8 to 0.9 m above the base) *Modocia* spp. *Marjumia* spp.		
8	**Shale**: olive, soft, calcareous, weakly fissile, with 20 per cent beds and lenses of grey, microcrystalline limestone, 0.5 to 1 cm thick	4 (1.2)	83 (25.3)
7	Covered: recessive (?)Shale as above	12.5 (3.8)	79 (24.1)
6	**Limestone**: ooid packstone with skeletal bands; ooids are completely dolomitized; weathers dark grey, brown specked; massive	2 (0.6)	66.5 (20.3)
5	**Limestone**: parted lime mudstone; irregular, discontinuous beds, 1 to 2.5 cm thick; dolomite partings constitute 40 per cent of unit	9.5 (2.9)	64.5 (19.7)
4	Covered Probably shale: as higher in section	6 (1.8)	55 (16.8)
3	**Dolomite**: ex-parted lime mudstone; grey, fine crystalline, with partings and mottlings of dolomite: dark grey, very fine crystalline, argillaceous	19.5 (5.9)	49 (14.9)
2	**Dolomite**: cryptalgal laminite; local crosslamination; dark grey, fine crystalline at base, dark grey, aphanitic above; bedding planes have black coating	8.5 (2.6)	29.5 (9)
1	**Dolomite**: ex-parted lime mudstone; very fine crystalline, grey to dark grey, beds 2.5 to 5 cm thick; partings are dark argillaceous dolomite at base, grading to tan shale at top.	21 (6.4)	21 (6.4)
	Concordant contact.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	ELDON FORMATION (approximately 893 ft/272.2 m) (Type section)		
	The Eldon Formation forms steep slopes and cliffs, pale in colour.		
12	**Dolomite**: stromatactoid; laminae of coarse white dolomite are vuggy; minor intervals of dolomite: dark grey, with white mottling. Spongy silicification common in uppermost 22 ft (6.7 m)	72 (21.9)	893 (272.2)
11	**Dolomite**: grey, weathers very pale grey, pitted; fine to medium crystalline, massive; fair to good vuggy porosity throughout; strongly cliff forming	24 (7.3)	821 (250.2)
10	**Dolomite**: brownish grey, locally dark grey, weathers grey, pitted to cavernous; fine crystalline; clear traces of relict, coarse, particulate fabric; crossbedded, in sets 15 to 30 cm thick. Unit is remarkably uniform. Contact at top gradational	100 (30.5)	797 (242.9)
9	**Dolomite**: ex-burrow-mottled lime mudstone; grey, weathers grey, pitted; fine crystalline, mottled by darker, finer dolomite; several vuggy zones in medium crystalline dolomite; bedding joints stylolitic	29 (8.8)	697 (212.4)
8	**Dolomite**: grey, weathers grey, cavernous; fine crystalline, crossbedded and crosslaminated (i.e., ex-particulate limestone), beds 30 cm and thicker, fair vuggy porosity	28 (8.5)	668 (203.6)
7	**Dolomite**: grey, weathering grey, cavernous; medium crystalline, in part finely mottled with white dolomite; beds 30 cm and thicker, crossbedding common; patches of poor to fair, vuggy porosity	27.5 (8.4)	640 (195.1)
	Upward line of section offsets 300 m to the west, to reach better outcrops.		
6	**Dolomite**: dark grey to black, mottled by white in vermicular fashion (i.e., ex-fenestral fabric); fine and medium crystalline; bedding joints, spaced 5 to 20 cm, have strong development of stylolites; fenestrae die out upward; dolomite grades to ex-parted lime mudstone	161.5 (49.2)	612.5 (186.7)
5	**Dolomite**: ex-parted lime mudstone; dark brownish grey, partly mottled in shades of grey; very fine crystalline; darker laminae preserve very thin (1–2.5 cm) bedding. Thin beds of ex-particulate dolomite (as below) occur at about 5 ft (1.5 m) intervals, and at 2 ft (60 cm) intervals in the uppermost 110 ft (33.5 m). Unit weathers dark brownish grey, recessive in uppermost 75 ft (22.9 m)	139 (42.4)	451 (137.5)
4	**Dolomite**: ex-burrow-mottled lime mudstone; dark grey, normally faintly mottled in paler and darker grey, weathers dark brownish grey, pitted; fine and very fine crystalline; local 1 ft (30 cm) thick zones mottled with coarser, white dolomite; massive, with bedding suggested by aligned mottlings; rare vuggy zones associated with white mottling. Thirty-two to forty-two feet (9.8 to 12.8 m) above the base is a lens of dolomite: pale pinkish grey, weathering pale brown; fine and medium crystalline; with many vuggy zones, 2.5 to 5 cm thick, commonly associated with breccia (?solution collapse breccia) along bedding planes. A distinctly cross-bedded unit, coarsely particulate, with dark intraclasts in a white matrix, occurs 117 to 120 ft (35.7 to 36.6 m) above the base. Cross-lamination is fairly common	130 (39.6)	312 (95.1)
	At this point, a west-side-down normal fault, with displacement estimated at 300 to 400 ft (91 to 122 m) is encountered. The contact between units 3 and 4 was relocated west of the fault, on the slope above Tower Lake, with a probable accuracy of ±15 ft (5 m).		
3	**Dolomite**: a massive, persistent body; dolomite grades upward from dark grey to black and fine crystalline at the base, to dark grey, medium crystalline, prominently mottled by white, for most of the unit (?ex-burrow-mottled lime mudstone); becomes vuggy and cavernous upward, the vugs are associated with the white dolomite, which clearly postdates the dark phase. The unit forms a persistent, nearly white cliff	21 (6.4)	182 (55.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	**Dolomite**: pale grey, partly mottled in pale and darker grey, mottlings less prominent than below, weathers dark grey; very fine crystalline; largely laminated, partly cross-laminated; strong development of stylolites has thinned the unit appreciably	82 (25)	161 (49.1)
1	**Dolomite**: dark grey, pale brown weathering, very fine crystalline; very regular, very thin and thin beds; prominent feeding burrows, about 1 cm wide; a cliff forming unit.	79 (24.1)	79 (24.1)

STEPHEN FORMATION
(237 ft/72.2 m)

The Stephen Formation supports a clearly demarcated, recessive weathering, ledged slope between the cliffs above and below.

Waputik Member
(142 ft/43.3 m)
(Units 7 to 14)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
14	Covered	20 (6.1)	237 (72.2)
13	**Limestone**: largely ooid grainstone/packstone, subordinate lime mudstone; irregularly very thin bedded, grey weathering, with scattered, orange weathering, dolomitized blotches	4 (1.2)	217 (66.1)
12	**Shale**: green-grey, fissile	10 (3)	213 (64.9)
11	**Limestone**: skeletal grainstone/packstone; medium bedded, with minor interbeds of shale (as below)	7.5 (2.3)	203 (61.9)
10	**Shale**: olive-green, silty, moderately fissile, with a variable content (locally up to 10 per cent), of 0.5 to 1 cm thick beds of pink weathering lime mudstone. Beds of flat-pebble rudstone, 10 to 15 cm thick, occur at about 5 ft (1.5 m) intervals in the basal 15 ft (5 m)	42.5 (13)	195.5 (59.6)

Section continues downward.

Reference section for the Eldon Formation at Mount Bosworth West

Section AC-3

(lat. 51°27′18″N, long. 116°20′W)

(For access see Appendix C)

PIKA FORMATION

Section continues upward.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Limestone**: platy, as below.		
5	**Shale**: grey with buff laminae, calcareous, slaty	5 (1.5)	105 (32)
4	**Limestone**: parted lime mudstone; very irregular, lenticular, 0.5 to 1 cm thick beds; very platy. Top bed is 2.4 cm of flat-pebble rudstone. Unit is recessive weathering; outcrop is slumped, poorly exposed	35 (10.7)	100 (30.5)
3	**Limestone**: grey lime mudstone, mainly laminated (cryptalgal laminite?); mainly medium bedded, thin bedded and dolomitic at the base. Mud-cracks in some beds. Unit weathers rusty locally	48 (14.6)	65 (19.8)
2	**Dolomite**: grey, microcrystalline, mainly argillaceous, laminated (?cryptalgal laminite), platy	10 (3)	17 (5.2)
1	Covered: recessive weathering.	7 (2.1)	7 (2.1)

Contact covered, concordant.

ELDON FORMATION
(1642 ft/500.5 m)
(Reference Section)

The Eldon Formation forms impressive, pale grey cliffs on the southern face of Mount Bosworth, above which the darker, more ledgy outcrops of the Pika Formation are clearly marked.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
22	**Dolomite**: as below, but the basal 50 ft (15.2 m) display distinctive pink and orange-buff weathering; mainly white, or white streaked with pale brown, vuggy throughout. The uppermost 40 ft (12.2 m) are very massive, cavernous weathering, and largely coarse crystalline (mega-crystalline facies)	266 (81.1)	1642 (500.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	**Dolomite**: as below, but mainly medium bedded. A few pale brown weathering zones, typically 2 ft (0.6 m) thick, massive, with up to 10 per cent vuggy porosity. Upward, medium bedded subunits alternate with units of 30 to 60 cm thick beds	159 (48.5)	1376 (419.4)
20	**Dolomite**: white, grey weathering, medium crystalline, generally nonbedded, but with a few beds as thin as 15 cm. Several vuggy subunits 5 to 10 ft (1.5 to 3 m) thick	52 (15.8)	1217 (370.9)
19	**Dolomite**: as Unit 18, but irregularly thin to thick bedded, bedding is very discontinuous. Finely mottled dolomite, white-on-black (ex-fenestral lime mudstone) occurs intermittently throughout the unit	173 (52.7)	1165 (355.1)
18	**Dolomite**: white, medium crystalline, in regular, 2.5 to 7.5 cm thick beds	23 (7)	992 (302.4)
17	**Dolomite**: white and nearly white, medium and coarse crystalline, irregularly thick bedded (mega-crystalline facies). The upper 100 ft (30.5 m) is stromatactoid dolomite. In the upper half, vuggy porosity is widely developed in patches, having little extent along the bedding	117 (35.7)	969 (295.4)
16	**Dolomite**: ex-fenestral lime mudstone; finely mottled, white on dark grey; fine crystalline, thin bedded	6 (1.8)	852 (259.7)
15	**Dolomite**: white, medium and locally coarse crystalline (megacrystalline facies), massive	29 (8.8)	846 (257.9)
14	**Dolomite**: ex-fenestral lime mudstone; finely mottled, white on dark grey, weathers grey, fine crystalline; regular, 5 to 22 cm thick beds, grainy. Widely spaced beds are white, medium to coarse crystalline. Bedding joints are developed locally, but much of the unit is massive	60 (18.3)	817 (249)
13	**Dolomite**: white, medium and locally coarse crystalline, massive (mega-crystalline facies), scattered vugs	85 (25.9)	757 (230.7)
12	**Dolomite**: white, coarse crystalline, massive, very vuggy. This mass of megacrystalline facies has irregular boundaries, and is seen to end downdip	13 (4)	672 (204.8)
11	**Dolomite**: grey, cream weathering; partly slightly mottled with nearly white; fine and medium crystalline, massive	17 (5.2)	659 (200.9)
10	**Dolomite**: ex-parted lime mudstone(?); nearly white, mottled with dark grey; fine and very fine crystalline; very regularly thin bedded, beds de-parting little from 2.5 cm	60 (18.3)	642 (195.7)
9	**Dolomite**: white, mottled with grey; fine crystalline, nonbedded, massive. Zones of poor vuggy porosity recur at about 10 ft (3 m) spacing	80 (24.4)	582 (177.4)
8	**Dolomite**: white, with grey, carbon-aceous specks, non-mottled, fine crystalline, uniform	80 (24.4)	502 (153)
7	**Dolomite**: cream to white, fine crystalline, partly medium crystalline, mottled with dolomite: dark grey, fine and very fine crystalline. Bedding regular, 5 to 15 cm. Unit weathers cream, grainy. Minor subunits, up to 1 ft (0.3 m) thick, of nearly white, medium to coarse crystalline dolomite	105 (32)	422 (128.6)
	Contact follows bedding.		
6	**Limestone**: parted lime mudstone, passing to massive, burrow-mottled lime mudstone in the upper 25 ft (7.6 m)	175 (53.3)	317 (96.6)
	Unit 6 is limestone in the western section, but dolomite on the line of section above the type section of the Stephen Formation.		
	Units 1 to 5 are recognizable in the western section, but are described from the exposures above the type section of the Stephen Formation, where they are better exposed.		
	At the eastern section limestone is succeeded upward by dolomite: cream, fine crystalline, mottled with dark grey, very fine crystalline, very thin bedded (Unit 6).		
5	**Limestone**: as Unit 3	61 (18.6)	142 (43.3)
4	**Dolomite**: cream, fine crystalline, in 2 cm thick beds; alternating with dolomite: dark grey, very fine crystalline, in 0.5 cm thick beds. Minor limestone relics	5 (1.5)	81 (24.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
3	**Limestone**: parted lime mudstone; 2.5 to 5 cm thick beds; a minor cliff former, weathering dark grey to black ("basal black band")	14 (4.3)	76 (23.2)
2	**Limestone**: parted lime mudstone; beds are very regular, 2 to 2.5 cm thick	55 (16.8)	62 (18.9)
1	**Limestone**: parted lime mudstone; beds 2 to 7.5 cm thick. Basal foot (30 cm) is ooid grainstone/packstone.	7 (2.1)	7 (2.1)
	Contact conformable, interbedded.		

STEPHEN FORMATION

The Stephen Formation is recessive weathering and ledgy, relative to the Eldon above.

Waputik Member

29	**Slate**: green-grey, weathering green and rusty, calcareous	9 (2.8)
28	**Limestone**: ooid grainstone/packstone, with lenses of trilobite coquina; bedding is generally thin, but very irregular and discontinuous. Unit weathers pale brown and grey	9 (2.8)
27	**Slate**: khaki, green, grey, calcareous. Widely spaced, 2.5 to 5 cm thick beds of green, argillaceous, microcrystalline limestone. Eight feet (2.4 m) above the base, a 7.5 cm thick bed of mottled lime mudstone	23 (7)
26	Covered	2 (0.6)
25	**Limestone**: oncoid packstone; pebbly; oncoids up to 2.5 cm maximum dimension. Top of bed is coated green (chloritic)	2 (0.6)
24	**Shale**.	
	Section continues downward.	

Reference section for the Eldon Formation at Ghost River (Orient Point)

Section AC-28

(lat. 51°15′20″N, long. 115°09′50″W)

PIKA FORMATION

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
6	Covered		
5	**Limestone**: parted lime mudstone. At the top, a 2.5 cm thick bed of flat-pebble rudstone	39 (11.9)	139 (42.4)
4	**Shale**: brown, micaceous, fissile, slightly calcareous. Abundant thin beds, nodular beds and lenses of calcisiltite and trilobite wackestone, partly argillaceous. Recessive weathering	16 (4.9)	100 (30.5)
3	Covered: recessive weathering	4 (1.2)	84 (25.6)
2	**Limestone**: as below, with fairly common beds of flat-pebble rudstone up to 10 cm thick. Lowest occurrence of trilobite fragments noted 8 ft (2.4 m) below the top	29 (8.8)	80 (24.4)
1	**Limestone**: parted lime mudstone, partly calcisiltite; weathers grey, striped and mottled with pale yellow-brown. Unit forms a cliff less steep than the Eldon below, and set back from the latter as a distinct ledge.	51 (15.5)	51 (15.5)
	Contact gradational.		

ELDON FORMATION
(776 ft/236.5 m)

The Eldon Formation forms a single, continuous, nearly vertical, grey cliff, incised by major gullies; the latter provide the only routes for examination of the formation.

11	**Limestone**: as below; very little dolomite. Unit becomes coarsely flaggy and less strongly cliff forming in the uppermost 30 ft (9.1 m)	50 (15.2)	776 (236.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Limestone** (90%) and **dolomite** (10%) Limestone: as below. Dolomite: pale brown and grey-brown, fine crystalline, mottled with very fine crystalline, darker dolomite, in the style of burrow-mottled lime mudstone, and occurring as beds 15 to 60 cm thick. Unit weathers grey, and forms a steep cliff continuous with the lower units	59 (18)	726 (221.3)
9	**Limestone**: mainly burrow-mottled lime mudstone and minor dark, pellet grainstone; nonbedded, massive; thin bedding suggested by alignment of mottling	23 (7)	667 (203.3)
8	**Limestone** (70%) and derived **dolomite** (30%) Limestone: burrow-mottled lime mudstone. Dolomite: brown, fine crystalline, mottled. Limestones of this unit are markedly recrystallized	22 (6.7)	644 (196.3)
7	**Limestone**: burrow-mottled lime mudstone; massive; minor intraclast grainstone and secondary dolomite	30 (9.1)	622 (189.6)
6	**Limestone** and derived **dolomite** (interbedded) Limestone: burrow-mottled lime mudstone as above. Dolomite: brown, fine equicrystalline, mottled with very fine crystalline, darker dolomite	40 (12.2)	592 (180.4)
5	**Dolomite**: as below, with minor relict masses of limestone: burrow-mottled lime mudstone and minor pellet grainstone. This unit is mainly limestone on nearby, inaccessible cliffs	46 (14)	552 (168.2)
4	**Dolomite**: partly brown, very fine crystalline, mottled; partly grey to white, fine equicrystalline, with relict particulate texture. Minor subunits of limestone: as below	24 (7.3)	506 (154.2)
3	**Limestone**: beds of burrow-mottled lime mudstone (up to 50 per cent dolomite mottlings), 10 to 30 cm thick, alternating with beds of non-mottled, dark, pellet grainstone 2.5 to 5 cm thick	40 (12.2)	482 (146.9)
2	**Limestone**: parted lime mudstone, grading to burrow-mottled lime mudstone; becomes flaggy on prolonged weathering. Unit forms a steep, grey cliff	426 (129.8)	442 (134.7)
1	**Limestone**: parted lime mudstone; dark, argillaceous, thin bedded, flaggy; minor beds of trilobite wackestone (calcisiltite) near the base; weathers dark grey, moderately resistant; slope steepens upward.	16 (4.9)	16 (4.9)

Contact gradational.

STEPHEN FORMATION
(71 ft/21.6 m)

The Stephen Formation is recessive weathering and forms a distinct, commonly vegetated ledge.

Waputik Member
(37 ft/11.3 m)
(Units 7 to 9)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	Slumped outcrop: rock type as below	17 (5.2)	71 (21.6)
8	**Shale**: as below, with several 5 to 15 cm thick lenticular beds of massive, ooid grainstone/packstone	5.5 (1.7)	54 (16.5)
7	**Shale**: grey at base, deep green, waxy, highly fissile above. At the top, a thin stratum of purple-red shale. In the basal 3 ft (1 m), three 5 cm thick beds of flat-pebble rudstone Unit is recessive weathering.	14.5 (4.4)	48.5 (14.8)

Section continues downward.

Lithology

The Eldon Formation generally has been dolomitized completely, or nearly so, but the original limestones may be studied at a number of sections.

The dominant limestone lithofacies of the platform region is massive, burrow-mottled lime mudstone. Thick intervals of this facies are commonly interrupted by a few thin and medium beds of dark-pellet grainstone, which usually contain dark, rounded intraclasts as well. Parted lime mudstone, or its dolomitized equivalent, invariably forms the base of the formation and grades upward into the massive, mottled facies.

Masses (apparently, large-scale lenses) of very pale grey weathering, pale-pellet grainstone occur here and there in the Eldon Formation, eastward at least to the mountain front (Figs. 69, 72). Such a grainstone was a former source of high-purity feedstock ($CaCO_3$ 97%-plus; SiO_2 less than 0.5% to 1%) for Loder's lime plant near Mount Yamnuska on Highway 1A. In the weathered outcrops above the roadcut at Windy Point on North Saskatchewan River, pale-pellet grainstone makes up the bulk of shallowing-upward cycles as follows:

3. Cryptalgal laminite (capped by an erosion surface in some cycles)

2. Pale-pellet grainstone, massive

1. Burrow-mottled lime mudstone.

These cycles range in thickness from about 15 ft (5 m) to about 45 ft (15 m).

Along the Kicking Horse Rim, dolomitization is general but, in a number of places, textures inherited from intraclast rudstone, fenestral lime mudstone, and cryptalgal laminite are recognizable, as are a few thrombolites and algal stromatolites (Fig. 64). Along the rim and for some distance northeastward dolomitized ooid grainstone forms significant units (see the section at Mount Field, AC–162); major oolite units extend eastward as far as Mount Weed (Section AC–171) and Beauty Creek (Section AC–48). A significant anomaly occurs at Chaba River (Section AC–143), where crosslaminated sandy skeletal grainstone (Fig. 65) occurs in association with fenestral lime mudstone, thrombolites, algal stromatolites, and oolite. At Mount Eon (Section AC–102), near the crest of the rim, the sedimentary structure *Yoholaminites* (McIlreath and Aitken, 1976) is prominent, suggesting

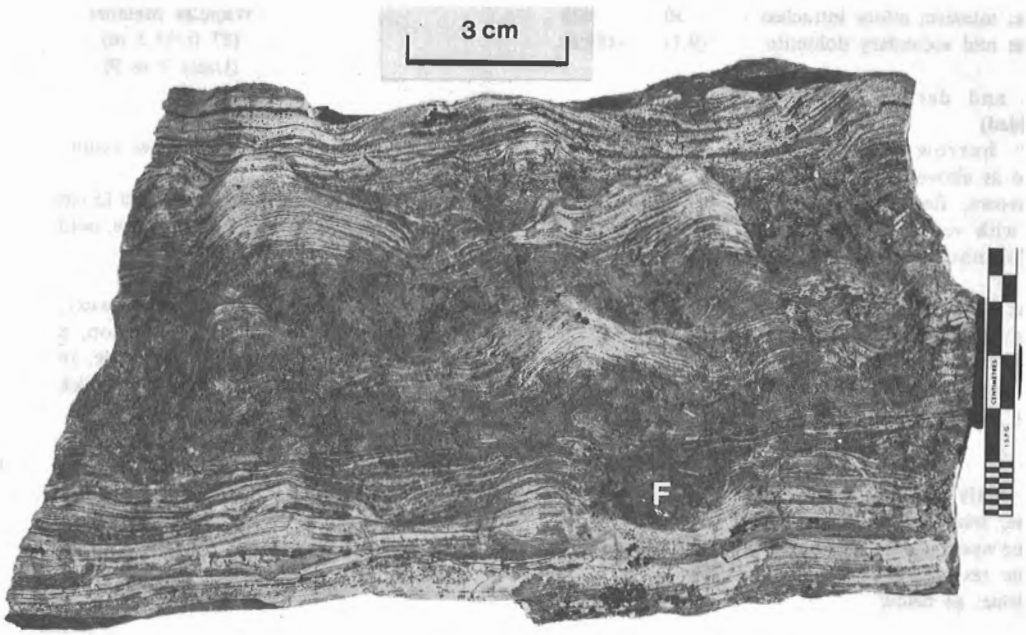


Figure 64. *Cryptalgal, dolomitic limestone in the Eldon Formation, near the summit of Mount Field. The surface is naturally weathered. The top and base of the specimen are cryptalgal laminite; the middle part is mainly laterally linked hemispheroids (stromatolites).* F*–centimetre-scale channel, filled with grainstone. ISPG photo 1759-1.*

Figure 65. *Crosslaminated, sandy limestone (quartz sand) in the Eldon Formation at Chaba River (Section AC–143). GSC photo 5-15-65.*

that a facies similar to the reef-flat facies of the Cathedral Formation is present there.

In addition to occurrences along the rim, stromatactoid and megacrystalline dolomite, commonly associated with relics of fenestral fabric, occur well to the east; for example, at Castle Mountain (Section AC–24). There several units of dolomitized, crossbedded rudstone (Fig. 66) also occur.

The slope facies of the Eldon Formation, west of the Kicking Horse Rim, has been observed only at widely scattered localities along strike, because there the Eldon dips westward beneath younger formations and is not seen again. At the one complete section studied, at Tokumm Creek (Section AC–160), the Eldon and Pika formations are interpreted as forming a single unit 1109.5 ft (338.2 m) thick, ending upward at an abrupt contact with interlaminated dark grey siltstone and pale green argillite, interpreted as basal Arctomys equivalent. The beds below the Field Member at this section consist of alternating ribbon-bedded lime mudstone and mottled and parted lime mudstone and dolomitized equivalents, including much stromatactoid dolomite. Evidence of sliding and slumping is sparse in this interval. Above the Field Member, the ribbon-bedded lime mudstone facies is dominant, and slide masses, sedimentary overfolds, and truncation of bedding by slide surfaces are common (Fig. 67). One debris flow, consisting of angular limestone fragments in a muddy, dolomitic matrix, is 6 ft (2 m) thick. Dolomitization is widespread but laterally impersistent in this part of the section. The incomplete section at Mount Duchesnay (Section AC–130) displays similar characteristics.

At Mount Burgess, above Field, and at Mount Mather on Blaeberry River, the Eldon/Pika, undifferentiated, is again dominated by the ribbon-bedded lime mudstone lithofacies, with abundant evidence of downslope movement (Fig. A-27). At Mount Duchesnay, south of Mount Stephen, the development of debris-flow breccias is spectacular in the upper 646 ft (196.9 m) of the Eldon/Pika (Fig. A-28). There, three tongues of grey slate interrupt the carbonate rocks. McIlreath (1977, p. 37-42) reported that tongues of argillite; that is, tongues of "Chancellor facies", occur at progressively lower stratigraphic levels in the Eldon/Pika from Tokumm Creek to the ridge connecting Mount Stephen with Mount Dennis (see also Cook, 1975, his Figure 7). Similar beds (tongues?) of mudrocks interrupt the Eldon carbonate rocks at Chaba River (Section AC–143). At Mount Duchesnay, intraclast wackestone, commonly crosslaminated and probably in part at least of turbiditic origin, is also prominent. This anomaly suggests that the Mount Duchesnay locality may have been in front of a persistent channel through the rim, which served to supply lime sand to the basin during Eldon/Pika time.

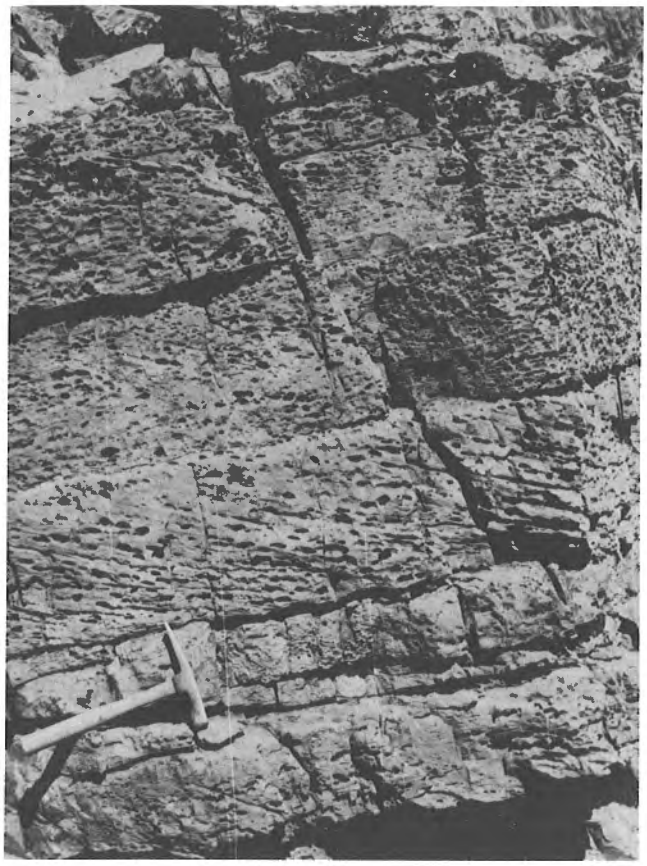


Figure 66. *Crossbedded dolomite (ex-rudstone) in the Eldon Formation at its type section. ISPG photo 758-3.*

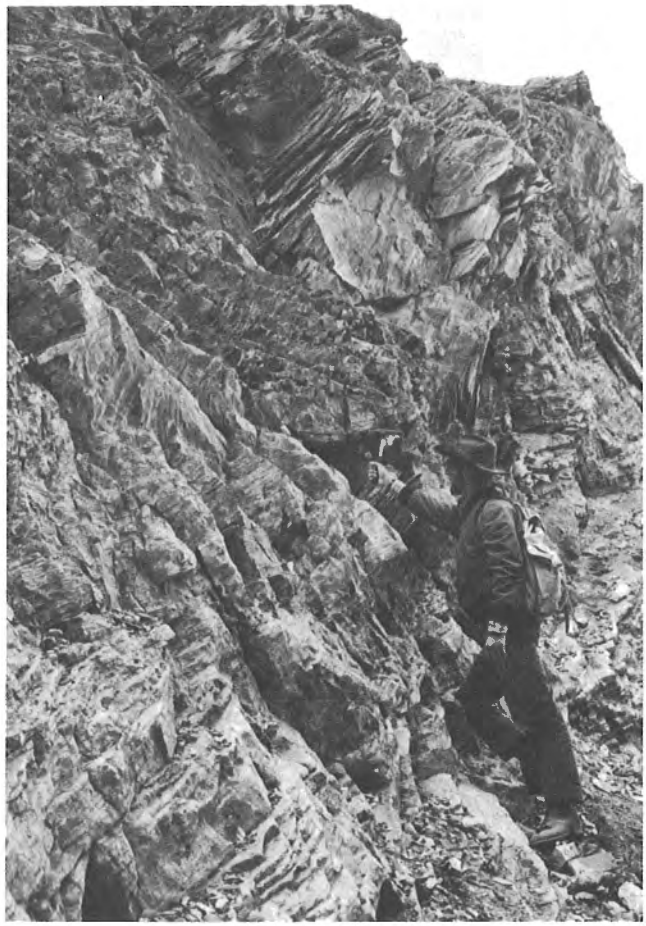


Figure 67. *Slump fold in Eldon-equivalent, ribbon-bedded lime mudstone at Tokumm Creek (Section AC–160). GSC photo 3-2-66*

Field Member

The Field Member, examined at only four localities, is laterally variable, but easily recognized as a dark grey to nearly black, slightly recessive weathering unit in the lower half of the undifferentiated Eldon/Pika. At the type section, the Field Member consists of the following three units, with the base 808.5 ft (246.4 m) above the Stephen/Eldon contact:

Overlying beds: dolomite-mottled lime mudstone, medium bedded, grading upward to parted lime mudstone. At a replacement contact 45 ft (13.7 m) above the base, these strata pass into thin bedded dolomite. Abrupt basal contact.

3. (30 ft/9.1 m)
   Argillite: dark grey, calcareous, silty, partly crosslaminated; minor thin beds, lenses and nodules of grey, microcrystalline limestone. Weathers mainly pale brown, resistant, with minor pale grey and green-grey near the top.

   GSC loc. 75190 (10 ft/3 m above the base)
   Spencella montanensis? Rasetti, 1963
   Bathyuriscus sp.
   Canadaspis sp.

2. (16 ft/4.9 m)
   At the base, **limestone** (as below), but with sparse laminae of orange weathering, microcrystalline dolomite. **Dolomite** laminae increase upward, producing typical ribbon-bedded lime mudstone. Trilobites abundant, with numerous complete specimens.

1. (18 ft/5.9 m)
   Lime mudstone: dark brownish grey, thin and very thin bedded, laminated, alternately flaggy and platy; weathers dark grey, moderately resistant. Ribbon-bedded lime mudstone lithofacies, lacking the usual dolomite laminae. Abrupt basal contact. Basal 10 ft (3 m) are richly fossiliferous.

GSC loc. 75189 (4-5 ft/1.3-1.7 m above base)
Elrathina sp.
Micromitra sp.
Parkaspis sp.
Peronopsis montis (Matthew), 1899
Ptychagnostus intermedius (Tullberg), 1880
Spencella sp.

A collection of loose material from Units 1 and 2 yielded additions to the above fauna.

GSC loc. 65837
Bathyuriscus cf. *B. adaeus* Walcott, 1916
Elrathina cf. *E. cordillerae* Walcott, 1887
Pegmatreta sp.
Peronopsis cf. *P. scutalis* (Salter), 1872
Tomagnostus?
Zacanthoides sp.

Thickness of Field Member ... 64 ft (19.5 m)

Underlying beds: dolomite: fine crystalline, ex-burrow-mottled lime mudstone; weathers pale yellow, massive; thick and monotonous.

At Stanley Peak (Section AC–55), the Field Member is 264 ft (80.5 m) thick, and consists mainly of ribbon-bedded lime mudstone. The argillite unit of the type section is missing. The trilobite fauna is nearly identical to that of the type section; inarticulate brachiopods and sponge spicules are also present:

GSC loc. 55341
Bathyuriscus cf. *B. adaeus* Walcott, 1916
Elrathina cf. *E. cordillerae* Walcott, 1887
Homotreta sp. or *Pegmatreta* sp.
Peronopsis sp.
Ptychagnostus cf. *P. intermedius* (Tullberg), 1880
Zacanthoides? sp.

On the western ridge of Mount Stephen, the Field Member consists of about 50 ft (15.2 m) of slate that weathers orange-tan (cf. dark grey on the north face), with minor thin beds of grey, fine crystalline, orange weathering dolomite.

At Tokumm Creek (Section AC–160), the variability of the Field Member can be examined in a single exposure. Where first encountered on the line of section, the Field Member is a brown weathering, recessive unit 26.5 ft (8.1 m) thick. It consists of ribbon-bedded lime mudstone in which the dolomite laminae are prominent. Carbonaceous imprints of a rope-like, leafy alga, partly disposed in loops, are common. The top 4 ft (1.2 m) of the unit has interbeds of grey slate, up to 10 cm thick. One hundred and fifty feet (46 m) along the cliff face to the southwest, in the downdip direction, the top 10 ft (3 m) of the member has changed to interbedded, black, silty argillite and grey siltstone, in thin, lenticular beds. The beds overlying the Field Member at the Tokumm Creek section converge against the top of the member at an angle of nine degrees (Fig. 68), and are of subtly to grossly different lithology from place to place, although ribbon-bedded lime mudstone predominates. The oldest of these overlying beds examined is a 4 ft (1.3 m) thick bed of massive intraclastic limestone, probably a debris-flow breccia. Like other overlying units it pinches to disappearance toward the southwest. These relationships show that the Field Member at Tokumm Creek is of fondoform origin, and was buried by outbuilding clinoform beds deposited on a slope of more than nine degrees. Bedding discordances and slide masses confirm the clinoform interpretation.

Contacts

The basal contact of the Eldon Formation, as amended here, is drawn at the top of the highest shale bed of the Stephen Formation. Lithological correlations (Figs. 55-58) strongly suggest that the Stephen maintains its thickness northeastward at the expense of the Eldon, by the addition of successively higher shale beds or tongues in that direction. A diachronous contact is implied.

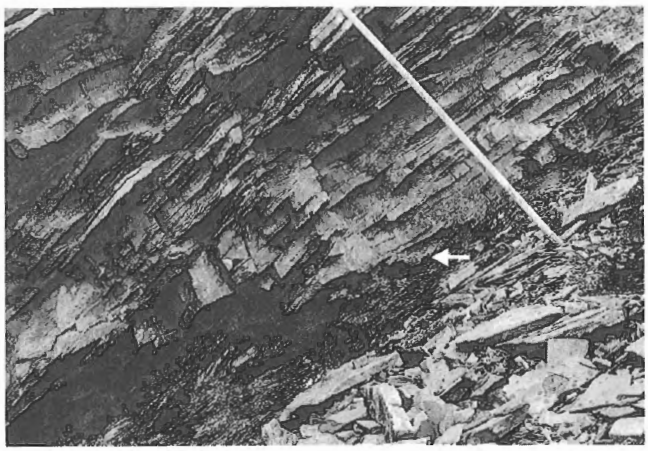


Figure 68. *Upper contact (arrow) of the Field Member of the Eldon Formation at Tokumm Creek (Section AC-160). Note the downward convergence and pinchout of the thin, clinoform beds of ribbon-bedded lime mudstone, which pass into fondoform laminae of black, silty argillite. Four feet (1.2 m) of the Jacob's staff show in the photograph. GSC photo 3-1-66.*

As discussed above, under "Stephen Formation", both Deiss (1939, 1940) and Rasetti (1951) excluded a basal unit of nearly black weathering limestone from the Eldon Formation, assigning it instead to the Stephen. In this, they followed Walcott's treatment of the section at Mount Stephen. At the type section of the Eldon Formation, however, Walcott (1928, p. 275, 276) drew the base of the Eldon one foot above the highest shale, although he recognized that the "dark-colored band" was present. The one-foot-thick bed of limestone that overlies the highest shale was placed in the Stephen for unknown reasons; one may speculate that it is succeeded by crystalline dolomite at the point at which Walcott crossed the contact. At any rate, as discussed under "Stephen Formation", neither Walcott's choice of contact at the type section, nor the top of the "dark-colored band", constitute a suitable or usable contact regionally.

The Eldon/Pika contact at most localities resembles the Cathedral/Stephen contact in every way. It is drawn where massive, mottled lime mudstone or derived dolomite give way gradationally upward to parted lime mudstone that is usually undolomitized (Figs. 71, 72). This change takes place beneath the first appearance of shale in the Pika Formation. It is marked by a recessive weathering notch and, at most localities, by an upward change to a darker weathered colour. At two localities, Mount Henry (Section AC–164) and Silverhorn Creek, beds containing quartz sand occur at or near the contact, and are associated with algal stromatolites. Cryptalgal laminite and small, linked stromatolites also occur at the contact at Mount Weed (Section AC–171).

The Eldon and Pika formations are not separable at their most westerly exposures; for instance, Vermilion Pass, Tokumm Creek, Mount Stephen, Mount Burgess, and the Columbia Icefields area. At some of these localities, an upward change to a more obviously bedded or thinner bedded character, more apparent in a long view than at the outcrop, might be taken as the

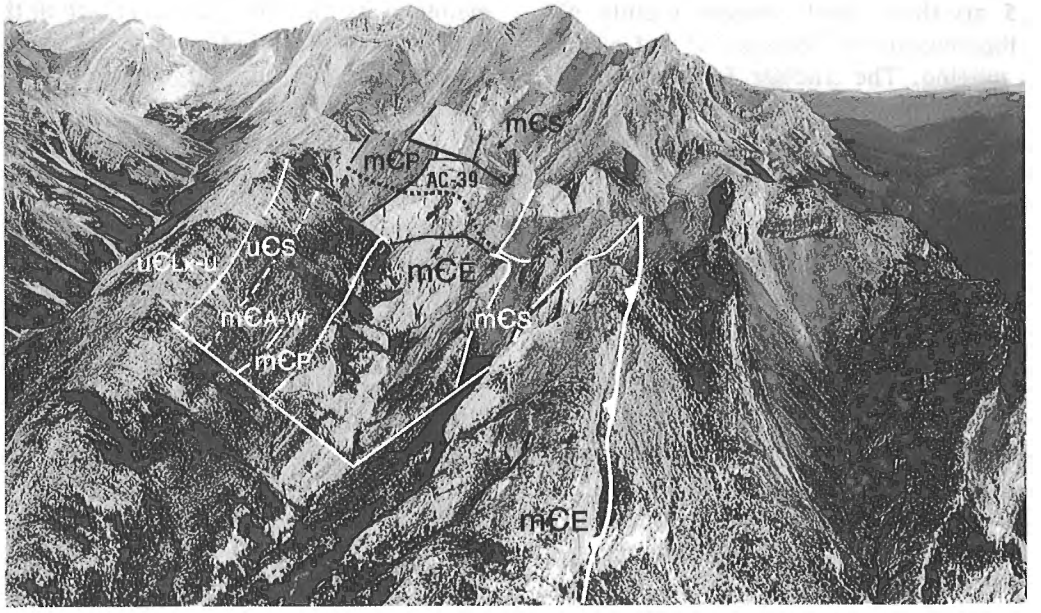


Figure 69. *The Cambrian section above Windy Point at Abraham Lake, North Saskatchewan River. (Low-level, oblique air photograph; view northwest.)* mЄS*–Stephen Formation;* mЄE*–Eldon Formation;* mЄP*–Pika Formation;* mЄA-W*–Arctomys and Waterfowl formations, undivided.* uЄS*–Sullivan Formation;* uЄLx-u*–Lynx Group (upper division). Compare the appearance of the Eldon Formation here, dominated by nearly white, massive exposures of the pale-pellet grainstone lithofacies, with that of the Eldon 10 km to the northwest (Fig. 70), where this lithofacies is inconspicuous. The dotted line marks the route of measurement for Section AC–39, which includes the type section of the Tershishner Member of the Pika Formation. ISPG photo 1518-13.*

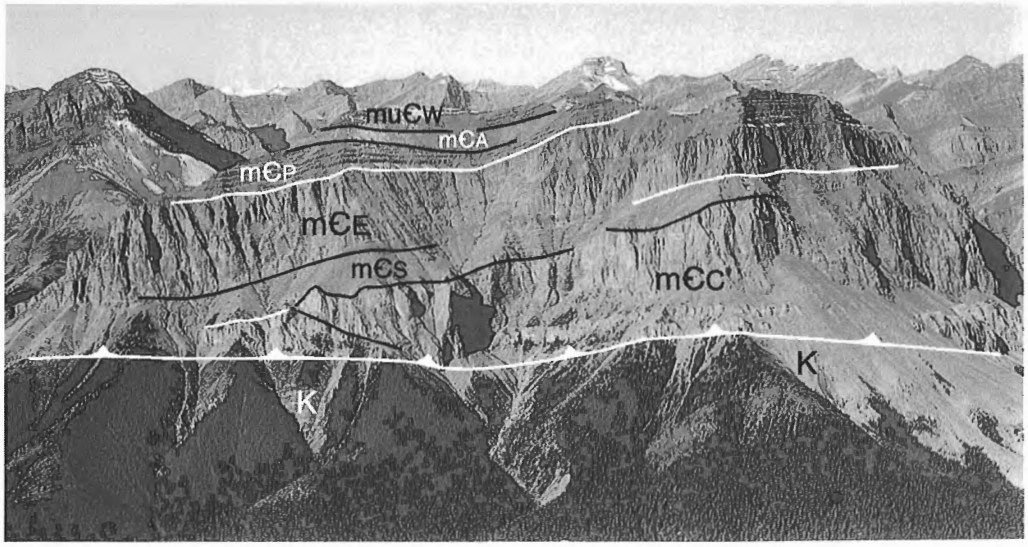


Figure 70. *Middle Cambrian formations exposed on a mountain immediately north of the head of Tershishner Creek, 10 km northwest of the Windy Point section (Fig. 69), and in the same structural panel. Annotation as for Figure 69, with the addition of* mЄC*–Cathedral Formation,* mЄA*–Arctomys Formation,* muЄW*–Waterfowl Formation, and* K*–Cretaceous strata. ISPG photo 1518-8.*

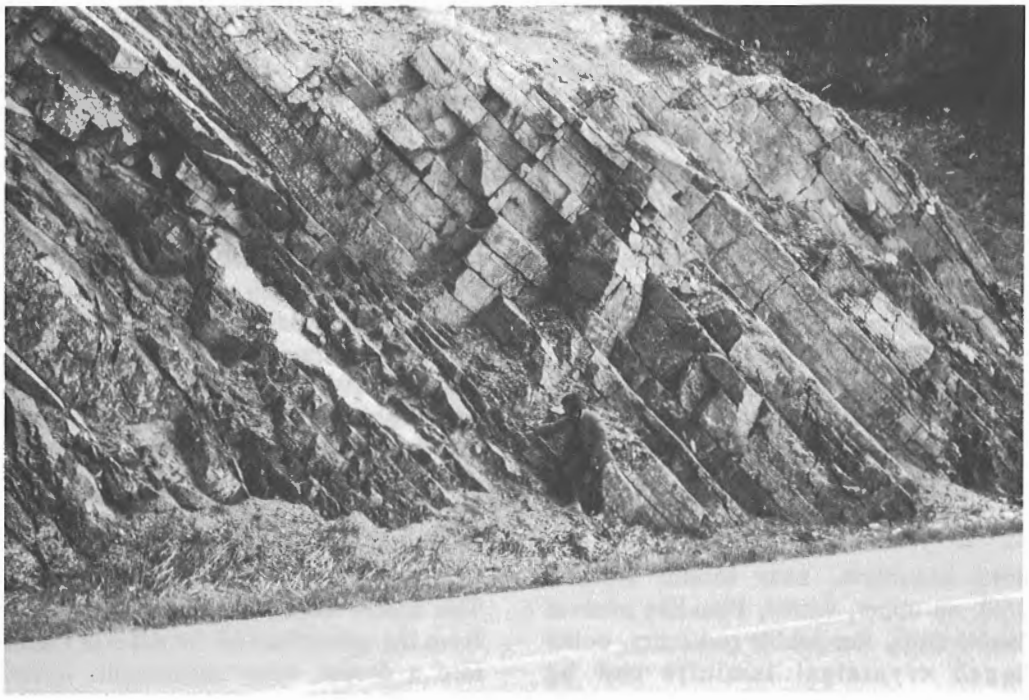


Figure 71. *The Eldon/Pika contact (pointing figure) at a mountain-front roadcut on Highway 1, near Seebe, Alberta. The contact, here indefinite within an interval of 3 ft (1 m), is much less obvious at this outcrop than in the natural outcrops uphill, where differential weathering has stripped back the basal Pika. ISPG photo 1569-4.*

Figure 72. *The Eldon/Pika contact (arrows) at Section AC–39, above Windy Point. (See Figures 69 and 70.) The contact is less abrupt and more gradational than this view suggests. A massive unit of pale-grey-weathering, pale-pellet grainstone, ten feet (3 m) below the contact, creates an unusual degree of contrast between the two formations. Differential weathering outlines five shallowing-upward cycles in the lower Pika Formation. GSC photo 1140-52.*

Eldon/Pika contact, but, in view of the presence of thin bedded intervals in definite Eldon equivalents in the west, this procedure is dubious and has not been followed. The combined unit is treated as "Eldon/Pika, undifferentiated".

At and near Mount Assiniboine (see Section AC–102, Appendix B), the overall character of the almost completely dolomitized Pika Formation, which there lacks shale, is little different from that of the Eldon. A recessive weathering interval of parted lime mudstone with a little oolite has been taken to mark the contact, but, if this limestone were dolomitized, differentiation of the two formations might be impracticable.

At Whitehorn Mountain, near Mount Robson (Section AC–166), an upper, varied, Pika-like interval with thin mudstone units, flat-pebble rudstones, oolite beds, and much cryptalgal laminite can be distinguished from an underlying, monotonous limestone interval lacking those features and displaying a number of deeper water characteristics. Nevertheless, the Pika-like characteristics appear one by one, and the choice of an Eldon–Pika (Titkana–Pika) contact within an interval of 250 ft (76.2 m) is arbitrary.

The position of the unique unit with quartz sand grains, near the Eldon/Pika contact, is interesting. At Chaba River (Section AC–142), the sand is in the uppermost 100 ft (30 m) of the Eldon Formation. At Mount Henry (Section AC–164), it is at the contact, and at Silverhorn Creek it is slightly above a straightforward Eldon/Pika contact. If the quartz sand is taken as recording a single brief pulse of sand supply to the inshore basin (an idea of some merit), and is, therefore, a time-surface marker, it demonstrates the diachroneity of the Eldon/Pika contact. The relationship is similar to that between the Cathedral Formation and the overlying Narao Member of the Stephen (p. 72).

Distribution and thickness

The Eldon Formation is a regional unit, extending from the subsurface of the Alberta Plains (Pugh, 1971) into a deeper water argillaceous facies, part of the Chancellor Formation, west of the Kicking Horse Rim. Contrary views as to the relationship between the Eldon/Pika and subdivisions of the Chancellor Formation have been published (Cook, 1975; McIlreath, 1977; Price and co-workers, 1970a, b and 1980a, b; Balkwill, 1980). Cook correlated the entire platformal succession, Cathedral Formation through Pika, with the lower Chancellor. McIlreath correlated

the Eldon/Pika with the lower, and part of the middle, Chancellor. The most recent interpretation, based on a field study specifically focused on the problem (Stewart, 1989) supports Cook's original correlations.

The Eldon Formation plunges from view southward, a little south of Mount Assiniboine. The Windsor Mountain Formation of the Castle River country, south of Highway 3, may be equivalent to the Eldon, although firm faunal confirmation is lacking.

Northward, the Eldon Formation persists through northern Jasper Park, where it has been mapped generally as Titkana Formation. Slind and Perkins (1966) showed the northern Titkana, in which they included the Pika equivalent, thinning but persisting northward to the vicinity of Pine Pass, at about latitude 55°30′.

Variables affecting the thickness of the Eldon Formation are discussed above, under "Stephen Formation". The Eldon is bounded by an upper contact that may display slight diachroneity (younger westward), and a lower contact that is diachronous (younger northeastward).

The thickness of the Eldon Formation measured at the type section, 1124.5 ft (342.7 m), is approximate, because of faulting. Maximum thickness measured, at Whitehorn Mountain, near Mount Robson (Section AC–166) is 1738.5 ft (529.9 m) if the Eldon/Pika contact is picked at the highest reasonable level. A lower contact, giving a thickness of 1495.5 ft (455.8 m) is preferred. Another very thick section is the one at Mount Bosworth (1642 ft/500.5 m).

Eldon thicknesses at the most westerly sections mainly range from 1370 ft (417.6 m) to about 1600 ft (487.7 m). The formation thins northeastward to 847 to 995.5 ft (258.2 to 303.4 m) along the mountain front (Fig. 59), and continues thinning northeastward in the subsurface (Pugh, 1971, 1973).

Interpretation, Stephen/Eldon Grand Cycle

By the end of Cathedral deposition, the Cathedral platform had been built up into very shallow water in an inshore basin essentially free of terrigenous mud, and intertidal shoals (recorded by cryptalgal laminites) were widespread on the western half of the platform. The beginning of Stephen deposition is recorded as deepening accompanied by a modest influx of terrigenous clay. During deposition of the Narao Member, continued upbuilding of the Kicking Horse Rim (as the Cathedral equivalent of the Narao) sheltered the inshore basin from open-sea waves; as a result, offshore transport of terrigenous mud was feeble, and deposition of lime mud was dominant in the study area. Subsequently, accelerated deepening drowned the rim, admitting open-sea waves to the inshore basin; the new energy regime caused terrigenous mud and silt to be spread toward and across the rim, as the Waputik and Wapta members. Two factors combined to reduce once more the supply of terrigenous mud to the outer parts of the inshore basin, early in *Bathyuriscus–Elrathina* time. The first factor involved the continued, transgressive, northeastward migration of the cratonal shoreline, making the entry points of detritus into the marine realm increasingly remote, as new supplies of terrigenous sediment were ponded within drowned estuaries. Secondly, and partly as a result of decreased mud supply, a carbonate rim, at first subtidal (basal Eldon Formation), was re-established along the Kicking Horse belt, and soon built up to peritidal levels, as recorded by oolite beds. This rim sheltered the inshore basin from open-sea wave action, further reducing the turbulence and the westward spread of craton-derived mud. Accordingly, the westward limit of detrital mud deposition, and the Stephen/Eldon contact in a lateral sense, migrated slowly northeastward, generating a diachronous contact. Thus, an upward traverse or section through the upper Stephen and lower Eldon may be viewed as equivalent to a traverse westward within a quiet inshore basin that was receiving terrigenous mud only intermittently in its eastern part, and not at all in its western part, where subtidal carbonate sediments (mainly muds) were accumulating. Farther westward, such a traverse would cross a carbonate shoal complex and then a slope into deeper water of the open basin.

Shoals were not limited to the Kicking Horse belt; the lenses of pale-pellet grainstone that occur at least as far east as the mountain front were deposited as shoals. Minor and local beds of cryptalgal laminite, and rare erosion surfaces, testify to local, intermittent emergence of the grainstone shoals.

The strong developments of ooid grainstone in the Eldon Formation at Mount Field (Section AC–162), Mount Weed (AC–171), and Beauty Creek (AC–48) are considered to represent tidal deltas built eastward into the inshore basin at the mouths of passes through the rim.

Accounting for deposition of the Wapta Member of the Stephen Formation in the basin west of the Cathedral Escarpment is not a problem. Wapta Member mudrocks are, in part, continuous with those of the Waputik Member of the platform and, in part at

least, originated as sediment swept off the platform into the progressively shallowing basin in front of the Cathedral Escarpment. The underlying Amiskwi Member presents a different problem. The partly coeval and limestone dominated Narao Member records only slight amounts of terrigenous mud reaching the outer part of the platform. At the crest of the rim, the Narao equivalent incorporated into the top of the Cathedral Formation contains no terrigenous mud at all; it represents a dam that prevented platform sediment from moving into the basin. The distant cratonal shoreline to the east, therefore, was not the source of the lower muds of the Amiskwi Member, unless passes existed through the rim to conduct platform sediment into the basin. Reasons for doubting the existence of such passes are given above, under "Paleogeographic and Sedimentological Synthesis". Given these constraints, it appears probable that the muds of the Amiskwi Member were transported longitudinally in the basin, outboard of the carbonate platform, and that they originated from the persistent northerly source evident throughout the Middle and Upper Cambrian (Aitken, 1978). Given a low-latitude position and east-west paleo-orientation for the platform edge, northeast trade winds impinging obliquely against the Kicking Horse Rim could have caused the implied westerly drift

In contrast to the upper Cathedral Formation, no known part of the Eldon Formation terminates basinward in a steep *bioconstructed* escarpment, although gravitational collapse has created a steep escarpment at several localities (Stewart, 1989). Instead, a westward change is observed, from peritidal carbonate strata along the rim to a deeper water facies. The latter is dominated by ribbon-bedded lime mudstone, with abundant evidence of gravitational creep, sliding, and mass movement on a depositional slope - the classical "carbonate ramp" (Wilson, 1975, p. 34), as noted by McIlreath (1977). In the known geological record, five main factors appear to have interacted to determine whether a steep, reefal margin or a gently sloping, ramp-like carbonate margin developed. These factors are summarized in the following table:

Steep, Reefal Margin	**Gentle, Ramp-like Margin**
Differential Subsidence Rate	
Moderate to rapid	Slow to moderate
Tectonic Differentiation	
Zone of marked differential subsidence; narrow, or a line	Zone of differential subsidence; broad
Hydrographic Factors	
High turbulence and/or abundant nutrients	Low turbulence and/or sparse nutrients
Dominant Direction of Movement of Water and Shoal-generated Carbonate Sediment	
Landward	Basinward
Stability of Platform Margin	
Unstable (large-scale failure)	Stable

The Field Member of the Eldon Formation represents an incursion of outer-detrital lithofacies and fauna into the long-term middle carbonate facies belt. Because the eastward disappearance of this member is more the result of facies change than depositional pinchout (McIlreath, 1974), it probably does not record an event limited to the basin, such as increased terrigenous input. More probably, it records deepening caused by a brief period of accelerated sea-level rise. The relationships at Tokumm Creek, demonstrating a fondoform origin for the member there, support such an interpretation. On the other hand, the deepening event is not known to be recorded east of the Kicking Horse Rim.

Paleontology and age

The Eldon Formation, even where undolomitized, is barren of fossils throughout most of the study area. Existing fossil control comes from: i) a persistent fossiliferous zone (*Bathyuriscus adaeus* faunule) in the basal black limestone of the Eldon in the vicinity of Field, British Columbia; ii) three fossil collections from the uppermost 200 ft (61 m) of the Eldon at Chaba River; iii) the rich and distinctive fauna of the Field Member; and iv) the fairly abundant faunas of the underlying Stephen and overlying Pika formations. All faunal data show that the Eldon Formation lies entirely within the Middle Cambrian, *Bathyuriscus–Elrathina* Zone, or nearly so.

The precise position of the boundary between the *Bathyuriscus–Elrathina* Zone and the overlying *Bolaspidella* Zone (the terminal Middle Cambrian zone) remains undetermined. The former zone has not been identified in the Pika, nor the latter in the Eldon and, at Chaba River, the boundary lies within a barren interval, 180 ft (54.9 m) thick, which also contains the Eldon/Pika contact. The boundary between the *Bathyuriscus – Elrathina* and *Bolaspidella* zones is a boundary between biomeres (Palmer, 1971) and, in at least some instances, biomere boundaries coincide with the boundaries between Grand Cycles (op. cit.). Thus, a plausible explanation is that the *Bolaspidella* fauna invaded the platform during the deepening event that initiated the Grand Cycle of the Pika Formation (see below).

Recommended sections

In addition to the type and reference sections, the following reasonably accessible sections display various aspects of the Eldon Formation.

Mount Field (south face)

Although it costs a long day, and presents some mountaineering difficulties, this section merits a visit to see the development of oolite in its lower part, the type section of the Field Member, and the peritidal aspect of the beds at the peak. Exposures of the upper Eldon Formation are incomplete. The basal Eldon comprises a ramp facies, which can be studied on the Mount Burgess side of the pass.

Vermilion Pass

The section is on the northwest shoulder of the ridge extending toward the highway between Stanley Peak and Storm Mountain. Easy to access via the Stanley Glacier trail, the section presents appreciable climbing difficulties, but shows aspects of the Eldon Formation and Field Member that are different from those seen at Mount Field. The Eldon–Pika contact cannot be located with confidence.

Tokumm Creek

The section is most easily approached by a good trail from Lake O'Hara, via Opabin Pass. It presents little mountaineering difficulty. The Eldon Formation comprises a ramp facies, continuous upward into strata presumed equivalent to the Pika Formation. The Field Member is observed as a fondoform unit, relative to the overlying clinoform beds.

Loder's Lime Quarry

This highly accessible section is approached from Highway 1A, via the abandoned limestone quarries. Although the section is incomplete and faulted, characteristic Eldon rock types and a large volume of pale-pellet grainstone (the high-purity limestone formerly quarried) are exposed. The cliffs to the north reveal that the pale weathering grainstone is a large lens. The gradational contact between the Eldon and Pika formations is well exposed, as it is in the Highway 1 roadcuts to the south across the Bow Valley.

Windy Point (North Saskatchewan River)

The roadcuts and adjoining outcrops on Highway 11 below Mount Tershishner reveal a high proportion of pale-pellet grainstone and shallowing-upward cycles with cryptalgal laminite at the top. To obtain a complete section a stiff climb to the ridge descending from Mount Tershishner is necessary.

Beauty Creek

The Eldon Formation is well exposed in the Beauty Creek section. Most of the formation can be examined in scoured, valley bottom exposures, where the unusual development of dolomitized oolite is evident.

Titkana Formation

Definition of the Titkana Formation was based on a hasty and incomplete examination of the Cambrian succession of the Mount Robson area by Walcott (1913, 1928). Walcott compared the Titkana with the Stephen Formation of the upper Bow River region - a bizarre correlation, in view of the fact that recognizable Arctomys equivalents immediately overlie the original Titkana (Mountjoy, 1962, p. 13). Mountjoy (ibid.) recognized that the Titkana Formation, as defined, included Pika equivalents in its upper part, and amended the formation by definition and removal of the Pika strata. He also concluded that the term Tatei Formation applies to the Stephen Formation equivalent in the Mount Robson area (a conclusion not entirely justified by Walcott's inadequate definition). Thus, bounded by the Tatei (Stephen?) and Pika formations, the Titkana is equivalent to the Eldon Formation (Mountjoy, 1962, p. 10).

In a recently published map of the Mount Robson area, Mountjoy (1980) mapped the rocks in question as Eldon Formation, in effect declaring the Titkana Formation obsolete. This was a satisfactory decision.

Murchison Formation

The term "Murchison Formation" has been used only by Walcott (1920, 1923, 1928), and no geological map employing the term has ever been published. In its first citation, the formation is described as thin bedded limestone, more than 200 ft (61 m) thick, subjacent to the type Arctomys Formation at Glacier Lake - a description that corresponds to that of the Pika Formation there. Subsequently (Walcott, 1923, 1928), the formation also was placed in an incorrectly assembled, faulted stratigraphic section near the junction of Siffleur and North Saskatchewan rivers, where its position was given as superjacent to the

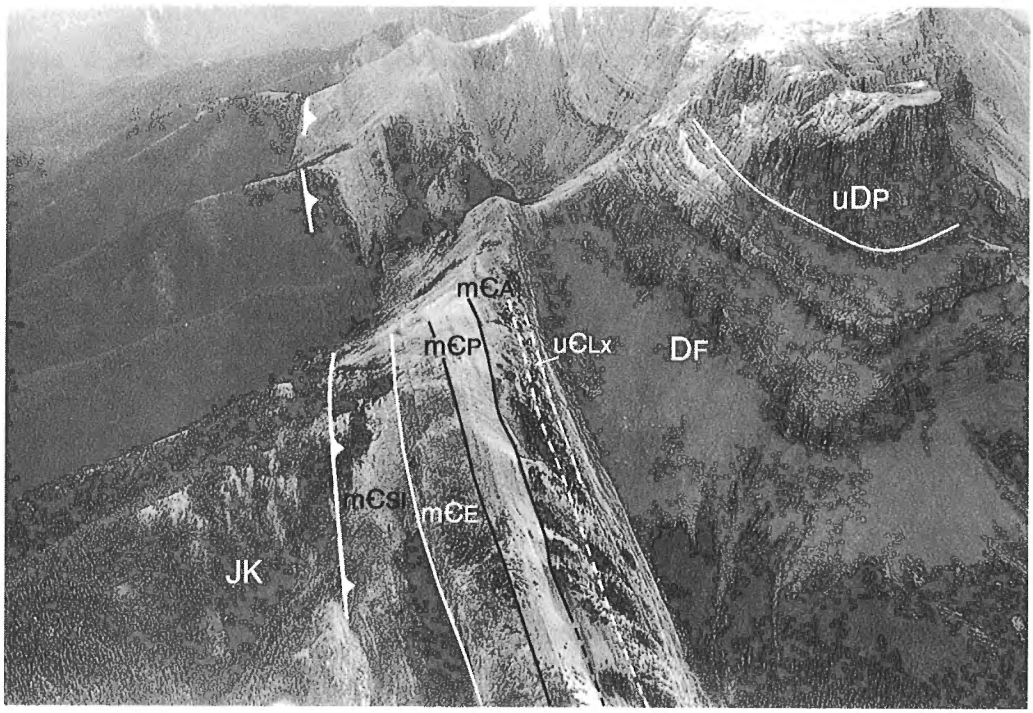


Figure 73. *Section AC-86 at Roche Miette, Athabasca River, looking south.* mЄSI*-Snake Indian Formation;* mЄE*-Eldon Formation;* mЄP*-Pika Formation;* mЄA*-Arctomys Formation;* uЄLx*-Lynx Group;* DF*-Devonian Fairholme Group;* uDP*-Palliser Formation;* JK*-Jura-Cretaceous strata. The fault shown is the Miette Thrust. ISPG photo 1518-33.*

Cathedral Formation and subjacent to the Arctomys. Walcott explicitly stated (1928) that the Eldon Formation was missing at this locality. His statement was incorrect; the Eldon has been described (Section AC–138) and mapped (Price and Mountjoy, 1978, Map 1466A) there. The term "Murchison Formation" serves no useful purpose, and is obsolete.

Pika Formation

Definition

The Pika Formation (Figs. 30, 51, 60, 69, 70, 73, 74) is recognized as a formation of well bedded carbonate rocks interrupted in its lower part by minor units of shale. Its weathering, at least in its lower part, is recessive or ledgy relative to the monolithic cliff of the underlying Eldon Formation, and the Pika is darker than the Eldon in overall aspect. It is overlain by the recessive, red- and yellow-weathering, mixed detrital and carbonate strata of the Arctomys Formation.

The Tershishner Member is newly recognized as a unit of yellowish weathering dolomite, with abundant ex-rudstone and ex-oolite beds, that forms the upper third, more or less, of the Pika Formation in the southern Front Ranges.

Origin of names

The Pika Formation was named by Deiss (1939) after Pika Peak, northeast of Lake Louise. The strata assigned to the Pika had been included, prior to that date, in the Eldon Formation (Walcott, 1908a, b, 1928). The Tershishner Member is named after Tershishner Creek, whose headwaters are 5.5 km north-northwest of the type section of the member.

Type section

The type section of the Pika Formation is on Helena Ridge, part of the Castle Mountain massif (Deiss, 1939, p. 1008), and is continuous with the type section of the Eldon Formation. At the well exposed type section (AC–24 of this report) there can be no doubt as to the stratigraphic position and relationships of the formation. On the other hand, Pika Formation strata at the type section are extensively dolomitized, and the Tershishner Member is not represented. Accordingly, the well exposed section above Windy Point, on North Saskatchewan River (Section AC–39; Fig. 69) is designated a reference section for the Pika Formation and the type section of the Tershishner Member.

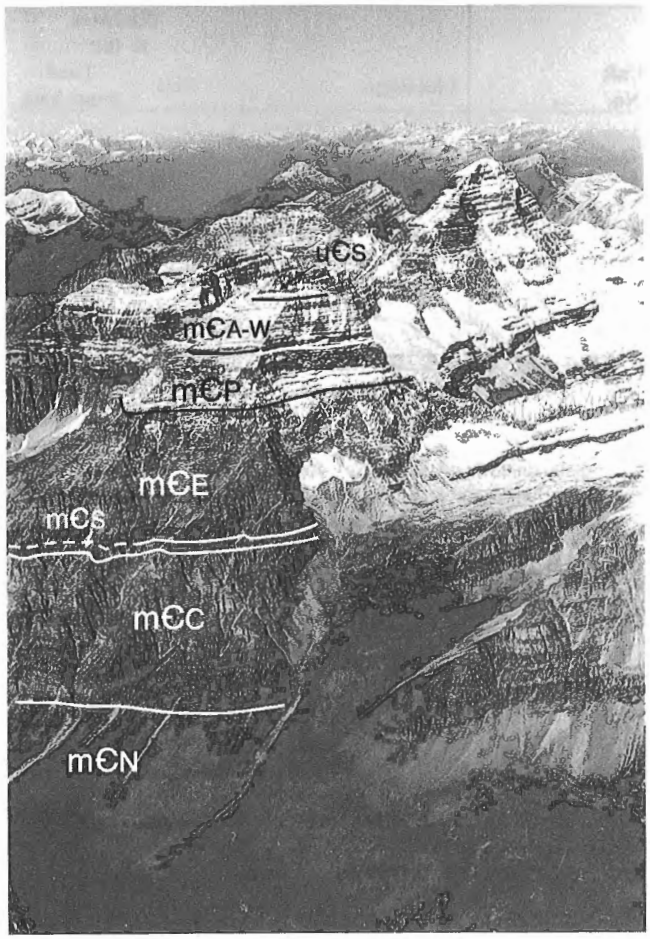


Figure 74. *Cambrian formations at Mount Assiniboine (middle background, right) and Mount Eon (foreground).* mЄN*–Naiset Formation;* mЄC*–Cathedral Formation;* mЄS*–Stephen Formation;* mЄE*–Eldon Formation;* mЄP*–Pika Formation;* mЄA-W*–Arctomys and Waterfowl formations, undivided;* uЄS*–Sullivan Formation. ISPG photo 1518-92.*

Type section of the Eldon and Pika formations at Helena Ridge (Castle Mountain massif)

SECTION AC-24

(lat. 51°18′52″N, long. 115°54′08″W)
(For access see Appendix C)

ARCTOMYS FORMATION

The Arctomys Formation is markedly recessive weathering relative to the underlying Pika Formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
4	**Shale**: purple-red, with calcareous, greenish white spots; weakly fissile	1 (0.3)	12 (3.7)
3	Covered	6 (1.8)	11 (3.4)
2	**Dolomite**: grey, dense, argillaceous; in green weathering beds, 1 to 2.5 cm thick	4 (1.2)	5 (1.5)
1	**Shale** (60%) and **dolomite** (40%) Shale: greenish grey, dolomitic. Dolomite: as above, in 2 cm thick beds.	1 (0.3)	1 (0.3)
	Abrupt contact. Relief of 1 ft (30 cm) or more follows the outline of underlying stromatolites.		

PIKA FORMATION
(522.5 ft/159.3 m)
(Type Section)

Units 16 to 25 are moderately to strongly cliff forming. Stylolites, subparallel to bedding, are strongly developed and imply post-depositional thinning of the formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
27	**Limestone**: grey, fragmental, vuggy	1.5 (0.5)	522.5 (159.3)
26	**Dolomite**: grey, microcrystalline, laminated, platy; infilling relief of stromatolites	1 (0.3)	521 (158.8)
25	**Dolomite**: microcrystalline, dark grey. In the middle, vuggy and brecciated. At the top, stromatolitic mounds of pale grey, microcrystalline dolomite, with diameters up to 5 ft (1.5 m), and a relief of more than 1 ft (30 cm)	4 (1.2)	520 (158.5)
24	**Dolomite**: cryptalgal laminite with laminoid fenestral vugs; dark grey, weathers pale brown, prickly; microcrystalline (aphanitic). Minor chert, in a black, nodular, 2 cm thick bed. Faint pinkish and greenish colours appear 40 ft (12.2 m) above the base	57.5 (17.5)	516 (157.3)
23	**Dolomite**: dark grey, weathers pale grey, pitted; microcrystalline, massive, scattered small vugs (cf. Unit 24)	7.5 (2.3)	458.5 (139.8)
22	**Dolomite**: cryptalgal laminite; pale grey, weathers very pale brown; microcrystalline (aphanitic). Minor zones with small vugs; these are quartz filled above. Thin breccias common on bedding planes. Bedding joints spaced 5 to 40 cm; blocky fracture	29 (8.8)	451 (137.5)
21	**Dolomite**: as Unit 19, largely ex-parted and ex-burrow-mottled lime mudstone. Rare intervals, 1 ft (30 cm) or less thick, are dominated by intraclast grain/rudstone	138 (42.1)	422 (128.6)
20	**Dolomite**: ex-intraclast grain/rudstone and ex-pellet grainstone	9 (2.7)	284 (86.5)
19	**Dolomite**: dark brownish grey, very fine crystalline, in regular, 5 to 20 cm thick beds	16 (4.9)	275 (83.8)
18	**Dolomite**: ex-parted lime mudstone, in 1 cm thick beds; grey, weathers pale brown, flaggy; very fine crystalline. A few, massive, 30 cm thick beds of mottled lime mudstone. Forty-four feet (13.4 m) above the base, a 5 cm thick bed of intraclast grain/rudstone. Sixty feet (18.3 m) above the base, a 30 cm thick massive bed of ex-oolite. Eighty-one to eighty-two feet (24.7 to 25 m) above the base, ex-oolite interbedded with ex-mudstone	82 (25)	259 (78.9)
17	**Dolomite**: largely flat-pebble rudstone with "edgewise" fabric; grey, very fine crystalline; ex-oolite in top 20 cm	8 (2.4)	177 (53.9)
16	**Dolomite**: pale grey, yellow weathering; microcrystalline, finely laminated (?cryptalgal)	15 (4.6)	169 (51.5)
	Units 1 to 15 support a ledgy topographic profile.		
15	Covered Shale (in float): as below	5 (1.5)	154 (46.9)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
14	**Dolomite**: dark grey, microcrystalline, laminated, largely platy, with 15 cm of dark grey, sheared shale in the middle	3 (0.9)	149 (45.4)
13	**Dolomite**: dark brownish grey, weathers grey and pale brown; very fine crystalline, partly laminated; bedding joints spaced 15 to 13 cm. Probably the same lithofacies as Unit 12, but dolomitized	30 (9.1)	146 (44.5)
12	**Limestone**: parted lime mudstone; beds regular, about 2 cm thick; weathers dark grey, cliff forming. In upper part, ripple crosslamination and burrows. Immediately north of the section, this unit is dolomitized	18 (5.5)	116 (35.4)
11	**Limestone**: parted lime mudstone, in beds 0.5 to 1 cm thick. Top 3 ft (1 m) of unit are generally altered to dolomite: very pale brown, very fine crystalline	6 (1.8)	98 (29.9)
10	**Shale**: olive, as below, very weakly fissile, with abundant small (0.5–2.5 cm) limestone nodules	6 (1.8)	92 (28)
9	**Limestone**: burrow-mottled lime mudstone. At the top, 0.3 ft (10 cm) of intraclast grainstone/packstone	3 (0.9)	86 (26.2)
	GSC loc. 52569 (2.5 to 3 ft/0.8 to 0.9 m above the base) *Modocia* spp. *Marjumia* spp.		
8	**Shale**: olive, soft, calcareous, weakly fissile, with 20 per cent beds and lenses of grey, microcrystalline limestone, 0.5 to 1 cm thick	4 (1.2)	83 (25.3)
7	Covered: recessive (?)Shale as above	12.5 (3.8)	79 (24.1)
6	**Limestone**: ooid packstone with skeletal bands; ooids are completely dolomitized; weathers dark grey, brown specked; massive	2 (0.6)	66.5 (20.3)
5	**Limestone**: parted lime mudstone; irregular, discontinuous beds, 1 to 2.5 cm thick; dolomite partings constitute 40 per cent of unit	9.5 (2.9)	64.5 (19.7)
4	Covered Probably shale: as higher in section	6 (1.8)	55 (16.8)
3	**Dolomite**: ex-parted lime mudstone; grey, fine crystalline, with partings and mottlings of dolomite: dark grey, very fine crystalline, argillaceous	19.5 (5.9)	49 (14.9)
2	**Dolomite**: cryptalgal laminite; local crosslamination; dark grey, fine crystalline at base, dark grey, aphanitic above; bedding planes have black coating	8.5 (2.6)	29.5 (9)
1	**Dolomite**: ex-parted lime mudstone; very fine crystalline, grey to dark grey, beds 2.5 to 5 cm thick; partings are dark argillaceous dolomite at base, grading to tan shale at top.	21 (6.4)	21 (6.4)

Concordant contact.

ELDON FORMATION

(893 ft/272.2 m)
(Type section)

The Eldon Formation forms steep slopes and cliffs, pale in colour. Resistance to weathering varies, but not sharply from unit to unit.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
12	**Dolomite**: stromatactoid; laminae of coarse white dolomite are vuggy; minor intervals of dolomite: dark grey, with white mottling. Spongy silicification common in uppermost 22 ft (6.7 m)	72 (21.9)	893 (272.2)
11	**Dolomite**: grey, weathers very pale grey, pitted; fine to medium crystalline, massive; fair to good vuggy porosity throughout; strongly cliff forming	24 (7.3)	821 (250.2)
10	**Dolomite**: brownish grey, locally dark grey, weathers grey, pitted to cavernous; fine crystalline; clear traces of relict, coarse, particulate fabric; crossbedded, in sets 15 to 30 cm thick. Unit is remarkably uniform. Contact at top gradational	100 (30.5)	797 (242.9)
9	**Dolomite**: ex-burrow-mottled lime mudstone; grey, weathers grey, pitted; fine crystalline, mottled by darker, finer dolomite; several vuggy zones in medium crystalline dolomite; bedding joints stylolitic	29 (8.8)	697 (212.4)

Section continues downward.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

Reference section for the Pika Formation, and type section of its Tershishner Member, at Windy Point, North Saskatchewan River.

SECTION AC-39

(lat. 52°16′21″N, long. 116°25′00″W)

The following description is adapted from Aitken (1968)

ARCTOMYS FORMATION

The Arctomys Formation is recessive weathering relative to the upper Pika, and outcrops are yellow, orange, and red.

Section continues upward.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Siltstone** and **shale** (alternating subunits) Siltstone: as below. Shale: olive-green, hard, fissile. Salt crystal casts	17.5 (5.3)	72.5 (22.1)
3	**Shale** and **siltstone** (interbedded) Shale: as above, green. Siltstone: partly pale green, dolomitic, partly silicified, hard, and partly yellow, calcareous, soft, earthy, porous. Ten feet (3 m) below the top, a 2.5 cm thick bed of flat-pebble rudstone	27 (8.2)	55 (16.8)
2	**Shale** and **siltstone** (interbedded) Shale: green above, purple below, fissile, with siltstone-filled mudcracks. Siltstone: pinkish green to pale yellow-brown, calcareous, laminated and crosslaminated, pyritic, vuggy, platy to flaggy. Unit forms a ledgy outcrop	25.5 (7.8)	28 (8.5)
1	Covered: recessive weathering.	2.5 (0.8)	2.5 (0.8)

Contact covered, concordant.

PIKA FORMATION
(318.5 ft/97.1 m)
(Reference section)

Tershishner Member
(69.5 ft/21.2 m)
(Type section, Units 13 to 18)

The Tershishner Member forms moderately resistant yellowish outcrops lacking the marked variation in resistance between units seen in the sub-Tershishner beds.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
18	**Dolomite**: partly ex-dark-pellet grainstone; pale grey to brown, weathers pale orange; fine crystalline, medium bedded, massive. Uppermost bed (5 cm thick) has abundant oncoids up to 5 cm in maximum diameter	15 (4.6)	318.5 (97.1)
17	**Dolomite** and **shale** At the base, 1 ft (0.3 m) of shale: grey to olive, dolomitic, fissile, khaki weathering, grading up through very argillaceous, dense rubbly dolomite to dolomite: grey-brown, partly mottled, fine crystalline, slightly silty, slightly argillaceous, thin bedded (ex-parted lime mudstone). Moderately resistant	8 (2.4)	303.5 (92.5)
16	**Dolomite**: ex-parted lime mudstone; mottled pale brown and brown, weathers mottled grey and orange, very fine crystalline, silty, argillaceous, thin bedded, flaggy, partly rubbly; moderately resistant. Six feet (1.8 m) above the base, a 30 cm thick, massive bed of dolomite (ex-intraclast grainstone)	13 (4)	295.5 (90.1)
15	**Dolomite**: ex-ooid and oolitic skeletal grainstone; coarse below, fine above; pale brown, very fine crystalline, massive, resistant	4.5 (1.4)	282.5 (86.1)
14	**Dolomite** Seventy-five per cent dolomite and ex-rudstone: as below. Twenty-five per cent medium beds of dolomite: ex-ooid and pellet grainstone; fine crystalline. Rudstones in part have oolitic matrix	29 (8.8)	278 (84.7)
13	**Dolomite** Seventy-five per cent dolomite: as below, irregularly thin bedded, flaggy (ex-parted lime mudstone). Twenty-five per cent thin and medium beds of dolomite: ex-flat-pebble rudstone; fine and very fine crystalline. Sixteen feet (4.9 m) above the base, a 10 cm thick bed of ex-oolite, with scattered oncoids	42 (12.8)	249 (75.9)
12	**Dolomite**: brown, weathers grey-brown, fine and very fine crystalline, mosaic, locally laminated, largely mottled in the style of burrow-mottled lime mudstone; partly ex-dark-pellet grainstone in the basal 5 ft (1.5 m); medium bedded, massive, moderately resistant; poorly exposed in upper half	25.5 (7.8)	207 (63.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Dolomite**: grey, pale brown, weathers smooth, pale yellow brown; fine and very fine crystalline, argillaceous, silty; bedding style and mottling as in underlying limestone; forms a small cliff	16.5 (5)	181.5 (55.3)
10	Mainly covered 1.5 ft (0.5 m) of thin bedded limestone: as below, 3 ft (0.9 m) above the base. Clay-rich talus suggests shale	10 (3)	165 (50.3)
9	**Limestone**: parted lime mudstone; bedding-plane traces as below. One 7.5 cm-thick bed of flat-pebble rudstone near the top	28 (8.5)	155 (47.2)
8	Mainly covered 1 ft (0.3 m) of thin bedded limestone: as below, 3 ft (0.9 m) above the base. Float of grey, fissile shale and parted lime mudstone	11 (3.4)	127 (38.7)
7	**Limestone**: calcisiltite and trilobite wackestone (calcisiltite matrix); thin bedded, flaggy to platy; weakly resistant	6 (1.8)	116 (35.4)
	GSC loc. 52577 *Bolaspidella* sp. *Americare* sp. *Rowia* sp. *Rowia*? sp. *Parehmania* sp.		
6	Covered	8 (2.4)	110 (33.5)
5	**Limestone**: parted lime mudstone (calcisiltite and skeletal wackestone); very thin bedded, flaggy; trace fossils prominently developed on bedding planes; weathers grey striped with pale tan; forms a small cliff	31 (9.4)	102 (31.1)
4	Covered Talus of dark grey, fissile shale	14 (4.3)	71 (21.6)
3	Poorly exposed **Limestone**: recessive weathering; calcisiltite and skeletal (trilobite) wackestone; very thin bedded, flaggy, with interbeds of grey shale; abundant burrows; minor rudstone	14 (4.3)	57 (17.4)
	GSC loc. 52576 *Marjumia* spp. *Modocia* sp. *Modocia*? spp.		
2	**Limestone**: as below, but irregularly bedded, beds 1 to 15 cm thick; minor cliff former, weathering pale brown	22 (6.7)	43 (13.1)
1	**Limestone**: parted lime mudstone (partly calcisiltite); scattered pellets and intraclasts; in regular, 2 cm thick, flaggy beds, with thin partings of pale brown, very fine crystalline dolomite. Forms a series of small ledges; weathers pale brown.	21 (6.4)	21 (6.4)

Gradational contact.

ELDON FORMATION

The Eldon Formation is much more massive and resistant than the overlying Pika; furthermore, at this locality, the pale weathering beds of pale-pellet grainstone near the top of the Eldon provide a marked contrast to the sombre colours of the Pika outcrops.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
22	**Limestone**: intraclast grainstone and burrow-mottled lime mudstone; thick bedded, massive, brown weathering, resistant	10.5 (3.2)	781.5 (238.2)
21	**Limestone**: pale-pellet and intraclast grainstone; dolomitic, nonbedded, massive, resistant; discontinuous laminae of dolomite locally pass into patches of dolomite: very pale grey, medium equicrystalline, mosaic. Unit weathers very pale grey	73 (22.3)	771 (235)
20	**Limestone**: as above, with mottling, filigree, and patches of pale dolomite	13 (4)	698 (212.8)
19	**Dolomite**: pale grey, weathers cream; fine and medium equicrystalline, mosaic, nonbedded, massive	32 (9.8)	685 (208.8)
18	**Limestone** (70%) and **dolomite** (30%) Limestone: pale-pellet grainstone; nonbedded, massive. Dolomite: grey, fine crystalline, in widely spaced, 1 to 2 ft (0.3 to 0.6 m) thick subunits and irregular masses	65 (19.8)	653 (199)
17	**Limestone**: pale-pellet and pale-pellet-intraclast grainstone. In the basal third, a few thick beds of brown lime mudstone and dark intraclast grainstone. Massive and resistant	130 (39.6)	588 (179.2)

Section continues downward.

Lithology

The Pika Formation is dominated by parted lime mudstone. Minor amounts of burrow-mottled lime mudstone, intraclast grain/rudstone, flat-pebble rudstone, ooid, pellet, and oncoid grainstone, and oncoid floatstone also occur. All of the foregoing are represented at some localities by their dolomitized equivalents. Minor units of grey, dark grey, and olive fissile shale interrupt the carbonate strata, especially in the lower half of the formation. The number of shale units and the aggregate thickness of shale decrease southwestward, the lowest shale tongues being the most extensive (Figs. 75-78). In the extreme north of the study area (Roche Miette and Chetamon Mountain), shale and silty mudstone are prominent in the upper third of the Pika; there, the least argillaceous part of the Pika is the middle, not the top.

Where shale units are present, they are the basal units of obvious asymmetric subcycles (Fig. 72) whose ideal, or complete, form is as follows:

a. Shale. (Basal unit of next cycle.)

Abrupt contact

d. **Parted lime mudstone**: thick bedded (thicker bedded than below); burrow-mottled lime mudstone in many cycles.

Gradation

c. **Parted lime mudstone**: at the base, the parted lime mudstone occurs as very thin beds, lenses and irregular nodules, with thick and prominent partings of argillaceous dolomite/dolomitic mudstone; bed thickness increases upward as bedding becomes more regular; thickness and clay content of partings decrease upward.

Gradation

b. **Shale**: with upward-increasing lenses and thin beds of lime mudstone. This is the most fossiliferous unit.

Gradation

a. **Shale** (basal unit of subcycle).

Abrupt contact

d. Parted or burrow-mottled lime mudstone. (Top unit of previous cycle.)

Flat-pebble rudstone, in thin beds and lenses, occurs sporadically in any of Units b, c, and d. Ooid, ooid-skeletal, and dark-pellet grainstone and, locally, oncoid floatstone occur sporadically as thin and medium beds in Units c and d. Ripple marks, partly of oscillation type, occur here and there. Ripple crosslamination is widespread in the parted lime mudstones, suggesting that they accumulated in part as calcisiltite. The thicknesses of most subcycles fall within the range of 20 to 35 ft (6.1 to 10.7 m).

Taken by themselves, these mud-based subcycles record only upward diminution of detrital mud supply, but their near-identity with subcycles in the Stephen Formation, which have been shown to record upward shallowing as well, justifies a shallowing-upward interpretation. This interpretation is supported further by the occurrence of subcycles in the Pika Formation at Chaba River (Section AC–142), in which an additional unit, "e", consisting of cryptalgal laminite and fenestral lime mudstone, is added to the subcycle just described.

Algal stromatolites and thrombolites are abundant in the Pika Formation only in sections at, or near, the Kicking Horse Rim; for example, Mount Eon and Chaba River. Elsewhere, they occur only near the top or base of the formation; except northeast of a line through Mount Macdonald (Section AC–94), where a few isolated horizons of stromatolites and thrombolites are found throughout the formation. Cryptalgal laminite also is prominent only along the rim, and diminishes northeastward. At the type section, it occurs only in the uppermost 100 ft (30.5 m) and, at Mount Bosworth, only in the top 150 ft (45.7 m).

In western sections, the basal Pika Formation contains one or more thick beds of an unusual, massive, internally featureless dolomite that is grey to dark grey, microcrystalline, siliceous, and bright orange weathering. These beds are an aid in locating the base of the Pika. Also in western sections, vugs lined with quartz crystals are common in the upper third of the formation.

Minor beds, nodules, and blebs of secondary black chert are present in carbonate rocks near the top of the formation, in the western half of its outcrop area.

Mudcracks were seen only at Roche Miette, the most northeasterly section examined, and at Mount Bosworth, a near-rim section. I did not see the mudcracks that Deiss reported in the type section.

Tershishner Member

The Tershishner Member consists of dolomite, distinguished by the presence of abundant, thin to thick, massive beds of ooid grainstone, and flat-pebble rudstone that is unusually coarse and characteristically of "edgewise" arrangement. The remainder of the member comprises dolomitized lime mudstone, like that found lower in the formation. Beds of silty, dolomitic mudstone occur in most sections, increasing in number and thickness northeastward. The member is probably cyclical, but the cycles have not been studied in detail.

The Tershishner Member is invariably dolomitized, with outstanding preservation of primary textural detail in many instances (Figs. A-47, A-50, A-51, A-65). Nevertheless, the base of the member is not defined as the base of the continuously dolomitized interval, but as the base of the interval with abundant, medium or thick beds of ex-grainstone or ex-rudstone. At every section examined, complete dolomitization extends below the base of the Tershishner Member, and the lower limit of dolomitization is observed to cross the bedding.

Contacts

The basal contact of the Pika Formation (Figs. 71, 72) is gradational and similar in every way to the Cathedral/Stephen contact described above. At a number of sections, basal Pika limestone rests upon Eldon dolomite, accentuating the contact, but limestone versus dolomite is not a criterion.

The Pika/Arctomys contact throughout most of the study area is so abrupt that it suggests disconformity. The contact is marked by the appearance of recessive weathering, purple-red and green, mudcracked shale, dolomitic siltstone, and minor, silty, yellow or orange weathering dolomite above carbonate strata. The contact is less pronounced in the extreme northeast, where there is much grey to olive shale and mudstone in the uppermost Pika Formation. In this northeastern region, the contact is drawn so as to place all lime mudstone in the Pika and all red and green shale, siltstone, and beds with salt crystal casts in the Arctomys. Flat-pebble rudstone (as limestone or dolomite) is conspicuous in the uppermost Pika and rare in the basal Arctomys.

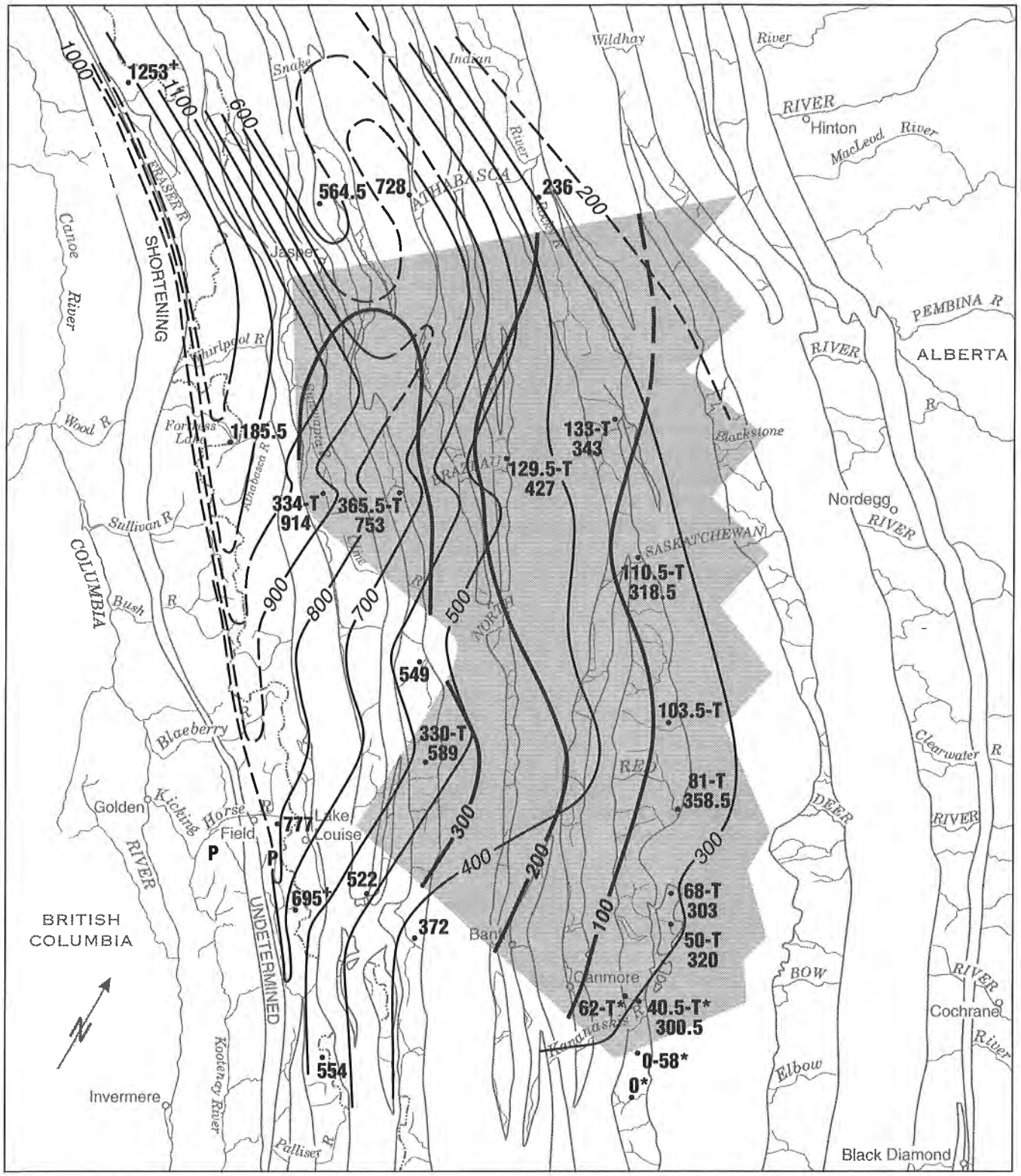
A northeastward facies change (not previously reported) occurs in the overlying Arctomys/Waterfowl cycle, namely a marked increase in the content of quartz sandstone – as seen at Maligne Lake, Chetamon Mountain north of Jasper, and at Mount Henry west of Jasper – suggests approach to the cratonal shoreline. Thus, the northeastward pinchout of the Arctomys/Waterfowl cycle, which has not been encountered anywhere in the subsurface east of the Foothills belt (Aitken, 1968; Pugh, 1971, 1973), appears to be largely depositional. In this view, the Arctomys/Waterfowl cycle is markedly regressive relative to overlying and underlying formations, and pinches out into the disconformity between the Pika and the Sullivan/Deadwood formations. Thus, it is probable that the base of the Arctomys Formation is disconformable, at least in the northern and eastern parts of the study area.

In the Kicking Horse belt, the Eldon/Pika contact is indefinite (see above under "Eldon Formation"). The top of the Eldon/Pika sequence can be delineated with ease wherever Arctomys redbeds persist, but where the redbeds pass entirely into grey or yellow-grey weathering dolomites of the Waterfowl Formation (Aitken, 1966b, p. 426), it may be impracticable to delineate an Eldon–Pika versus Waterfowl contact, except through detailed studies. At Mount Stephen, the uppermost 20 ft (6 m) or so of beds at the peak are dolomite, with a high content of quartz silt, and siltstone. Small-scale crosslamination and ripple marks are conspicuous. These beds are interpreted here as basal Waterfowl, but those who have mapped the vicinity in detail (Cook, 1975; McIlreath, 1977) have not recognized a mappable contact. In the absence of a mappable, base-of-Waterfowl contact, the Eldon, Pika, and Waterfowl formations should be mapped as a single, giant carbonate unit characterizing the Kicking Horse Rim.

Distribution and thickness

The Pika Formation is the most extensive of the Middle Cambrian carbonate formations of the southern Rocky Mountains. From its westward disappearance into the Chancellor Formation, it extends eastward as a carbonate facies to longitude 111°W (Range 8, west of the Fourth Meridian), well beyond the eastward disappearance of the Cathedral and Eldon as carbonate formations (Pugh, 1971).

The Pika Formation is recognizable (with some difficulty) at Mount Eon, in the Mount Assiniboine massif of the Main Ranges, whence southward plunge carries it from sight at White Man Pass. Along the mountain front, sub-Devonian erosion bevelled the Pika progressively southward from Bow River, so that it is missing at Little Elbow River and beyond (Fig. 79).



Measured thickness, Pika Formation (feet) . . . . . 236.
Pika thickness - "best pick" where Eldon-Pika is undifferentiated (feet) . . . . . 1253+.
Pika thickness, erosionally thinned at sub-Devonian unconformity (feet) . . . . . 62-T.
Pika Formation present as undifferentiated Eldon-Pika . . . . . P
Isopach of Pika Formation (interval 100 ft) . . . . . ⌒
Isopach of Tershishner Member (interval 100 ft) . . . . . ⌒

Figure 79. *Isopach map of the Pika Formation and Tershishner Member (shaded area). (Palinspastic restoration based on Fig. 15.)*

Slind and Perkins (1966) reported that northward from Jasper, strata recognizable as Pika Formation are present beneath the Arctomys as far as Kakwa Lake, but not beyond. It is not clear whether this disappearance of the Pika Formation is by depositional pinchout, erosion, or facies change.

Mountjoy (1980) recognized the Pika Formation throughout Mount Robson map area, but the position of the base of the Pika in the west limb of the Mount Robson Syncline is uncertain and arbitrary. In McBride map area, the adjoining area to the west, the Pika is separable from the underlying Titkana (Eldon) Formation only in the most northeasterly thrust sheet (Campbell et al., 1973).

Like other Middle Cambrian formations, the Pika thickens from east to west (Fig. 79). The thickness of the Pika at the type section represents roughly an average value, 522 ft (159.1 m) by my measurement, 539 ft (164.3 m) according to Deiss (1939). On the Bow River transect, the formation thickens from slightly more than 300 ft (91.5 m) at the mountain front to 777 ft (237 m) at Mount Bosworth; best placement of the indefinite Eldon/Pika contact at Mount Stephen results in a thickness measurement for the Pika of 789 ft (240.5 m). The greatest unequivocal thickness of Pika measured is 1185.5 ft (361 m), at Chaba River (Section AC–142). At Whitehorn, in the west limb of the Mount Robson Syncline, the thickness is 1000 ft (305 m) or 1253 ft (379 m), depending on the choice of contact. The latter measurement is favoured.

Two anomalously thin sections were measured, one at Mount Henry, Section AC–164 (564.5 ft/172 m), the other at Mount Cory, Section AC–23 (372 ft/113.5 m). Neither of these sections display unusual amounts of "shallow water" rock types, as would be expected if they represented penecontemporaneous "highs"; it therefore appears possible that they record erosion of the Pika on sub-Arctomys "highs".

Paleontology and age

The characteristic occurrence of fossils within the Pika Formation is either in thin beds crowded with trilobites, or on bedding planes "tiled" with trilobite cranidia and pygidia. The fossiliferous beds are separated by intervals of strata that are barren, or nearly so. Although rich in individuals, these fossiliferous beds are characteristically poor in species, and in a few instances contain only one.

All collections from the Pika Formation belong to the latest Middle Cambrian, *Bolaspidella* Zone, and the basal contact of the formation approximates the boundary between that zone and the *Bathyuriscus-Elrathina* Zone (see above, under "Eldon Formation").

Interpretation, Pika Grand Cycle

The early stages of the Pika Grand Cycle correspond almost exactly to the early stages of the Stephen/Eldon Grand Cycle. At the end of Eldon deposition, carbonate sediments extended eastward farther than at any previous time, and the inshore basin had filled up to shallow depths, with intertidal carbonate shoals (preserved as cryptalgal laminites) widespread. Abrupt deepening of the platform initiated deposition of the Pika Formation as subtidal lime mud, soon followed by cyclical incursions of terrigenous mud. Evidence from what appears to be a single zone of quartz sand near the Eldon/Pika contact (reviewed above, under "Eldon Formation") can be taken to support the view that an elevated rim, mapped as Eldon Formation, persisted in the west while Pika sedimentation was under way in the northeast, a model duplicating almost exactly the Cathedral/Stephen relationship described above.

A northerly source for much of the terrigenous mud incorporated in the Pika Formation can be seen in the northward increase of mudrocks in eastern, but not western, sections. This suggests that a clockwise gyre may have been active, carrying mud southward in the eastern part of the inshore basin, as postulated earlier (Aitken, 1979) for the Sullivan/Lyell Grand Cycle.

No shale unit of the Pika Formation crosses the Kicking Horse Belt, and Pika carbonate rocks in the belt contain abundant indicators of peritidal deposition. It appears, therefore, that the Kicking Horse Rim was maintained as a positive feature throughout Pika deposition.

As in previous cycles, the pinchout lines of successive shale tongues from the northeast retreated progressively northeastward, following the transgressive advance of the cratonal shoreline, except in the north, where mud supply continued and even increased toward the end of the cycle. The end of the Pika cycle represents the maximum advance of Cambrian carbonate deposition onto the craton (Pugh, 1971).

In the west, peritidal facies are increasingly well represented near the top of the Pika Formation, in a development parallel to that of the Mount Whyte/Cathedral and Stephen/Eldon grand cycles. In the Front Ranges, such a change is seen only where the

Tershishner Member is present. The Tershishner Member is not recognizable in any well in the Foothills or Plains; therefore, the narrow belt outlined in Figure 79 apparently approximates its total distribution. The Tershishner Member must represent a late Pika shoal complex within the inshore basin; it has no counterpart in any other Middle Cambrian Grand Cycle.

What localized the Tershishner shoal? The Tershishner Member corresponds in position and orientation to the paleostructural and paleotopographic feature of Early and Middle Devonian age that has been referred to as the West Alberta Ridge (e.g., Grayston et al., 1964). The structure underlying the ridge has a Cambrian expression in the Arctomys/Waterfowl cycle and in the Sullivan Formation, in which the formations are thicker in the subsurface of the Foothills than in mountain-front surface sections on the crest of the ridge (e.g., Aitken, 1968, Figs. 3, 4). It appears, therefore, that the shoal represented by the Tershishner Member of the Pika Formation was localized by an early, subtle manifestation of the positive structure later expressed as the West Alberta Ridge.

In the Front Ranges (but not in the subsurface of the Plains), dolomitization of the Pika Formation is systematic in a manner without parallel elsewhere in the Middle Cambrian of the region. The upper third, more or less, of the Pika is dolomitized, except in the shaly, northernmost sections, and the dolomite beds include lithofacies that are preserved as limestone lower in the formation. The dolomites are distinctive, brown to dark brown with a steely lustre, fine and very fine crystalline, and commonly preserve much fine primary textural detail (Figs. A-47, A-50, A-51, A-65). They thus contrast markedly with the pale, coarser, commonly fracture-controlled dolomites found in all Middle Cambrian carbonate formations in the Main Ranges.

Three initially plausible hypotheses may be considered to explain the "stratiform" dolomite of the upper Pika Formation:

1. A "dorag" model (Badiozamani, 1973), in which dolomitization is attributed to the mixing of fresh groundwater and connate brine, following subaerial exposure. In the present case, exposure would have taken place at the inferred sub-Arctomys disconformity. Dolomitization: post-Pika, pre-Arctomys.

2. A "reflux" model (Adams and Rhodes, 1960), in which hypersaline brine, concentrated on the Tershishner shoal, is considered to have seeped downward and basinward through underlying limestones, dolomitizing them *en passant*. Dolomitization: penecontemporaneous with upper Pika deposition.

3. A second "reflux" model, in which the dolomitizing brines are considered to have originated in the evaporitic environment of the succeeding Arctomys Formation. Dolomitization: post-Pika, syn-Arctomys.

Hypothesis (1) fails to explain the observed relationships. Following it, the upper Pika should be dolomitized whether it is overlain by the Arctomys Formation or not, and whether the Tershishner Member is present or not, but, eastward, where both of these units are missing, the Pika Formation is mainly undolomitized.

Hypothesis (2) also fails to explain observed relationships, because dolomites developed elsewhere under shoal conditions [e.g., rim facies of the Cathedral, Eldon and Pika, and cyclical dolomites of the Lyell Formation (Aitken, 1979)] are pale and more coarsely crystalline, and preserve less primary textural detail.

Hypothesis (3), dolomitization by evaporitic brine concentrated during deposition of the Arctomys Formation, fits the facts rather well. Eastward, general dolomitization of the upper Pika ends within the zone in which the Arctomys pinches out. In the north, where the upper Pika limestones are not dolomitized, they were shielded from descending solutions by shale beds that appear to have acted as impermeable membranes.

Recommended sections

In addition to the type and reference sections of the Pika Formation (the latter embracing the type section of the Tershishner Member), the following sections are recommended as combining important aspects of the Pika with reasonably easy access.

Chetamon Mountain

Section AC–89, the upward continuation of the type section of the Snake Indian Formation, provides a good example of the northward increase in the mudrock content of the Pika, an increase paralleled in the Snake Indian Formation beneath.

Loder's Lime Quarry

The section stratigraphically overlying the old limestone quarries (in the Eldon Formation) of Loder's Lime Company, at Kananaskis Station near Seebe, illustrates the southern, low-mudrock aspect of the Pika. The Pika/Eldon contact is particularly well exposed and rather indefinite. The Tershishner Member is present, though rather weakly developed.

Roche Miette

Section AC-86, on the lower slopes of Roche Miette above Highway 16, exposes an aspect of the Pika Formation that is both eastern (thin) and northern (high in mudrocks). The Pika/Arctomys contact is well exposed but rather indefinite.

REFERENCES

Adams, J.E. and Rhodes, M.L.
1960: Dolomitization by seepage refluxion. American Association of Petroleum Geologists, Bulletin, v. 44, no. 12, p. 1912–1920.

Ahr, W.M.
1971: The carbonate ramp: an alternative to the shelf model. Transactions of the Gulf Coast Association of Geological Societies, v. 41, p. 221–225.

Aitken, J.D.
1966a: Sub-Fairholme Devonian rocks of the eastern Front Ranges, southern Rocky Mountains, Alberta. Geological Survey of Canada, Paper 64-33.

1966b: Middle Cambrian to Middle Ordovician cyclic sedimentation, southern Rocky Mountains of Alberta. Bulletin of Canadian Petroleum Geology, v. 14, p. 405–441.

1967: Classification and environmental significance of cryptalgal limestones and dolomites, with illustrations from the Cambrian and Ordovician of southwestern Alberta. Journal of Sedimentary Petrology, v. 37, p. 1153–1168.

1968: Cambrian sections in the easternmost southern Rocky Mountains and the adjacent subsurface, Alberta. Geological Survey of Canada, Paper 66-23.

1969: Documentation of the sub-Cambrian unconformity, Rocky Mountains Main Ranges, Alberta. Canadian Journal of Earth Sciences, v. 6, no. 2, p. 193–200.

1971: Control of lower Paleozoic sedimentary facies by the Kicking Horse Rim, southern Rocky Mountains, Canada. Bulletin of Canadian Petroleum Geology, v. 19, p. 557–569.

1978: Revised models for depositional Grand Cycles, Cambrian of the southern Rocky Mountains, Canada. Bulletin of Canadian Petroleum Geology, v. 26, no. 4, p. 515–542.

1981: Cambrian stratigraphy and depositional fabrics, southern Canadian Rocky Mountains, Alberta and British Columbia. *In* The Cambrian System in the Southern Rocky Mountains, Alberta and British Columbia, M.E. Taylor (ed.). Second International Symposium on the Cambrian System, Guidebook, p. 1–27.

1988: Palinspastic base map of southern Rockies. Geological Survey of Canada, Open File.

1989: Birth, growth and death of the Middle Cambrian Cathedral carbonate lithosome, southern Rocky Mountains. Bulletin of Canadian Petroleum Geology, v. 37, p. 316–333.

Aitken, J.D. and Fritz, W.H.
1968: Burgess Shale Project, British Columbia. Geological Survey of Canada, Paper 68-1A, p. 190–192.

Aitken, J.D., Fritz, W.H., and Norford, B.S.
1972: Cambrian and Ordovician biostratigraphy of the southern Canadian Rocky Mountains. Guidebook, 24th International Geological Congress, Field Excursion A19.

Aitken, J.D. and Greggs, R.G.
1967: Upper Cambrian formations, southern Rocky Mountains of Alberta, an interim report. Geological Survey of Canada, Paper 66-49.

Aitken, J.D. and McIlreath, I.A.
1984: The Cathedral reef escarpment, a Cambrian Great Wall with humble origins. Geos, v. 13, p. 17–19.

1990: Comment [on Ludvigsen's (1989) denial of the Cathedral Escarpment]. Geoscience Canada, v. 17, p. 111–116.

Aitken, J.D. and Norford, B.S.
1967: Lower Ordovician Survey Peak and Outram formations, southern Rocky Mountains of Alberta. Bulletin of Canadian Petroleum Geology, v. 15, p. 150–207.

Allan, J.A.
1912: Geology of Field map-area, Yoho Park, B.C. Geological Survey of Canada, Summary Report for 1911, p. 175–187.

1914a: Rocky Mountain section between Banff, Alberta, and Golden, B.C., along the Canadian Pacific Railway. Geological Survey of Canada, Summary Report for 1912, p. 165–176.

1914b: Geology of Field map-area, B.C. and Alberta. Geological Survey of Canada, Memoir 55, 312 p.

1916: Simpson Pass to Kananaskis, Rocky Mountains Park, Alberta. Geological Survey of Canada, Summary Report for 1915, p. 100–102.

Badiozamani, K.
1973: The dorag dolomitization model – application to the Middle Ordovician of Wisconsin. Journal of Sedimentary Petrology, v. 43, no. 4, p. 965–984.

Balkwill, H.R., Price, R.A., Cook, D.G., and Mountjoy, E.W.
1980: Geology of Golden (East Half), British Columbia. Geological Survey of Canada, Map 1496A (1:50 000 scale).

Bally, A.W., Gordy, P.L., and Stewart, G.A.
1966: Structure, seismic data, and orogenic evolution of southern Canadian Rocky Mountains. Bulletin of Canadian Petroleum Geology, v. 14, p. 337-381.

Beales, F.W.
1953: Ancient sediments of Bahaman type. American Association of Petroleum Geologists, Bulletin, v. 42, no. 8, p. 1845-1880.

Bond, G.C. and Kominz, M.A.
1984: Construction of tectonic subsidence curves for the early Paleozoic miogeocline, southern Canadian Rocky Mountains - implications for subsidence mechanisms, age of breakup, and crustal thinning. Geological Society of America, Bulletin, v. 95, p. 155-173.

Briggs, D.E.G. and Collins, D.
1988: A Middle Cambrian chelicerate from Mount Stephen, British Columbia. Palaeontology, v. 31, pt. 3, p. 779-798.

Burling, L.D.
1914: Early Cambrian stratigraphy in the North American Cordillera, with discussion of *Albertella* and related faunas. Geological Survey of Canada, Museum Bulletin 2, Geological Series no. 17, pt. VI, p. 93-129.

1915: Shallow-water deposition in the Cambrian of the Canadian Cordillera. Ottawa Naturalist, v. 29, p. 87, 88.

1916a: Notes on the stratigraphy of the Rocky Mountains, Alberta-British Columbia. Geological Survey of Canada, Scientific Report for 1915, p. 97-100.

1916b: The *Albertella* Fauna located in the Middle Cambrian of British Columbia and Alberta. American Journal of Science, 4th series, v. 42, p. 469-472.

1923: Cambro-Ordovician section near Mount Robson, British Columbia. Geological Society of America, Bulletin, v. 34, p. 721-747.

1955: Annotated index to the Cambro-Ordovician of the Jasper Park and Mount Robson region. Alberta Society of Petroleum Geologists, Guidebook, 5th Annual Field Conference, p. 15-52.

Campbell, R.B., Mountjoy, E.W., and Struick, L.C.
1982: Structural cross-section through south-central Rocky and Cariboo Mountains to the Coast Range. Geological Survey of Canada, Open File 844.

Campbell, R.B., Mountjoy, E.W., and Young, F.G.
1973: Geology of McBride map-area (93 H), British Columbia. Geological Survey of Canada, Paper 73-35.

Collins, D. and Rudkin, D.M.
1981: *Priscansermarinus barnetti*, a probable lepadomorph barnacle from the Middle Cambrian Burgess Shale of British Columbia. Journal of Paleontology, v. 55, no. 5, p. 1006-1015.

Collins, D., Briggs, D.E.G., and Conway Morris, S.
1983: New Burgess Shale fossil sites reveal Middle Cambrian faunal complex. Science, v. 222, no. 4620, p. 163-167.

Conway Morris, S. and Whittington, H.B.
1985: Fossils of the Burgess Shale. Geological Survey of Canada, Miscellaneous Report 43, 31 p.

Cook, D.G.
1975: Structural style influenced by lithofacies, Rocky Mountain Main Ranges, Alberta-British Columbia. Geological Survey of Canada, Bulletin 233.

Cook, H.E. and Taylor, M.E.
1977: Comparison of continental slope and shelf environments in the Upper Cambrian and lowest Ordovician of Nevada. *In* Deep-water Carbonate Environments, H.E. Cook and P. Enos (eds.). Society of Economic Paleontologists and Mineralogists, Special Publication No. 25, p. 51-81.

Deiss, C.
1939: Cambrian formations of southwestern Alberta and southeastern British Columbia. Geological Society of America, Bulletin, v. 50, p. 951-1026.

1940: Lower and Middle Cambrian stratigraphy of southwestern Alberta and southeastern British Columbia. Geological Society of America, Bulletin, v. 51, p. 731-794.

Dunham, R.J.
1962: Classification of carbonate rocks according to depositional texture. *In* Classification of Carbonate Rocks, W.E. Ham (ed.). American Association of Petroleum Geologists, Memoir 1, p. 108-121.

Embry, A.F., III. and Klovan, J.E.
1971: A Late Devonian reef tract on northeastern Banks Island, N.W.T. Bulletin of Canadian Petroleum Geology, v. 19, p. 730-781.

Folk, R.L.
1959: Practical petrographic classification of limestones. American Association of Petroleum Geologists, Bulletin, v. 43, no. 1, p. 1-38.

Foo, W.K.
1979: Evolution of transverse structures linking the Purcell Anticlinorium to the Western Rocky Mountains near Canal Flats, British Columbia. Unpublished M.Sc. thesis, Queen's University, Kingston, Ontario.

Fritz, W.H.
1971: Geological setting of the Burgess Shale. North American Paleontological Convention, Chicago, 1969, Proceedings, Part I, p. 1155-1170.

1975: Broad correlations of some Lower and Middle Cambrian strata in the North American Cordillera. *In* Report of Activities, Part A. Geological Survey of Canada, Paper 75-1A, p. 533-540.

1981: Cambrian biostratigraphy, southern Rocky Mountains, Alberta and British Columbia. *In* The Cambrian System in the Southern Canadian Rocky Mountains, Alberta and British Columbia, M.E. Taylor (ed.). Second International Symposium on the Cambrian System, Guidebook, p. 29-33.

Fritz, W.H.
1990: Comment: In defense of the escarpment near the Burgess Shale fossil locality. Geoscience Canada, v. 17, p. 106–110.

Fritz, W.H. and Mountjoy, E.W.
1975: Lower and early Middle Cambrian formations near Mount Robson, British Columbia and Alberta. Canadian Journal of Earth Sciences, v. 12, no. 2, p. 119–131.

Fritz, W.H. and Norris, D.K.
1965: Lower Middle Cambrian correlations in east-central Cordillera. *In* Report of Activities, Part A. Geological Survey of Canada, Paper 66-1A, p. 105–110.

Gabrielse, H.
1972: Younger Precambrian of the Canadian Cordillera. American Journal of Science, v. 272, p. 521–536.

Gebelein, C.D. and Hoffman, P.F.
1973: Algal origin of dolomite laminations in stromatolitic limestone. Journal of Sedimentary Petrology, v. 43, no. 3, p. 603–613.

Grayston, L.D., Sherwin, D.F., and Allan, J.F.
1964: Middle Devonian. *In* Geological History of Western Canada, Chapter 5, R.G. McCrossan and R.P. Glaister (eds.). Alberta Society of Petroleum Geologists, p. 49–59.

Greggs, R.G.
1962: Upper Cambrian biostratigraphy of the southern Rocky Mountains, Alberta. Unpublished Ph.D. thesis, University of British Columbia, Vancouver, B.C.

Harrison, R.S.
1969: The petrology of some mottled and laminated Middle Cambrian dolomites from Banff and Yoho National Parks. Unpublished M.Sc. thesis, University of Calgary, Calgary, Alberta.

Hatfield, C.B. and Rohrbacker, T.J.
1966: Dolomite-insoluble residue relationships in the Ten Mile Creek Dolomite (Middle Devonian) near Toledo, Ohio. Journal of Sedimentary Petrology, v. 36, no. 3, Notes, p. 828–831.

Hockley, G.D.
1973: Stratigraphy and paleoenvironmental patterns of the Peyto–Mount Whyte sediments (lower-Middle Cambrian) of the southwestern Canadian Rocky Mountains. Unpublished M.Sc. thesis, University of Calgary, Calgary, Alberta.

Hughes, R.D.
1955: Geology of portions of Sunwapta and Southesk map-areas, Jasper National Park, Alberta, Canada. Alberta Society of Petroleum Geologists, Guidebook, 5th Annual Field Conference, p. 69–116.

Hutchinson, R.D.
1960: Middle Cambrian fossils in eastern Alberta. Journal of the Alberta Society of Petroleum Geologists, v. 8, p. 137.

Illing, L.V.
1954: Bahaman calcareous sands. American Association of Petroleum Geologists, Bulletin, v. 38, no. 1, p. 1–95.

Kennard, J.M. and James, N.P.
1986: Thrombolites and stromatolites: two distinct types of microbial structures. Palaios, v. 1, p. 492–503.

Lis, M.G. and Price, R.A.
1976: Large-scale block faulting during deposition of the Windermere Supergroup (Hadrynian) in southeastern British Columbia. *In* Current Research, Part A. Geological Survey of Canada, Paper 76-1A, p. 135, 136.

Lochman-Balk, C.
1971: The Cambrian of the craton of the United States. *In* Cambrian of the New World, C.H. Holland (ed.). Wiley-Interscience, Toronto, p. 79–168.

Logan, B.W., Rezak, R., and Ginsberg, R.N.
1964: Classification and environmental significance of algal stromatolites. Journal of Geology, v. 72, no. 1, p. 68–83.

Ludvigsen, R.
1989: The Burgess Shale: not in the shadow of the Cathedral Escarpment. Geoscience Canada, v. 16, p. 51–59.

1990: Reply to comments by Fritz and Aitken and McIlreath (regarding the Cathedral Escarpment). Geoscience Canada, v. 17, p. 116–118.

McConnell, R.G.
1887: Report on the geological structure of a portion of the Rocky Mountains, accompanied by a section measured near the 51st parallel. Geological Survey of Canada, Annual Report for 1886, Pt. D, p. 5–41.

McEvoy, J.
1900: Report on the geology and natural resources of the country traversed by the Yellow Head Pass Route from Edmonton to Tete Jaune Cache, comprising portions of Alberta and British Columbia. Geological Survey of Canada, Annual Report for 1898, v. 11, p. 5D–44D.

McGehee, J.R.
1949a: Pre-Waterways Paleozoic stratigraphy of Alberta Plains. Western Canada Sedimentary Basin Symposium, 1954, Alberta Society of Petroleum Geologists, Bulletin of American Petroleum Geologists, v. 33, p. 131–142.

1949b: Pre-Waterways Paleozoic stratigraphy of Alberta Plains. Western Canada Sedimentary Basin Symposium, 1954, Bulletin of American Petroleum Geologists, v. 33, p. 603–613.

McIlreath, I.A.
1975: Stratigraphic relationships at the western edge of the Middle Cambrian carbonate facies belt, Field, British Columbia. Geological Survey of Canada, Paper 74-1A, p. 333, 334.

1977a: Accumulation of a Middle Cambrian, deep-water limestone debris apron adjacent to a vertical, submarine carbonate escarpment, southern Rocky Mountains, Canada. *In* Deep-water Carbonate Environments, H.E. Cook and P. Enos (eds.). Society of Economic Paleontologists and Mineralogists, Special Publication No. 25, p. 113–124.

1977b: Stratigraphic relationships at the western edge of the Middle Cambrian carbonate facies belt, Field, British

Columbia. Unpublished Ph.D. thesis, University of Calgary, Calgary, Alberta.

McIlreath, I.A. and Aitken, J.D.
1976: *Yoholaminites* (Middle Cambrian), problematical calcareous sediment-stabilizing organism. (Abstract.) Program with Abstracts, Geological Association of Canada, 1976 Annual Meetings.

Morel, P. and Irving, E.
1978: Tentative paleocontinental maps for the early Phanerozoic and Proterozoic. Journal of Geology, v. 86, no. 5, p. 535–561.

Mountjoy, E.W.
1962: Mount Robson (southeast) map-area, Rocky Mountains of Alberta and British Columbia. Geological Survey of Canada, Paper 61-31.

1980: Mount Robson map-area (83 E). Geological Survey of Canada, Map 1499A (1:250 000 scale).

Mountjoy, E.W. and Aitken, J.D.
1978: Middle Cambrian Snake Indian Formation (new), Jasper region, Alberta. Bulletin of Canadian Petroleum Geology, v. 26, no. 3, p. 343–361.

Ney, C.S.
1954: Monarch and Kickinghorse mines, Field, British Columbia. *In* 4th Annual Field Conference, Guidebook, J.C. Scott (ed.). Alberta Society of Petroleum Geologists, p. 119–140.

Norris, D.K. and Price, R.A.
1966: Middle Cambrian lithostratigraphy of southeastern Canadian Cordillera. Bulletin of Canadian Petroleum Geology, v. 14, no. 4, p. 385–404.

Osmond, J.C.
1956: Mottled carbonate rocks in the Middle Devonian of eastern Nevada. Journal of Sedimentary Petrology, v. 26, no. 1, p. 32–41.

Palmer, A.R.
1960: Some aspects of the early Upper Cambrian stratigraphy of White Pine County, Nevada and vicinity. *In* Guidebook to the geology of east central Nevada, Intermountain Association of Petroleum Geologists, p. 53–58.

1965: Biomere – a new kind of biostratigraphic unit. Journal of Paleontology, v. 39, p. 149–153.

1971: The Cambrian of the Great Basin and adjacent areas, western United States. *In* Cambrian of the New World, C.H. Holland (ed.). Toronto, Wiley-Interscience, p. 1–78.

1973: Cambrian trilobites. *In* Atlas of Paleobiogeography, A. Hallam (ed.). Elsevier, London, p. 3–11.

Palmer, A.R. and Campbell, D.P.
1976: Biostratigraphic implications of trilobite biofacies, *Albertella* Zone, Middle Cambrian, western United States. Brigham Young University Geological Studies, v. 23, Pt. 2, p. 39–50.

Palmer, A.R. and Halley, R.B.
1979: Physical stratigraphy and trilobite biostratigraphy of the Carrara Formation (Lower and Middle Cambrian) in the southern Great Basin. United States Geological Survey, Professional Paper 1047.

Palonen, P.A.
1976: Sedimentology and stratigraphy of Gog Group sandstones in southern Canadian Rockies. Unpublished Ph.D. thesis, University of Calgary, Calgary, Alberta.

Parrish, R. and Armstrong, R.L.
1983: U-Pb zircon age and tectonic significance of gneisses in structural culminations of the Omineca Crystalline Belt, British Columbia. (Abstract, no. 17608.) Geological Society of America, Joint Meeting of the Rocky Mountain and Cordilleran sections, Abstracts with Programs, p. 324.

Pitman, W.C., III.
1978: Relationship between eustacy and stratigraphic sequences of passive margins. Geological Society of America, Bulletin, v. 89, p. 1389–1403.

Price, R.A.
1956: The base of the Cambrian System in the southeastern Cordillera of Canada. Canadian Mining and Metallurgical Bulletin, Canadian Institute of Mining and Metallurgy, v. 49, p. 765–771.

Price, R.A. and Fermor, P.R.
1982: Structure section of the Cordilleran fold and thrust belt west of Calgary, Alberta. Geological Survey of Canada, Open File 882.

Price, R.A. and Mountjoy, E.W.
1970: Geologic structures of the Canadian Rocky Mountains between Bow and Athabasca rivers – a progress report. *In* Structure of the Southern Canadian Cordillera, J.O. Wheeler (ed.). Geological Association of Canada, Special Paper No. 6, p. 7–26.

Price, R.A., Cook, D.G., Aitken, J.D., and Mountjoy, E.W.
1980a: Geology of Lake Louise (East Half), Alberta–British Columbia. Geological Survey of Canada, Map 1482A (1:50 000 scale).

1980b: Geology of Lake Louise (West Half) Alberta–British Columbia. Geological Survey of Canada, Map 1483A (1:50 000 scale).

Price, R.A., Mountjoy, E.W., and Cook, D.G.
1979a: Geology of Mount Goodsir (East Half), British Columbia–Alberta. Geological Survey of Canada, Map 1476A (1:50 000 scale).

1979b: Geology of Mount Goodsir (West Half), British Columbia. Geological Survey of Canada, Map 1477A (1:50 000 scale).

Pugh, D.C.
1971: Subsurface Cambrian stratigraphy in southern and central Alberta. Geological Survey of Canada, Paper 70-10.

1973: Subsurface lower Paleozoic stratigraphy in northern and central Alberta. Geological Survey of Canada, Paper 72-12.

Raasch, G.O. and Campau, D.E.
1957: Cambrian biostratigraphy of California Standard Parkland No. 4-12. Alberta Society of Petroleum Geologists, Journal, v. 5, no. 7, p. 140-144.

Rasetti, F.
1951: Middle Cambrian stratigraphy and faunas of the Canadian Rocky Mountains. Smithsonian Miscellaneous Collections, v. 116, no. 5, 277 p.

1956: The Middle and Upper Cambrian of Western Canada. 20th International Geological Congress, Tome II, Parte II, p. 735-750.

Raymond, P.E.
1930a: The Paleozoic formations in Jasper Park, Alberta. American Journal of Science, 5th series, v. 20, p. 289-300.

1930b: The base of the Ordovician in the Canadian Rockies. American Journal of Science, 5th series, v. 20, p. 301-307.

Read, J.F. and Grover, G.A. Jr.
1977: Scalloped and planar erosion surfaces, Middle Ordovician limestones, Virginia: analogues of Holocene exposed karst or tidal rock platforms. Journal of Sedimentary Petrology, v. 47, no. 3, p. 956-972.

Resser, C.E.
1936: Second contribution to nomenclature of Cambrian trilobites. Smithsonian Miscellaneous Collections, v. 95, no. 4, p. 1-29.

Robison, R.A.
1960: Lower and Middle Cambrian stratigraphy of the eastern Great Basin. *In* Guidebook to the Geology of East Central Nevada, Intermountain Association of Petroleum Geologists, p. 43-52.

Sleep, N.H.
1971: Thermal effects of the formation of Atlantic continental margins by continental break up. Royal Astronomical Society of London, Geophysical Journal, v. 24, p. 325-350.

Slind, O.L. and Perkins, G.D.
1966: Lower Paleozoic and Proterozoic sediments of the Rocky Mountains between Jasper, Alberta and Pine River, British Columbia. Bulletin of Canadian Petroleum Geology, v. 14, p. 442-468.

Stewart, J.H.
1972: Initial deposits in the Cordilleran Geosyncline: evidence of Late Precambrian (<850 m.y.) continental separation. Geological Society of America, Bulletin, v. 83, p. 1345-1360.

Stewart, W.D., Dixon, O.A., and Rust, B.R.
1993: Middle Cambrian carbonate-platform collapse, southeastern Canadian Rocky Mountains. Geology, v. 21, p. 687-690.

Stewart, W.D.
1989: A preliminary report on stratigraphy and sedimentology of the lower and middle Chancellor Formation (Middle to Upper Cambrian) in the zone of facies transition, Rocky Mountain Main Ranges, southeastern British Columbia. *In* Current Research, Part D. Geological Survey of Canada, Paper 89-1D, p. 61-68.

Stockwell, C.H., McGlynn, J.C., Emslie, R.F., Sanford, B.V., Norris, A.W., Donaldson, J.A., Fahrig, W.F., and Currie, K.L.
1970: Geology of the Canadian Shield. *In* Geology and Economic Minerals of Canada, R.J.W. Douglas (ed.). Geological Survey of Canada, Economic Geology Report No. 1, Chapter IV, p. 45-150.

Tucker, M.E.
1977: Stromatolite biostromes and associated facies in the Late Precambrian Porsanger Dolomite Formation of Finnmark, Arctic Norway. Palaeogeography, Palaeoclimatology, Palaeoecology, v. 21, p. 55-83.

Walcott, C.D.
1908a: Nomenclature of some Cambrian Cordilleran formations. Smithsonian Miscellaneous Collections, v. 53, no. 1, p. 1-12.

1908b: Cambrian trilobites. Smithsonian Miscellaneous Collections, v. 53, no. 2, p. 13-52.

1908c: Cambrian sections of the Cordilleran area. Smithsonian Miscellaneous Collections, v. 53, no. 5, p. 167-230.

1911: Middle Cambrian Holothurians and Medusae. *In* Cambrian Geology and Paleontology II. Smithsonian Miscellaneous Collections, v. 57, p. 41-68.

1916a: Cambrian trilobites. *In* Cambrian Geology and Paleontology, III, no. 3. Smithsonian Miscellaneous Collections, v. 64, no. 3, p. 157-258.

1916b: Cambrian trilobites. *In* Cambrian Geology and Paleontology, III, no. 5. Smithsonian Miscellaneous Collections, v. 64, no. 5, p. 303-456.

1917: Nomenclature of some Cambrian Cordilleran formations. *In* Cambrian Geology and Paleontology: Pt. IV, no. 1. Smithsonian Miscellaneous Collections, v. 67, no. 1, p. 1-8.

1920: Middle Cambrian Spongiae. *In* Cambrian Geology and Paleontology IV, no. 6. Smithsonian Miscellaneous Collections, v. 67, no. 6, p. 261-364.

1928: Pre-Devonian Paleozoic formations of the Cordilleran provinces of Canada. Smithsonian Miscellaneous Collections, v. 75, p. 175-367. [Written by C.E. Resser after Walcott's death, from Walcott's notes and publications.]

Walter, M.R. (editor)
1976: Stromatolites. Elsevier, Amsterdam, 790 p.

Whittington, H.B.
1971: The Burgess Shale: history of research and preservation of fossils. North American Paleontological Convention, Chicago, 1969, Proceedings, Part I, p. 1170–1201.

1980: The significance of the fauna of the Burgess Shale, Middle Cambrian, British Columbia. Geological Association, Proceedings, v. 91, p. 127–148.

1985: The Burgess Shale. Yale University Press, New Haven and London, 151 p.

Wilson, J.L.
1975: Carbonate Facies in Geologic History. Springer-Verlag, New York.

Winwood, H.H.
1885: Geological age of the Rocky Mountains. Geological Magazine, v. 2, p. 240.

Yochelson, E.L.
1967: Charles Doolittle Walcott. National Academy of Sciences, Biographical Memoir, v. 39, p. 471–540.

van Hees, H.
1959: Middle Cambrian of the southern Alberta Plains. *In* Guidebook, 9th Annual Field Conference, Alberta Society of Petroleum Geologists, p. 73–85.

1964: Cambrian, Part I - Plains. *In* Geological History of Western Canada, Chapter 3, R.G. McCrossan and R.P. Glaister (eds.). Alberta Society of Petroleum Geologists, p. 20–28.

APPENDIX A

DESCRIPTIONS OF LITHOFACIES

The following lithological descriptions are based primarily on field examination, with emphasis on macroscopic characteristics, and only secondarily on microscopic examination of thin sections and acetate peels. Accuracy and completeness of the field descriptions improved continuously during fieldwork, as petrographic study expanded understanding.

The main objective of the lithological studies, apart from providing descriptions useful to subsequent researchers, was to identify primary sediment character; thus, most aspects of diagenesis have received little detailed attention. More detailed sedimentological and petrographic study would undoubtedly bring to light phenomena not described here, and might lead to modification of what follows.

Assignment of all beds or sequences of beds to one lithofacies or the other is pragmatic and, to a degree, inconsistent, in that some lithofacies consist of a single rock type, whereas others comprise two or more rock types in a frequently observed association. Some such "lumping" procedure is unavoidable in dealing with so enormous a volume of strata, and desirable in a stratigraphic column so characterized by repetition of rock types and lithofacies.

Carbonate lithofacies

For the purposes of this report, the nature of the primary sediment now represented by consolidated rocks that have undergone deep burial is more significant than the details of the products of the various postdepositional processes suffered by that primary sediment. Accordingly, rocks are named as much as possible for their primary characteristics; for example, "dolomite: ex-ooid grainstone", or "dolomite: ex-rudstone". Only those rocks, fortunately a minority, in which unselective dolomitization has destroyed all trace of primary fabric, are described as crystalline rocks.

The carbonate nomenclature employed is mainly that of Dunham (1962), as expanded by Embry and Klovan (1971), with explanatory reference to certain terms and concepts of Folk (1959).

Mudstone group and derived dolomites

Burrow-mottled lime mudstone

The burrow-mottled lime mudstone lithofacies is easily identified in the field as massive, medium to very thick bedded or nonbedded carbonate strata, in which resistant dolomite mottling, weathering pale yellow-brown to dark grey-brown, stands in relief against a smooth, pale grey weathering limestone matrix. Intervals lacking bedding joints commonly have the mottling dispersed along planes parallel to bedding (Figs. A-1 to A-3).

Although clearly deposited as lime muds, these rocks have largely suffered grain growth that has increased average grain size beyond the 4 micron limit of the original definition of micrite (Folk, 1959). Grain size commonly ranges up to 30 μ, and locally exceeds 100 μ; a modal grain size in the 10 to 15 μ range is common (Fig. A-4). In Folk's terms, these lime mudstones would be termed microspar. The absence of lamination and current bedding, and the continuous intergradation with the uncommon true micrites, without change in other characteristics, provide evidence that the primary sediment was of mud rather than silt grade.

Many specimens contain a scattering of indistinct dark brown pellets, assumed to be fecal in origin; others contain crude laminae, patches, or clumps of well defined dark pellets, separated by clear calcite that may be either very finely crystalline sparry cement or microspar. The pellets are commonly composed of true micrite, which may have been inhibited from undergoing grain growth by its content of organic matter.

The burrow-mottled lime mudstones normally contain very few fossils, and many thin sections contain no skeletal material. Fossils seen include trilobites and echinoderms, and rounded objects of uncertain origin composed of a few grains of clear calcite.

The presence of patches of dolomite in a mottled pattern is characteristic of the lithofacies. The dolomite, ranging in grain size from 30 to over 100 μ, is not obvious on freshly fractured surfaces, but stands

out clearly following etching for a few seconds with dilute HCl. The arrangement of the dolomite "mottles" is best observed on weathered surfaces (Fig. A-5). Many of the dolomite masses weathered in relief are elongate objects of nearly circular cross-section, oriented either at high angles to the bedding plane (in which case they are more or less straight), or else in the bedding plane (in which case they are curved, locally branching, and of constant diameter). Typical diameters of these cylindroidal objects range from 2 to 10 mm. They are almost certainly dwelling and feeding burrows. Selective, early dolomitization may have been localized by the organic mucus coating burrow walls or contained in feces (Gebelein and Hoffman, 1973).

By no means is all the mottling organically controlled. In many instances, dolomitization has spread outward from minute fissures (?syneresis cracks). In others, a burrow appears to have been the initial site of dolomitization which subsequently spread beyond the boundaries of the burrow into the surrounding lime mudstone, to terminate in a "front" that is abrupt in some cases and diffuse in others.

As summarized in Figure A-24, the burrow-mottled lime mudstone lithofacies is nearly pure carbonate, and approaches a mixture of pure calcite and pure dolomite phases. Much of the departure from single carbonate phases in the analyses is attributable to the difficulty in selecting separates of pure mudstone and pure dolomite phases from crushed material. Differences in content of noncarbonate matter between the host lime mudstone and the dolomite "mottles" are insignificant.

The burrow-mottled primary lithofacies is generally easily recognized in rocks that have undergone complete diagenetic or hypogene dolomitization. In most instances, an interesting inversion of colour and textural relationships has taken place. The organically controlled, early diagenetic dolomite "mottles" have undergone little, if any, grain growth during the later pervasive dolomitization, while the original lime mudstone component has been converted to fine to medium crystalline[1] dolomite. The "mottles", which were originally pale relative to the matrix, have become brown or dark grey, in contrast to their very pale brown to nearly white "ex-mudstone" matrix (Fig. A-6). Prior to pervasive dolomitization, the early dolomite "mottles" were apparently more porous than their calcitic mudstone matrix. During pervasive dolomitization, the organic component of the latter appears to have been largely eliminated and driven into the pore space of the early "mottles". Harrison (1969) illustrated the mottled dolomites thoroughly.

The burrow-mottled lime mudstones are all but devoid of primary inorganic sedimentary structures. Where deeply weathered, masses of derived dolomite commonly develop a bedding plane parting, along surfaces with concentrations of dolomitized burrows.

The burrow-mottled lithofacies intergrades with the parted lime mudstone lithofacies, as the dolomite "mottles" coalesce along bedding planes to become dolomite partings between thin beds. This change is accompanied by an increase in the noncarbonate component of the dolomite phase (Fig. A-24).

Parted lime mudstone

The parted lime mudstone lithofacies is distinguished in the field from the burrow-mottled lime mudstone facies primarily by its bedding style and flaggy outcrop (Figs. A-7, A-8); however, important differences in composition, sedimentary structures, and lithological associations exist between the two facies.

The parted lime mudstone lithofacies consists of thin beds and laminae of of grey weathering lime mudstone (including calcisiltite) separated by irregular partings, weathering greyish yellow or pale brown, that range from impure very fine crystalline dolomite to shale (Figs. A-9, A-10). Dolomite partings are ubiquitous; shale partings are rare. The facies containing the latter has not been distinguished in the graphic representations of described sections, firstly because it is volumetrically unimportant and, secondly, because of the difficulty in distinguishing between shaly dolomite and dolomitic shale in the field.

In the lime mudstone fraction, microspar is more common than true micrite; as is the case for the burrow-mottled lime mudstone lithofacies described above. Given widespread grain growth, the calcisiltites are recognized essentially through the presence of current lamination.

Laminae of grainstone, packstone, and wackestone - with pellets, skeletal grains, and intraclasts as the principal allochems - commonly interrupt the predominant lime mudstones of the parted lime mudstone lithofacies.

[1]Modal Crystal Size	Class
Greater than 16 mm	Megacrystalline
4–16 mm	Very coarsely crystalline
1–4 mm	Coarsely crystalline
0.25–1 mm	Medium crystalline
0.06–0.25 mm	Finely crystalline
0.015–0.06 mm	Very finely crystalline
Less than 0.015 mm	Microcrystalline

The dolomitic parting material usually contains abundant feeding traces and burrows (Figs. A-11 to A-14). Burrowing also accounts in part for the observation that the parting material appears to invade the lime mudstone beds. These "invasions" also result from dolomitization following syneresis cracks and spreading out from burrows (Figs. A-15, A-16).

It is clear that the parted lime mudstone lithofacies records alternating deposition of two distinct sediments. One was a relatively pure calcium carbonate mud and the other an impure calcium carbonate mud susceptible to early diagenetic dolomitization (Fig. A-24).The relatively pure beds, now seen as lime mudstone, clearly were lithified earlier than the parting material, now seen as impure dolomite, based on the following evidence. First, where early cracks developed in the lime mudstone, through either syneresis or loading, the parting material has been squeezed in a ductile manner into the opening (flow lines are visible in some examples). Commonly, this crack-filling process was halted by upward or downward narrowing of the crack, so that a wedge-shaped void has been left to be filled with sparry calcite. Second, intraclasts of lime mudstone, obviously derived from the underlying bed, are commonly strewn throughout dolomite partings, whereas intraclasts of parting dolomite have not been observed.

The argument for the existence of two distinct sediments is especially clear when shale partings occur between lime mudstone beds; these shale partings intergrade with the typical dolomite partings. In other examples, the parting material contains abundant quartz silt or, locally, even sand (Fig. A-17), while these materials are inconspicuous or missing in the adjoining limestone beds.

Although the parting surfaces are most commonly marked with conspicuous, dolomitized feeding traces and dwelling burrows, calcite-filled burrows also occur locally, interrupting dolomitic parting material (Figs. A-12, A-14, A-16). In thin sections of the lime mudstone phase, inconspicuous, mud filled burrows are common; a few burrows are filled by sparry calcite, and a few of these contain fecal pellets (Figs. A-10, A-18, A-19, A-20).

Although by no means rich in fossils, the parted lime mudstone lithofacies contains much more skeletal material than the burrow-mottled lime mudstone lithofacies. The fossils, largely trilobites with a few small brachiopods, occur in two modes. The first consists of scattered specimens embedded in parting material. The second, less conspicuous but yielding better specimens, consists of thin laminae, or lenses of lamina thickness, of trilobite grainstone or packstone. These coquina-like laminae normally contain at least some sparry calcite filling primary shelter cavities, and appear to be lag deposits (Fig. A-21); the presence of mud filled fossils in sparse cement supports this interpretation.

Primary sedimentary structures of the parted lime mudstone lithofacies are scour-and-fill, ripple mark (mainly of current type, Fig. A-22) and, in the calcisiltites, ripple crosslamination (Fig. A-29). The lithofacies is strongly associated with flat-pebble rudstones (Fig. A-23) and with intervals containing terrigenous shale.

A sizeable literature exists concerning strata similar to the parted and mottled lithofacies of this report (i.e., Beales, 1953; Osmond, 1956; Hatfield and Rohrbacker, 1966, and literature cited by them).

The textural and compositional differences among lime mudstone beds, dolomitic partings, and biogenic structures are normally distinguishable in strata that have undergone complete hypogene dolomitization. Thus, the primary lithofacies can be deduced with confidence. Upon dolomitization, the lime mudstone phase became paler (very pale brown to yellowish white) and coarser (grain size up to 0.25 mm), while the partings became grey, brown, or black, and remained very fine crystalline.

Uniform lime mudstone

Intervals of lime mudstone lacking both the mottling and partings that distinguish the two preceeding lithofacies are relatively unimportant. They are thin and medium bedded, usually with undulating bedding planes. Lacking distinctive structures that could withstand complete dolomitization, they are unidentifiable in the dolomitized state and are described as crystalline dolomites.

Fenestral lime mudstone

The bulk of fenestral ("bird's-eye") fabric is associated with either cryptalgal laminites or pale-pellet grainstones, in which cases the containing strata are assigned to one or other of these lithofacies. Nevertheless, the succession contains minor intervals of both pale and dark lime mudstones with well-developed, spar-filled fenestrae that cannot be assigned to either of these lithofacies. These are assigned to the fenestral lime mudstone lithofacies.

Fenestral fabric has generally survived dolomitization well. It is, in fact, commonly more obvious in dolomite than in the calcitic precursor, because of colour differentiation between white ex-fenestrae and dark ex-matrix. Units of pale-pellet grainstone that have suffered complete dolomitization may have been assigned to the fenestral lime mudstone lithofacies because, of the primary fabric elements of the rock, only the fenestrae, if any, are likely to be recognizable.

Ribbon-bedded lime mudstone

The ribbon-bedded lime mudstone lithofacies is seen only in the most westerly exposures of the Cathedral, Eldon, and Pika formations and their equivalents. It superficially resembles the parted lime mudstone facies, with the obvious distinction that the dolomite partings between thin beds or laminae of lime mudstone are notably regular and planar, or smoothly curviplanar, and do not "invade" the adjoining mudstone, as do those of the parted lime mudstone lithofacies (Figs. A-25, A-26). The grey to black weathering lime mudstone strata in a given exposure are notably uniform in thickness, mainly 1 to 2 cm, but locally up to 3 cm. The yellow-grey to orange weathering dolomite partings range from less than 1 mm to nearly the thickness of the adjoining lime mudstone beds or laminae; where the partings are thick, they are themselves finely laminated. In a few occurrences, dolomite laminae are missing.

Much of the lime mudstone is true micrite, with grain size modes 4 μm and less. The micrite is commonly interrupted by thin laminae of calcisiltite. The limestone is generally dolomitic, with dolomite grains and crude rhombs with a modal diameter of about 20 μm. It is also siliceous, with diffuse secondary chalcedonic silica, and up to 15 per cent authigenic feldspar. Clumps and "clouds" of minute pyrite grains are widespread. The material of the partings is dolomite and calcareous dolomite of 20 to 30 μm grain size, usually with a much higher content of both argillaceous and carbonaceous matter than the associated lime mudstone.

The facies is normally unfossiliferous. Primary structures consist of slim lenses and laminae of calcisiltite (some of which show micro-loadcasts, flame structures, and incipient pull-apart structures), and low-angle scour surfaces overlain by a few intraclasts (Fig. A-26). Organic burrows are absent. Slumped zones and penecontemporaneous overfolds are widespread; ribbon-bedded lime mudstone forms the clasts of major debris flows directed into the open basin from the platform margin (Figs. A-27, A-28). The composition, structures and association of this lithofacies are identified with the "black lime mudstone" facies of Cook and Taylor (1977), and the "peri-platform ooze" of Schlager and James (1978). The ribbon-bedded lime mudstone facies has not been observed in a completely dolomitized state.

Calcisiltite

Units of limestone interpreted as calcisiltite are recognized as a distinct facies only where they are more than 10 ft (3 m) thick, and thus can be separated from the parted lime mudstone lithofacies on graphic plots. In thin sections or acetate peels, the calcisiltite texture is distinguished from microspar by its uniformity of grain; typically, the grain size mode is less than 16 μm. In the field, the presence of crosslamination is diagnostic.

The calcisiltites are thin bedded, usually with dolomitic partings, and carry numerous burrows, mainly dolomitized but locally filled with sparry calcite. Lag concentrates of trilobite and chitinous brachiopod fragments are common. Well sorted dark brown pellets and quartz silt are more common than in the parted lime mudstone lithofacies (Figs. A-29, A-30).

Upon complete dolomitization, the calcisiltite lithofacies becomes indistinguishable from the dolomitized, parted lime mudstone lithofacies.

Wackestone group and derived dolomites

Skeletal wackestone

Skeletal wackestone is an unusual lithofacies in the deposits of the inshore basin, where it is limited to rare thin beds in the Mount Whyte and Stephen formations, and the lower Pika Formation, whose skeletal beds are predominantly grainstone and packstone. It is prominent only in the proximal deposits of the open basin, notably the Amiskwi Member of the Stephen Formation, and in the Waputik Member on the inshore flank of the platform rim.

Skeletal wackestone occurs in laminae, thin beds, and rare medium beds, associated either with parted lime mudstone or with shale. Skeletal material is exclusively of trilobite origin in some beds, but trilobites, echinoderms and, less commonly, hyolithids are associated in others (Figs. A-31, A-32). Skeletal wackestone forming a supporting matrix for algal oncoids is relatively common.

The matrix of wackestones from the inshore basin differs from that of the open basin deposits. The former shows no sign of skeletal origin, whereas the latter consists largely of finely comminuted skeletal material, and resembles the matrix "paste" of many upper Paleozoic limestones. This difference is a possible criterion for separating limestones of basinal and platform origins in Cambrian sequences.

Intraclast wackestone

The distinction between intraclasts and pebbles is artificial but useful. With certain exceptions, particles smaller than 4 mm are called intraclasts, and larger ones are called pebbles, cobbles, or boulders (see under "Rudstone and derived dolomite", below). The exception is that particles obviously derived from an immediately underlying bed, and lacking evidence of significant transport, are called intraclasts, regardless of their size. Rocks with a significant content of pebbles, cobbles, or boulders are called rudstones.

If intraclasts are indicators of high-energy conditions, as is widely maintained, then the existence of intraclast wackestones is anomalous. Such rocks are rather common in association with the parted and burrow-mottled lime mudstones of this study. The intraclasts are consistently composed of lime mudstone. Two types of intraclast are seen, and are mutually exclusive. One type is well rounded and more or less spheroidal; the other is irregular, nonrounded and typically embayed (Fig. A-33). The two intraclast types are equally difficult to account for in a fundamentally mud-depositing environment (intraclasts associated with erosional surfaces in the parted facies excepted). As an alternative to mechanical rounding, it is possible that the rounded "intraclasts" are nonlaminated (or not visibly laminated) algal oncoids, that is, products of accretion, rather than degradation. Such objects have, in fact, been identified here and there (Figs. A-34, A-55).

Two possibilities may be considered to account for the origin of the embayed intraclasts; they may result from solution corrosion, or they may be displaced fragments of a burrowed, cohesive surface. In either case, they are the remnants of a submarine hardground.

Oncoid wackestone

Strata composed of oncoids supported by a lime mudstone or skeletal packstone/wackestone matrix (Figs. A-35, A-36) are fairly common in association with burrowed and parted lime mudstones. They form thin and medium beds, or else thin zones, undefined by bedding joints, within thicker lime mudstone beds. A filamentous or microtubular texture is fairly common within the oncoids.

The presence of oncoids (necessarily, free rolling objects during their growth) in a supporting mud matrix implies that the oncoids, during growth, were objects of low bulk density, capable of being moved by the feeble water-movement in a mud-depositing environment. The alternative explanation, that oncoids and lime mud were mixed during mass movement, is not supported by companion features, such as slump folds, whose presence would be expected in such a case.

Dolomitized products

In some, but by no means all, modes of dolomite replacement, dolomite grains bounded by the outlines of skeletal particles may permit recognition of dolomitized skeletal facies. Rarely, however, is preservation of primary texture complete enough to permit distinction between, for example, skeletal ex-wackestone and ex-packstone.

Relict oncoids and intraclasts are recognized in dolomites commonly enough to suggest that their preservation as dolomite with a colour and texture different from that of their matrix may be the rule rather than the exception. With such coarse particles, the distinction between matrix support and grain support, and hence between wackestone and packstone, can usually be made with some confidence.

Grainstone/packstone group and derived dolomites

Grainstone and packstone have not in general been distinguished in lithological descriptions. This is in part because of the difficulty in distinguishing one from the other in the field, and in part because, in virtually all of the packstones, there is evidence of a subsequent filling, by finer sediment, of void spaces in beds deposited originally as grainstone.

Pellet grainstones

The distinction between pellets that are dark brown and those that are cream to white (on a moistened, acid etched surface) is an important one. The two classes of pellets appear to have disparate origins, and rarely, if

ever, occur side by side in the limestones studied. The distinction between dark pellets and pale pellets is recognized here in lithofacies nomenclature.

Dark-pellet grainstone

This rock type (Fig. A-37) occurs as beds not normally more than a few centimetres thick, chiefly associated with the burrow-mottled lime mudstone and, to a lesser extent, the parted lime mudstone lithofacies. The dark pellets characteristically are very well "sorted" and largely of uniform ovoid shape, with diameters of 30 to 40 μm and lengths up to 65 μm. They are composed of micrite that has resisted grain growth (presumably because of its organic content) and hence are recognizable in rocks that are substantially recrystallized. Most are almost certainly true fecal pellets. In the dark-pellet grainstones, the only type of cement observed is equant sparry calcite. The only primary structure observed is rare crosslamination. Dark-pellet grainstone tends to occur within units that also contain intraclast grainstones. It has not been recognized in dolomite.

Pale-pellet grainstone

Pale-pellet grainstone (Figs. A-38, A-39) usually occurs as thick, massive units devoid of primary structures. These units weather a paler grey than any of the other carbonate lithofacies. Pale pellets, although rounded, are less regular in shape than dark pellets, and usually less well sorted, with diameters of 30 to 50 μm and lengths of 60 to 100 μm. They display a consistent tendency to merge with one another so that, in thin section, areas of clearly defined pellets with sparry cement intergrade with areas appearing superficially to be merely pale micrite, except for scattered, cusp-shaped "eyes" of sparry calcite limited by the curved margins of pellets. This appears to be the Bahamian "grapestone" phenomenon (Illing, 1954). Only equant cements have been observed in pale-pellet grainstone. A weakly developed fenestral texture is common, and clumps of pale dolomite crystals are usually seen. Pale-pellet grainstone is associated with cryptalgal laminite and burrow-mottled lime mudstone, and much of the cryptalgal laminite studied microscopically is made up of pale pellets. Dolomitization has altered pale-pellet grainstone into distinctive, nearly white, uniform, equicrystalline dolomite. Pale-pellet grainstone is also the precursor of most megacrystalline and stromatactoid dolomite.

Skeletal grainstone/packstone

For reasons given above, packstones in which the framework consists mainly of skeletal grains have not in general been distinguished from similar grainstones in the routine descriptions of measured sections.

Trilobite and echinoderm fragments account for most of the skeletal grains and either may predominate in a given specimen. Hyolithids are prominent in the Peyto limestone, and sparse in the Mount Whyte and Cathedral formations. Fragments of calcareous and/or chitinous brachiopods are, at most, minor constituents, and are commonly lacking. Hockley (1973) reported rare archaeocyathid fragments from the Peyto, and rare gastropods and calcareous sponges from the Mount Whyte. The skeletal grains are typically immature in shape (Figs. A-40 to A-43), but echinoderm fragments rounded by abrasion are encountered in a few beds (Figs. A-43 to A-45). The sheet-like fragments of trilobite carapace did not, of course, undergo significant rounding, but responded to prolonged agitation by progressive comminution. The sheathing of skeletal grains by successive coats of calcium carbonate (?aragonite), now seen as calcite with radial-fibrous habit, has occurred widely. This process initially created superficial ooids or "pseudo-ooids"; in advanced stages, ooids with skeletal nuclei were formed (Fig. A-46). Rocks containing such coated grains are designated oolitic. For some reason, possibly the transverse-fibrous fabric of the arthropod skeleton, the oolitic coatings formed preferentially on trilobite fragments; thus, the association of coated trilobite grains with uncoated echinoderm fragments is common.

Peripheral micritization of skeletal grains is generally inconspicuous or absent.

Accessory particles in the skeletal grainstone/packstone lithofacies are: ooids (common), intraclasts (common), quartz sand or silt (fairly common), and glauconite pellets (very rare).

Cementation in the grainstones is variable. Both radial-fibrous and blocky calcite cements are common, and occur side by side in some specimens. Syntaxial overgrowths on echinoderm grains are widespread. Micrite cement has been observed only in traces; where observed, it is the earliest cement.

Decimetre-scale beds of grainstone and packstone are typically tabular at the scale of individual outcrops,

but centimetre-scale layers are generally lenticular. Grainstones and packstones commonly rest on an erosional base and incorporate a few intraclasts of the underlying bed. Little internal structure is visible.

Dolomitization of skeletal packstone and grainstone has generally resulted in relatively coarse grained (i.e., fine or medium crystalline), pale dolomite. Usually, sufficient dolomite crystals have inherited the shape of skeletal grains to reveal the skeletal character of the primary calcitic sediment. Rarely, the primary texture is well preserved as dolomite (Fig. A-47).

Ooid grainstone and packstone

Ooid grainstones and ooid packstones are not distinguished from one another in section descriptions, for reasons given above. If the oolite beds selected for petrographic examination are a representative sample, packstone is more common than grainstone.

Destructive postdepositional processes have rarely progressed to the extent that the identification of ooids is in much doubt. With certain exceptions, only bodies with distinct concentric and/or radial structure (Figs. A-48, A-49) have been so identified. A nucleus, if present, provides further confirmation. The preferential replacement of ooids by a small number of large dolomite crystals, or by a single crystal, is so widespread that a scattering of such crystals strongly suggests the presence of ooids, and leads to closer inspection, which usually reveals traces of perfect spheres. Where these criteria are met, the former existence of ooids is inferred. Finally, in rocks that are strongly recrystallized or completely dolomitized, a population of very well sorted and highly spherical objects, usually revealed only by their pale brown pigmentation (Figs. A-50 to A-52), can scarcely be other than a population of ooids, and is so interpreted where it occurs.

Once experience with the rock suite considered here has been gained, there is rarely any difficulty in distinguishing between true ooids and the less regular, less well sorted, darker oncoids that nowhere display radial structure, and in which the cell walls or sheaths of filamentous or tubular algae are commonly preserved.

Ooid grainstones have blocky cements in some instances and radial-fibrous cements in others; "over-packed" fabrics with little cement also occur. Among the ooid packstones, and those grainstones with patches or pockets of matrix, calcisiltite is more common than lime mud as matrix. Very fine grained skeletal wackestone is also common as matrix.

Ooids were very vulnerable to dolomitization, and, without exception, were dolomitized before the sparry calcite cement. A few examples of calcitic ooids in a dolomitized matrix occur, leading to the interpretation that the matrix was dolomitization-prone calcisiltite.

The Middle Cambrian oolites of the region occur in units a few centimetres to one or two metres thick. While some of these units, especially the thinner ones, are internally structureless, others are thin to medium bedded in an irregular to almost nodular style. Such irregular bedding is not easily reconciled with the assumed mode of accumulation of grainstones; that is, grain by grain, as bedload. Such a process would be expected to produce crossbedding in these relatively coarse grained rocks, but crossbedding is rare, although a few of the thicker oolite beds are topped by subdued wave forms consistent with a traction bedload origin. Destruction of current bedding by burrowing might have occurred, but no obvious burrows are retained in the oolite beds. Alternatively, the irregular to nodular bedding may be a postdepositional feature.

Oncoid grainstone and packstone

Cryptalgal oncoids are widespread in the succession. They range in diameter from a few millimetres up to the six-centimetre giants of the Peyto Formation, and occur in part as constituents of grainstones and packstones.

The packstones have various matrices: lime mud, calcisiltite, skeletal wackestone, and skeletal packstone. In many instances, the presence of shelter cavities proves that the matrix postdates the framework of oncoids. Where the matrix is skeletal, there is a strong tendency for only trilobite remains to be represented. Grainstones consisting of oncoids and cement only (Fig. A-53) are rare. Much more common is an oncoid-supported framework infilled with a matrix of skeletal grainstone/packstone, or "floating" oncoids in skeletal grainstone/packstone of much finer grain (Figs. A-54, A-55).

Oncoids commonly have survived dolomitization as identifiable objects, possibly because of their tendency to become dolomitized before their matrix. Identification of the primary character of the dolomitized matrix is not usually practicable, however.

Intraclast grainstone/packstone

The term intraclast is applied in this report mainly to particles of limestone less than 4 mm in diameter (excepting pellets, see under "Pellet grainstone" above), but also to particles of any size obviously derived from an immediately underlying bed and lacking evidence of significant transport.

One type of intraclast grainstone, characterized by dark intraclasts (Figs. A-56, A-57), is mainly associated with units of lime mudstone. Another, less common type is characterized by cream to nearly white intraclasts; this type is associated with pale-pellet grainstone.

A scattering of dark intraclasts is common in a number of other rock types, notably skeletal grainstone and packstone (Figs. A-40, A-45, A-47, A-55).

Rudstone and derived dolomite

Rudstones are limestones characterized by their content of particles of pebble (4 to 64 mm) or larger size (Klovan and Embry, 1971). In this report, only those rocks having 25 per cent or more of such particles are classed as rudstones.

Considered in detail, the Middle Cambrian rudstones of the region are varied in both lithology and associations. A very complex and possibly useful classification could be erected, but at the level of detail of this report, and in view of the fact that the data were mainly gathered before the subtle differences among rudstones were appreciated, it is practicable here to assign all rudstones to one of only four categories: intraclast grain/rudstone, floatstone, flat-pebble rudstone, and equant-pebble rudstone.

The rocks herein termed intraclast grain/rudstone are exclusively associated with units of lime mudstone and burrowed lime mudstone. They consist of roughly centimetre-scale mudstone intraclasts, well rounded or less commonly embayed (Figs. A-58, A-59), which are cemented by sparry calcite. They occur as structureless, planar, thin and medium beds. Weathering of these beds does not produce an obvious surface contrast between intraclasts and cement; thus, they can easily be overlooked in the field.

Two kinds of floatstone (Klovan and Embry, 1971) occur. Oncoid floatstones with lime mud matrices (Figs. A-34, A-35) are associated with the various lime mudstone lithofacies, and are common in the lower parts of shallowing-upward cycles. Oncoid floatstones with skeletal matrices (Fig. A-36) occur more commonly as interruptions of shaly units. Intraclast floatstones are simply intraclast wackestones with larger intraclasts. They are found mainly within units of parted lime mudstone (Fig. A-33). The intraclast floatstones that occur in shaly formations appear to be mostly submarine hardgrounds (Figs. A-60 to A-63).

The rocks herein termed flat-pebble rudstone (Figs. A-64, A-65) are strongly associated with the parted lime mudstone facies, particularly units containing shale beds, and with "clearing-upward" cycles. Flat-pebble rudstones consist of tabular or discoid, uncoated pebbles of lime mudstone or calcisiltite, obviously derived from immediately underlying beds. Nearly all examples that have been carefully studied are packstones rather than grainstones; calcisiltite (with accessory quartz silt in some instances) is the principal matrix. Matrices are commonly dolomitized, with the consequence that weathering produces an obvious contrast between intraclasts and matrix. Pebble fabric is predominantly bedding parallel, less commonly imbricated. An "edgewise" fabric, with pebbles standing at a high angle to bedding, is rare, and limited almost entirely to the Tershishner Member of the Pika Formation. Flat-pebble rudstones commonly occur in lenses resting on an erosional base.

The beds herein termed equant-pebble rudstone occur only in shaly formations, where they either interrupt shale units or occur in the upper parts of "clearing-upward" cycles. They consist of blocky, embayed to well rounded pebbles of various limestone rock types, including compound pebbles (pebbles of rudstone), typically in a skeletal grainstone matrix (Fig. A-66). Commonly and perhaps generally, the pebbles carry a coating in which filamentous algal structure is locally preserved. Like ooid and skeletal grainstones, and in contrast to flat-pebble conglomerate and intraclast grain/rudstones, equant-pebble grainstones commonly have acted as substrates for algal stromatolites and thrombolites. The blocky and commonly embayed ("corroded-looking") shapes of the pebbles, the presence of compound and bored pebbles (Figs. A-63, A-66, A-67), the almost ubiquitous algal coatings, the characteristic skeletal infill, and the common erosion surfaces within beds, all suggest that the equant-pebble conglomerates represent submarine hardgrounds.

The rudstone fabrics described above have in general survived complete dolomitization, and in most occurrences the resulting dolomite can be related to one of the four categories described.

The rocks that I formerly termed "microconglomerate" (Aitken, 1966) consist of small pebble- and coarse sand-sized tabular clasts obviously created by fragmentation of the cryptalgal laminae with which they are associated. A more modern and appropriate term is "**flakestone**" (Tucker, 1977). Like the cryptalgal laminites, the flakes are pale, whether they are calcitic or dolomitic. Because flakestone/microconglomerate occurs exclusively in laminae, lenses, and very thin beds, overlying or interbedded with cryptalgal laminite, it is included with the laminite for purposes of graphic display.

Boundstone group and derived dolomites

Stromatolites and thrombolites

Stromatolites and thrombolites are "fixed bodies of cryptalgal origin" (Aitken, 1967), the former characterized by domed, parallel laminae, the latter by a nonlaminated, clotted fabric. The Middle Cambrian cryptalgal carbonate rocks of the region merit re-study, in the light of advances in stromatolitology made during the past ten years (e.g., Walter, 1967); such a study is beyond the scope of this paper.

A few generalizations can be made about the associations of stromatolites (Figs. A-68, A-69) compared to those of thrombolites (Figs. A-70, A-71). The former are prominent, the latter unrepresented, in association with unequivocal intertidal to supratidal lithofacies such as cryptalgal laminites. In such associations, both laterally linked (LLH) and nonlinked (SH) forms (Logan et al., 1964) occur, the linked forms tending to intergrade with cryptalgal laminites. Thrombolites are largely or entirely associated with lithofacies (skeletal and ooid grainstone, parted lime mudstone) for which a subtidal origin is inferred from other criteria, but well laminated stromatolites also occur, although less commonly, in such associations. The thrombolites occur mainly in simple, domal, loaf or tabular bolster-shaped forms. In some occurrences, the bolster-shapped thrombolites are so extensive as to appear as thick beds of clotted lime mudstone, unless traced laterally to their rounded or overhanging termination against bedded, particulate limestones (Fig. A-71).

The lamination of stromatolites is preserved during dolomitization, and the differentiation of stromatolites from thrombolites is thus usually straightforward in dolomites, even though the internal fabric of the thrombolites is normally destroyed.

Cryptalgal laminite[1]

Because cryptalgal laminites (Figs. A-72 to A-77) occur as limestone, dolomite, and interlaminated limestone and dolomite, all three of these mineralogical aspects of the laminites are lumped together in a single lithofacies. Criteria for the recognition of cryptalgal laminites have been summarized previously (Aitken, 1967). An additional field aid in their recognition in the present context is the colour of weathered surfaces, consistently very pale yellow to very pale grey. In thin sections or acetate peels, the distinctive "spongiostromatid" fabric (Figs. A-75 to A-77) is diagnostic. Fenestrae are commonly present.

Laminae of mat-chip breccia, the well named "flakestones" of Tucker (1977), are ubiquitous in association with the laminites studied, and therefore are considered to belong to the cryptalgal laminite lithofacies (Fig. A-74). Simple domal stromatolites of centimetre scale likewise are considered to be a normal part of the lithofacies, and are not plotted separately.

Crystalline dolomite group

Cryptic dolomite

Dolomites in which all useful traces of primary fabric have been destroyed are classified according to the crystallinity scale in the footnote to the "Burrow-mottled lime mudstone" section above.

Stromatactoid and megacrystalline dolomite

"Stromatactoid" dolomite (Aitken, 1966) appears to be a late, hypogene or hydrothermal facies from which virtually all trace of primary fabric has disappeared. It is characterized by an abundance of vuggy, lenticular to tabular bodies and laminae of coarse, white, space-filling dolomite crystals. The bodies are in many instances subparallel to bedding and undulose; elsewhere, they stand at angles of 26 to 60° to the plane of bedding, and parallel to one another. Harrison (1969) provided a complete description and illustrations.

[1]This work was virtually all carried out prior to the reclassification of blue-green algae to cyanobacteria. This reclassification rendered the term cryptalgal (Aitken, 1967) obsolete, to be replaced by microbial (e.g., Kennard and James, 1986). The obsolete term, however, permeates notebooks, specimen descriptions, explanations of columnar sections, and earlier publications by the author. It is retained here, therefore, for the sake of the unity of the work, while the appropriateness of the newer term is freely acknowledged.

Where limestone is traced along bedding into masses of stromatactoid dolomite, as for instance in roadcuts in Kicking Horse Pass, no primary structure that might be a precursor to the inclined bodies is visible.

Masses of white, megacrystalline dolomite, with crystals up to decimetre scale, are commonly associated with stromatactoid dolomite, and appear to represent an extreme development of the processes that produced the latter.

Stromatactoid and megacrystalline dolomites are spatially associated with dolomitized and undolomitized fenestral limestones and pale-pellet grainstones.

"Ex-particulate" dolomites

In most dolomitized sequences, some beds bear traces of a relict particulate fabric; that is, they are clearly not ex-mudstones, ex-calcisiltites, or ex-boundstones. On the other hand, there may be great uncertainty as to whether, for example, the grains were originally ooids, pellets, or intraclasts, and whether the grains were separated by cement or matrix. Such beds are referred to as ex-particulate dolomites.

Siliciclastic lithofacies

Shale and mudstone

In the course of this study, mudrocks received only field examination. The term shale is applied to argillaceous strata displaying lamination and/or fissility, while mudstone is reserved for nonfissile, nonlaminated rocks, these in general being highly silty and/or calcareous to dolomitic. The distinction is blurred in the more westerly sections, where weak slaty cleavage appears.

Where Cambrian mudrocks of the region have been examined mineralogically (e.g., Hockley, 1973; Palonen, 1976; McIlreath, 1977), illite is the dominant clay mineral, with some chlorite that is probably a low-grade metamorphic addition. Kaolinite occurs sporadically, and may be a product of Recent weathering.

Cambrian mudrocks studied in the mountain outcrops are mainly greenish grey and grey, less commonly olive and brown. Green and purple-red shales occur in the subsurface of the Plains in the Mount Whyte, Stephen, and Pika formations and equivalents; only in the Stephen Formation do these colours persist sufficiently far westward to appear locally in outcrops in the Front Ranges. The Snake Indian Formation contains red units in the Main Ranges, however.

Siltstone

The Middle Cambrian siltstones are white and green quartzose rocks, intergrading on the one hand with silty calcisiltite and on the other with silty mudstone. They contain only minor feldspar, mica and, locally, glauconite in addition to quartz, carbonate, and clay minerals. Shards of chitinous brachiopods are the only significant organic contribution.

Nearly all the siltstones are either ripple crosslaminated or thoroughly bioturbated, and very thin planar and lenticular bedding is the rule.

Sandstone

Sandstones encountered in this study are entirely quartzose sandstones associated with carbonate rocks. They form a miniscule proportion of the total column. Beyond this, no worthwhile generalization can be made, and the reader is referred to the descriptions of individual occurrences.

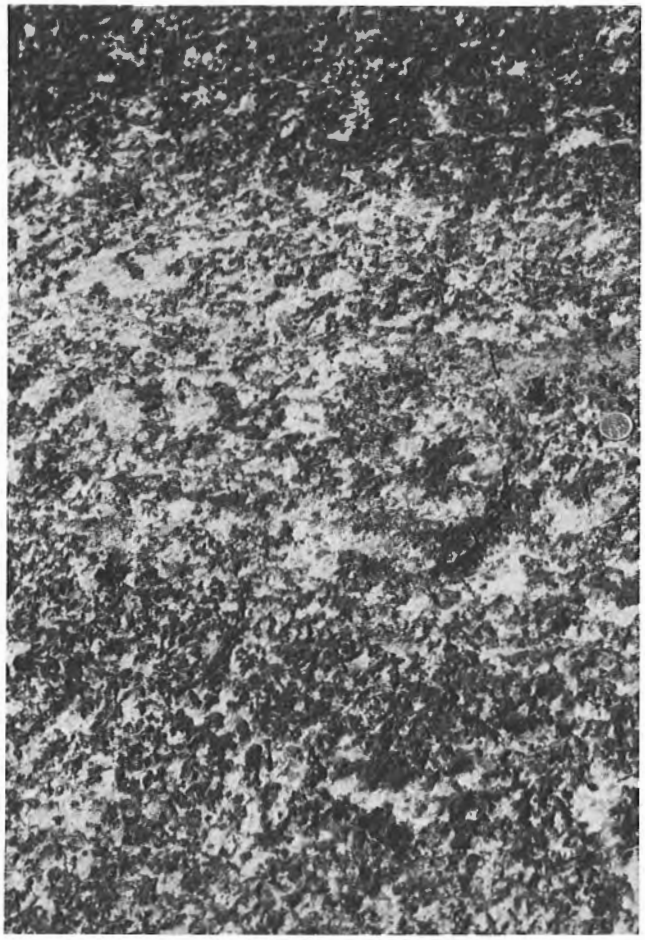


Figure A-1. *Burrow-mottled lime mudstone lithofacies, Cathedral Formation at Ross Lake (Section AC–172). Weathered outcrop, twenty-five cent coin for scale. ISPG photo 1569-13.*

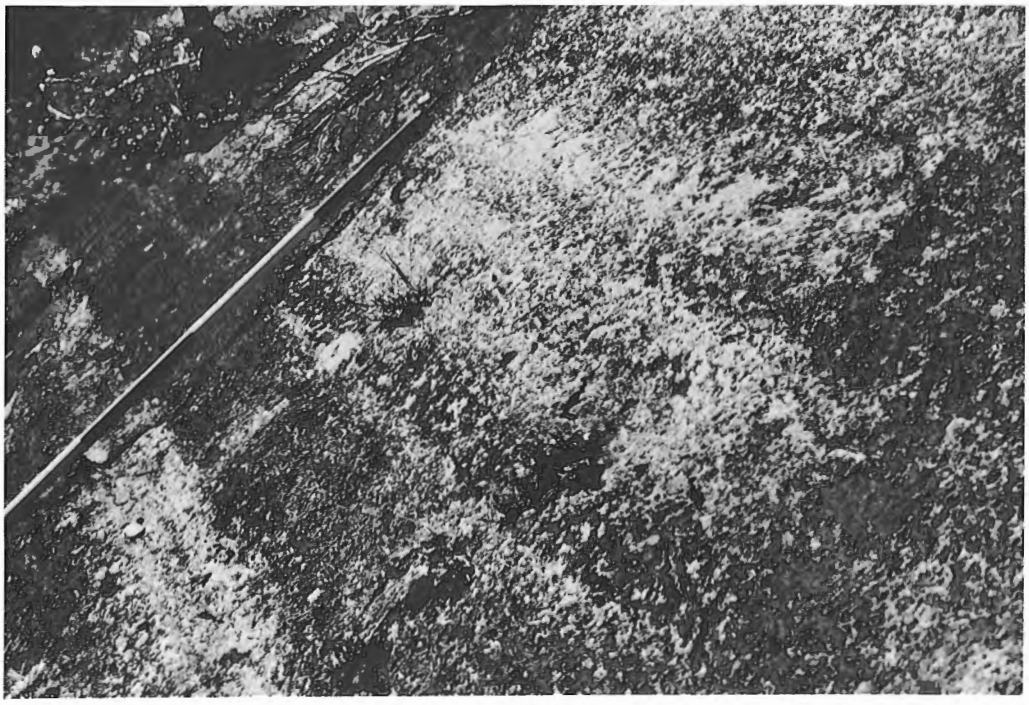


Figure A-2. *General view of the outcrop illustrated in Figure A-1. Bedding is revealed by variation in the content of burrows. Jacob's staff is graduated in feet. ISPG photo 1569-10.*

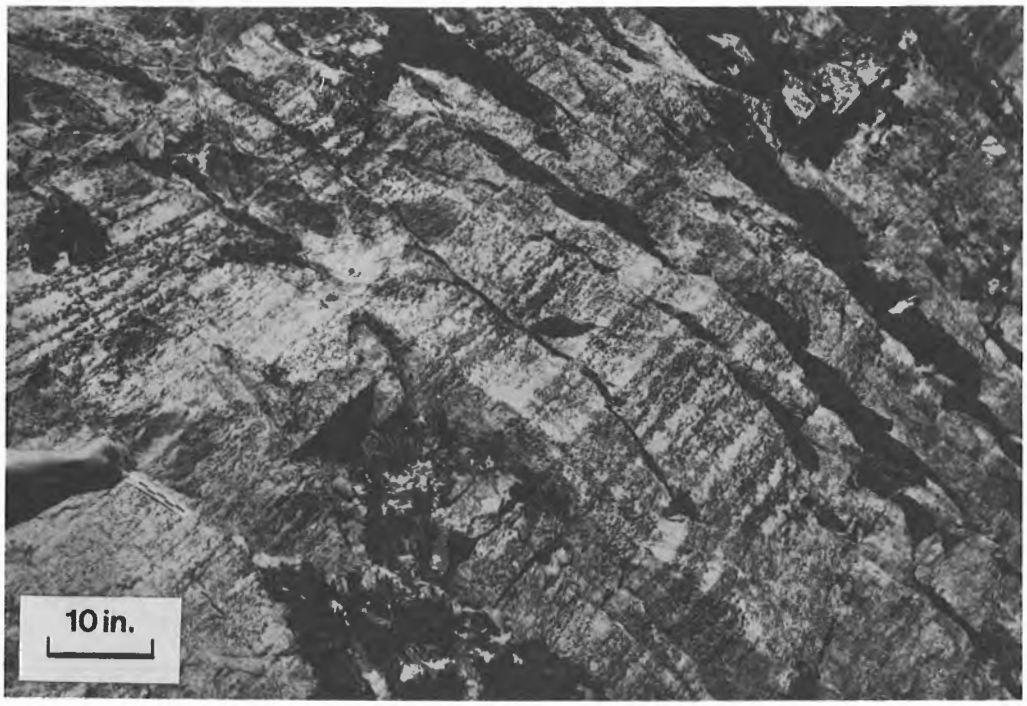


Figure A-3. *Burrow-mottled lime mudstone lithofacies, Eldon Formation, Arête Mountain (Section AC–96). ISPG photo 1762-1.*

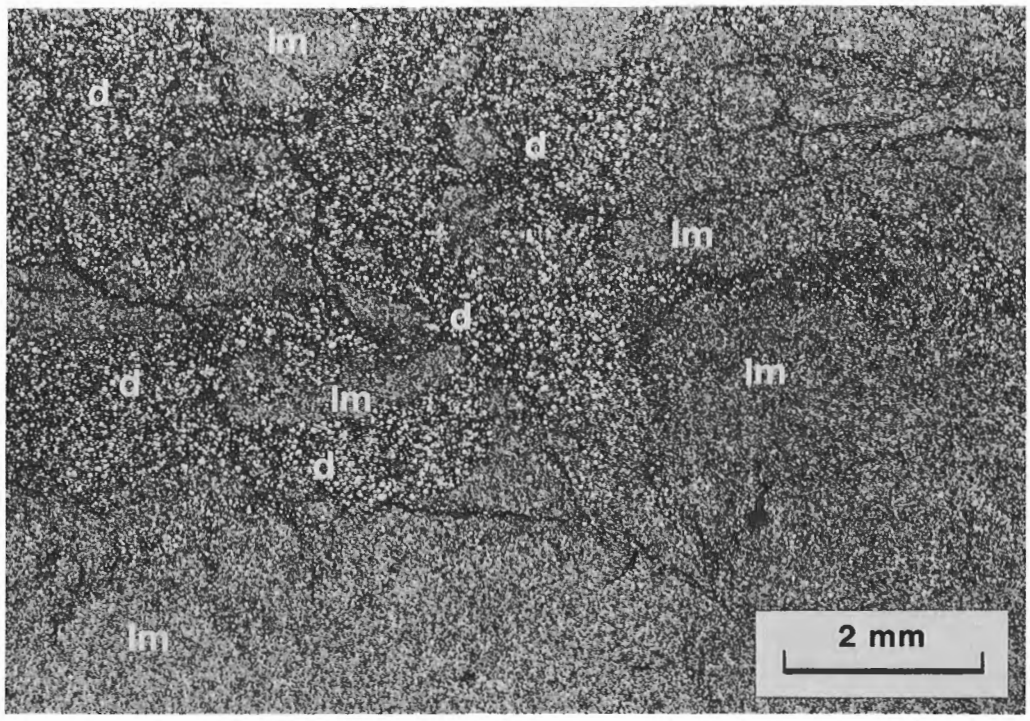


Figure A-4. *Burrow-mottled lime mudstone, Pika Formation, Windy Point (Section AC–39), North Saskatchewan River. Thin-section photomicrograph. lm–lime mudstone; d–dolomite. ISPG photo 760-26.*

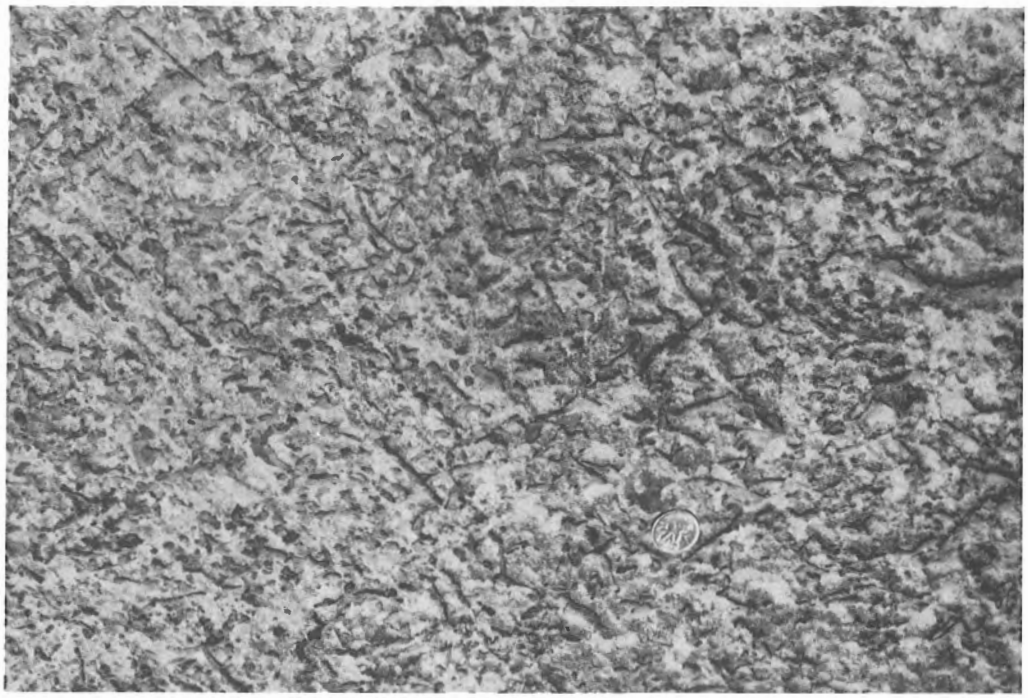


Figure A-5. *Burrow-mottled lime mudstone lithofacies, Eldon Formation, near Seebe; Loder's Lime Quarry; detail of weathered surface. Dolomitized burrows have weathered out in three dimensions. One cent coin for scale. ISPG photo 1569-11.*

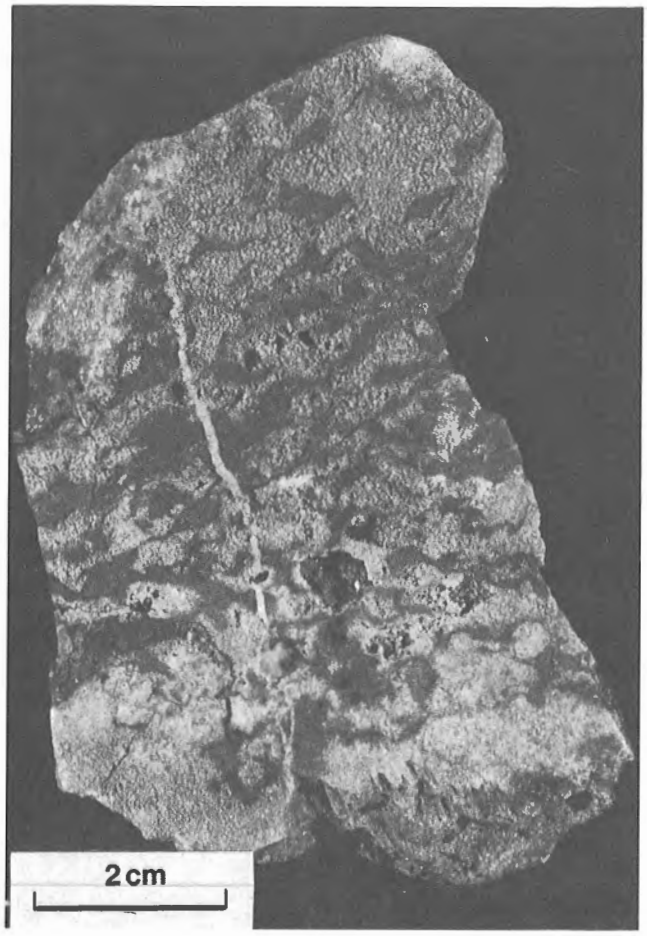


Figure A-6. *Dolomite, ex-burrow-mottled lime mudstone, Eldon Formation, Beauty Creek (Section AC–48). Polished slab. The patches of dark grey, very fine crystalline dolomite inherit the form of the early dolomitic mottling. ISPG photo 786-15.*

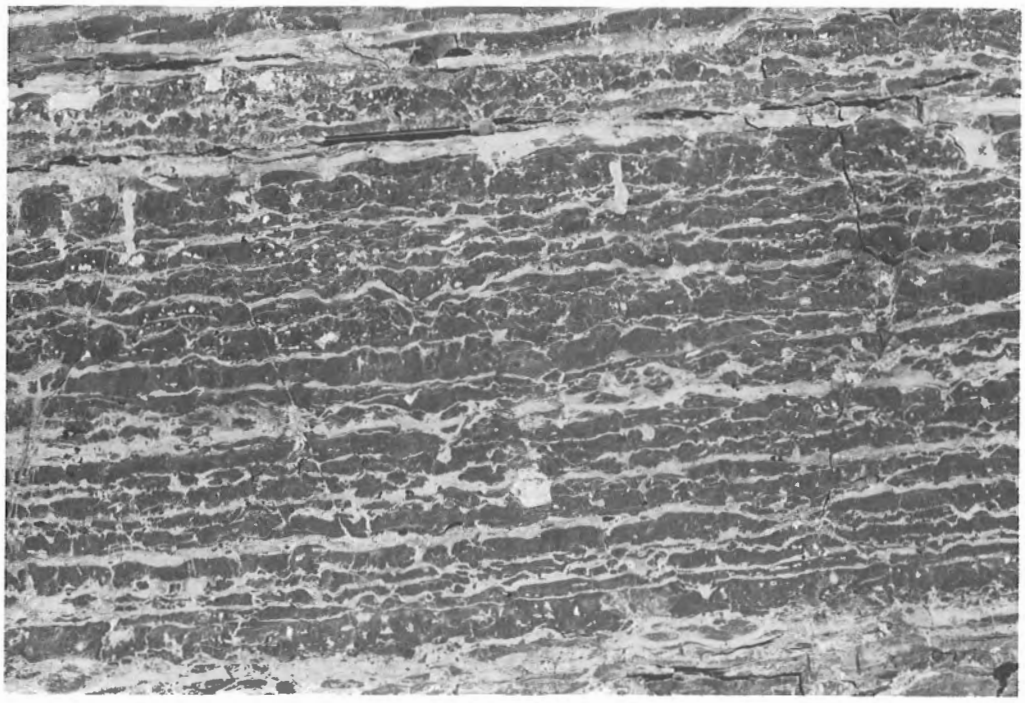


Figure A-7. *Outcrop of parted lime mudstone lithofacies, Pika Formation, Whitehorn Mountain section (AC–166), Mount Robson district. Pencil for scale. GSC photo 5-15-66.*

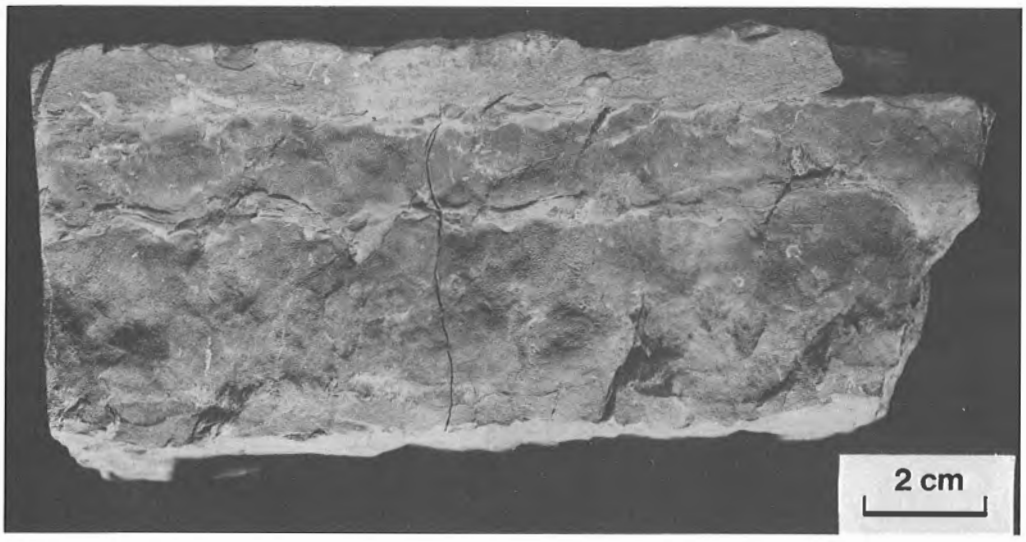


Figure A-8. *Parted lime mudstone from a roadside borrow-pit in basal Eldon Formation at Lower Waterfowl Lake. Hand specimen, weathered surface. ISPG photo 786-6.*

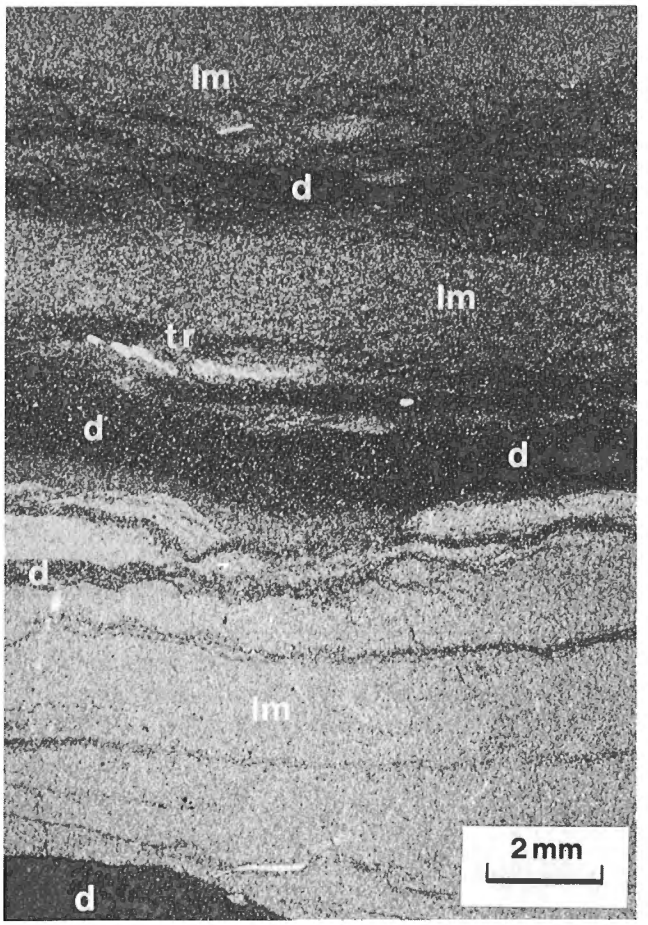


Figure A-9. *Parted lime mudstone, Waputik Member of the Stephen Formation, Kicking Horse Pass roadcuts (Section AC–123). Thin-section photomicrograph. lm–lime mudstone; d–dolomite; tr–section of a trilobite thorax. ISPG photo 760-53.*

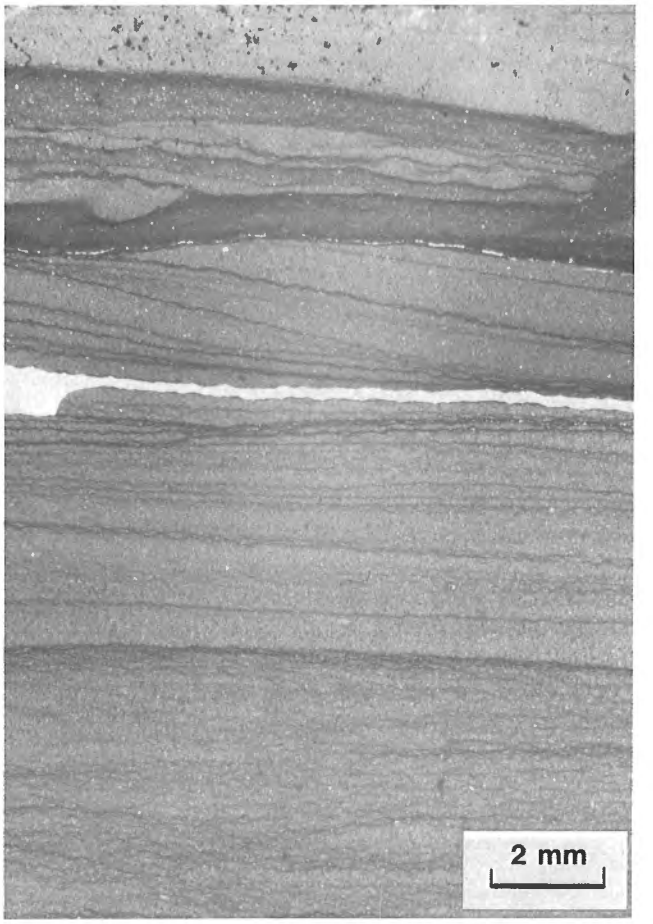


Figure A-10. *Calcisiltite of the parted lime mudstone lithofacies, Cathedral Formation, Mount Bosworth (Section AC–3). Thin-section photomicrograph. Note the fine crosslamination. ISPG photo 760-34.*

Figure A-11. *Dolomitized feeding traces on a bedding plane of the parted lime mudstone lithofacies, Pika Formation, Martin Lake (Section AC–139). GSC photo 4-17-65.*

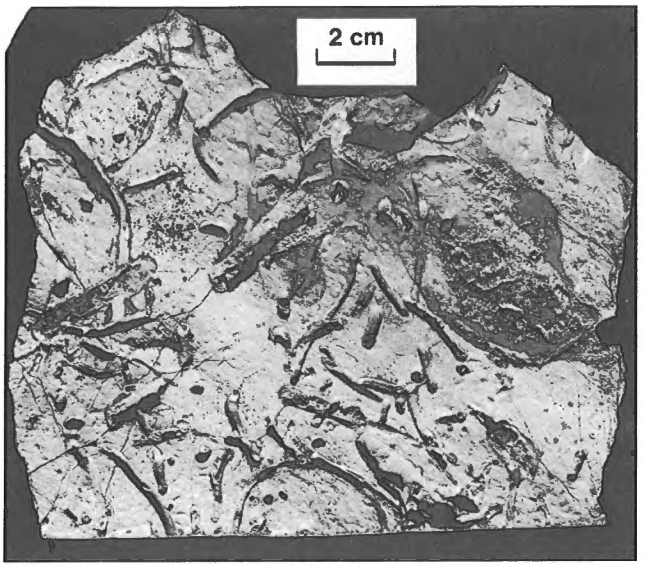


Figure A-12. *Feeding traces preserved as calcite. Same locality as Figure A-11. Dwelling burrows, normal to bedding, are also present. ISPG photo 786-2.*

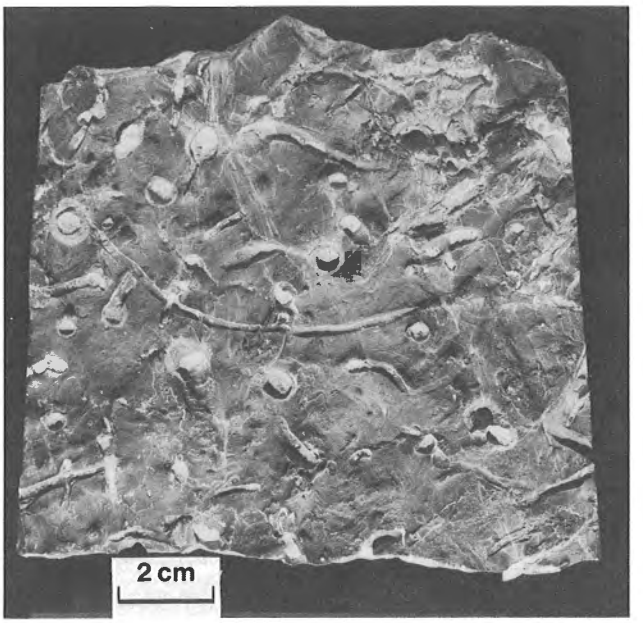


Figure A-13. *Feeding traces and dwelling burrows (dolomite), same locality as Figure A-11. ISPG photo 786-3.*

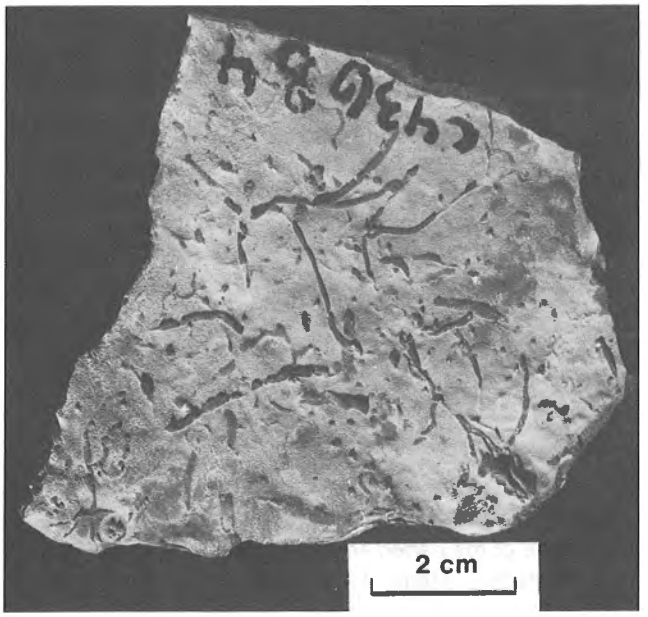


Figure A-14. *Feeding traces and (?)coprolites in parted lime mudstone, Stephen Formation, Beauty Creek (Section AC–48). ISPG photo 786-11.*

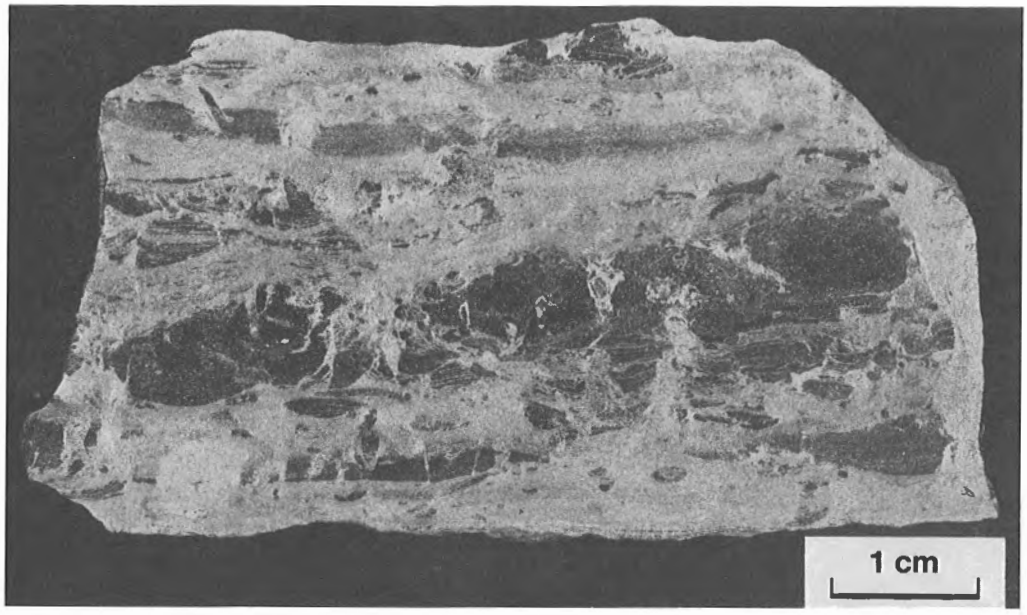


Figure A-15. *Parted lime mudstone, Cathedral Formation, Beauty Creek. Etched slab. Note that dolomite (pale) occurs not only as a replacement of certain depositional layers and burrows, but also as replacement veinlets unrelated to primary structures. At the base of the specimen, calcitic burrows (dark) lie in a dolomitized parting. ISPG photo 786-26.*

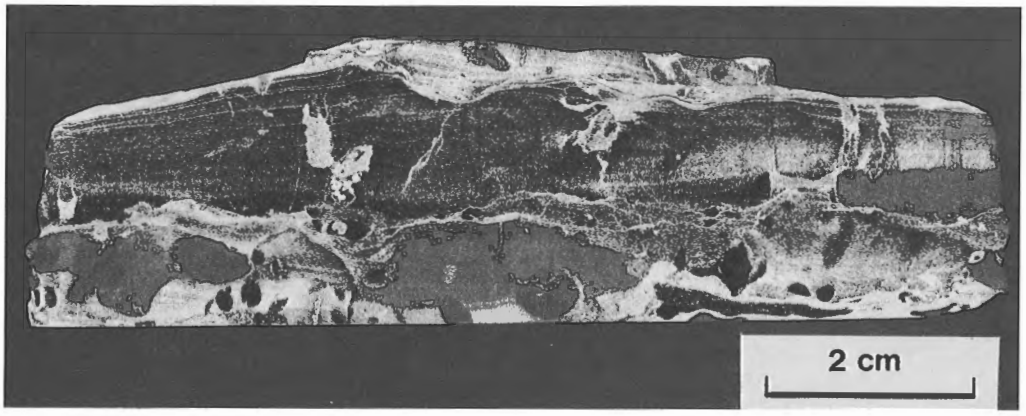


Figure A-16. *Calcisiltite of the parted lime mudstone lithofacies. Same locality as Figure A-15. Etched slab. ISPG photo 786-23.*

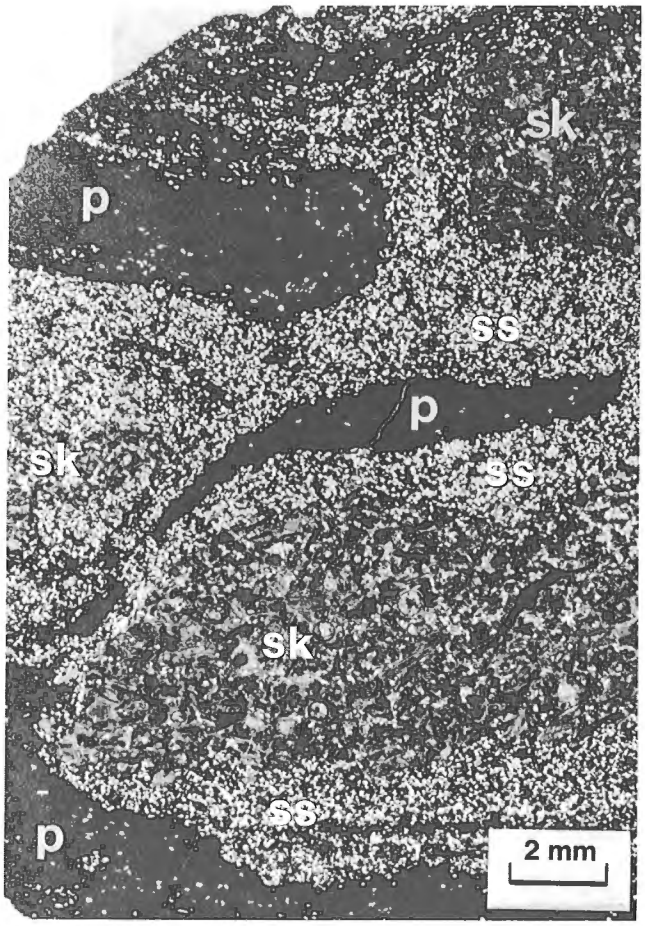


Figure A-17. *Sandy, skeletal ooid-pellet packstone displaying the structure of parted lime mudstone lithofacies, Naiset Formation, Mount Field. Thin section photomicrograph. This uncommon rock reinforces the point that the "parted" fabric results from the alternating of two distinct sediment types. The observed disruption of primary layering (by differential compaction?) is commonplace in the parted lithofacies. p–parting material (argillaceous dolomite); sk–skeletal packstone; ss–sandstone laminae, disrupted. ISPG photo 760-46.*

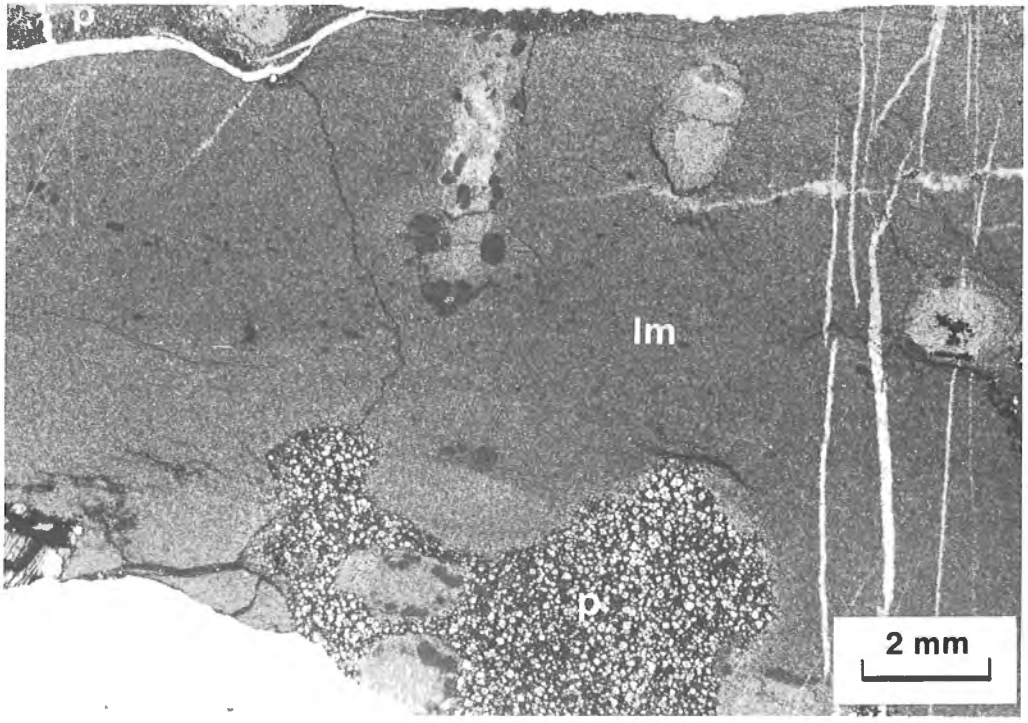


Figure A-18. *Parted lime mudstone, Waputik Member of the Stephen Formation, Kicking Horse Pass roadcuts (Section AC–123). Thin section photomicrograph. Note that sectioned feeding traces occur both in dolomitized parting material (p) and in lime mudstone (lm). ISPG photo 760-33.*

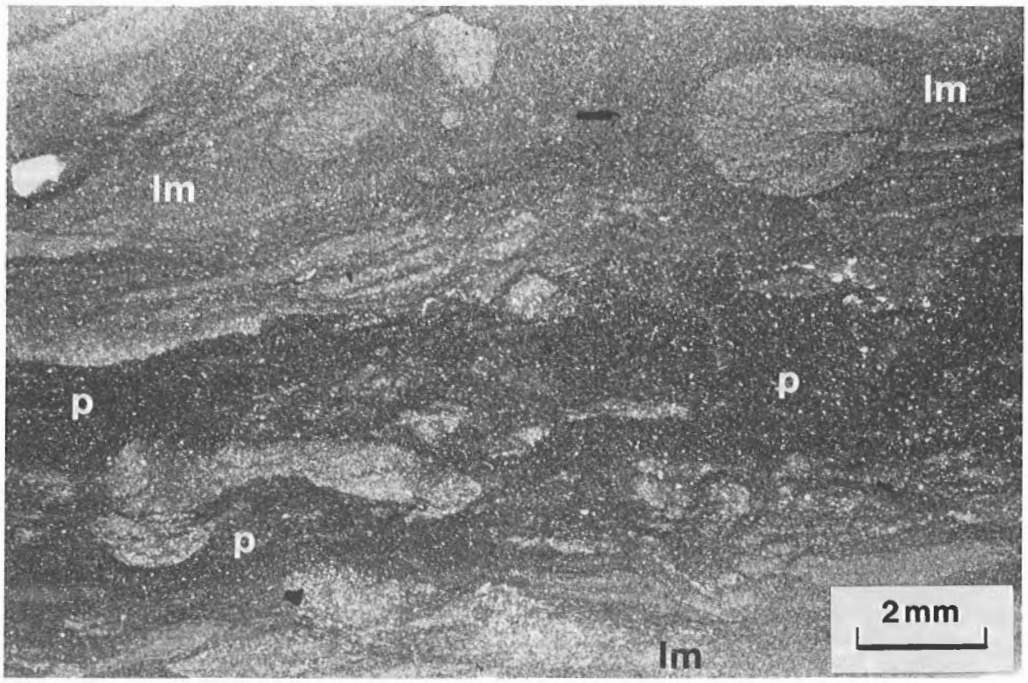


Figure A-19. *Differential compaction around the early calcite filling of a burrow, same bed as Figure A-18. Thin section photomicrograph. ISPG photo 760-52a.*

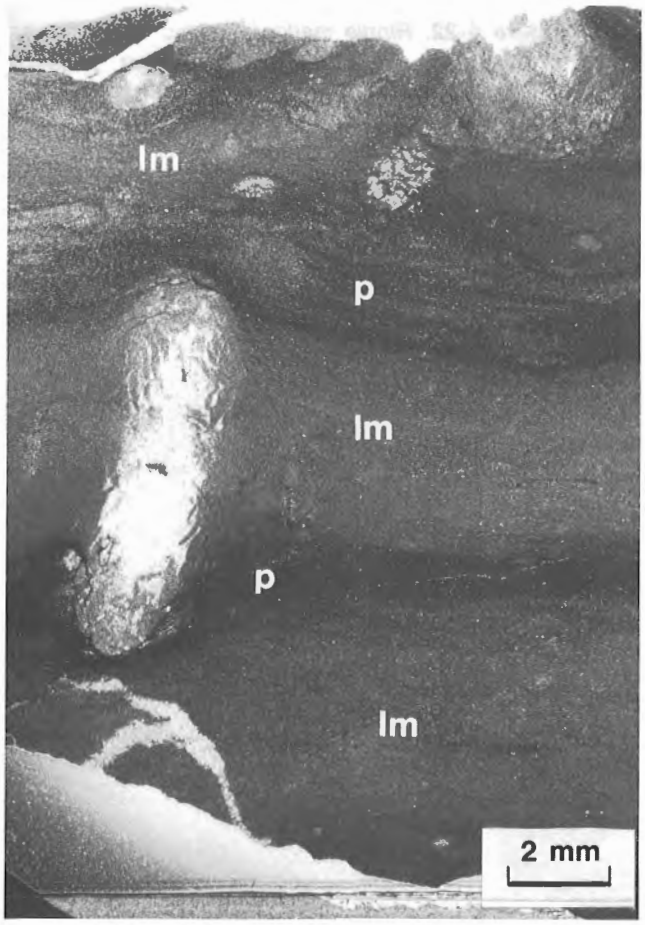


Figure A-20. *Details of the filling and cementation of burrows in parted lime mudstone, Pika Formation, Windy Point (Section AC–39), North Saskatchewan River. Thin-section photomicrograph. Note the long, vertical burrow (centre) with partial backfill of pellets, presumably fecal, as well as void-filling sparry calcite. ISPG photo 760-52.*

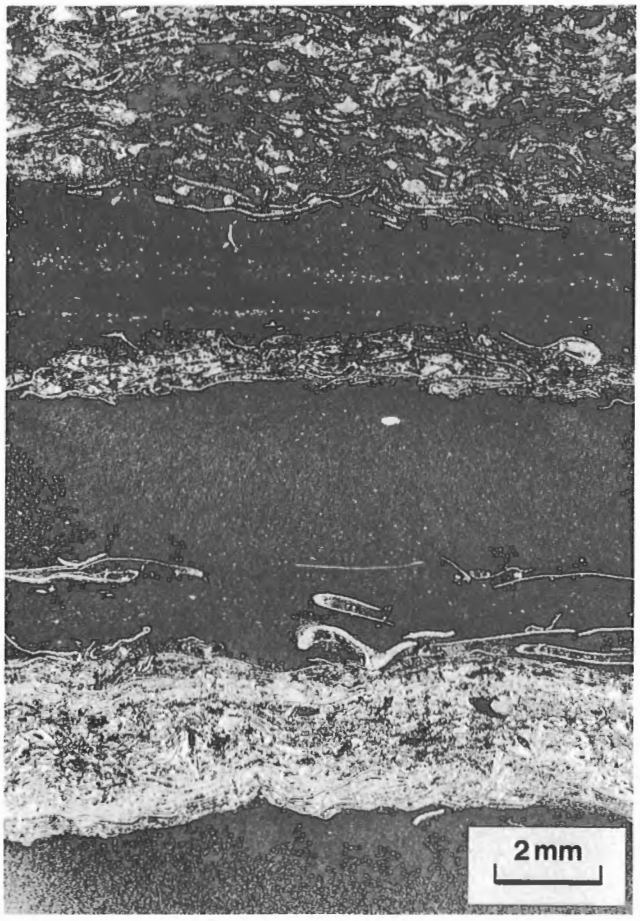


Figure A-21. *Laminae of trilobite coquina (lag deposits?) in parted lime mudstone, Wapta Member of the Stephen Formation, Mount Stephen (Section AC–114). Thin-section photomicrograph. ISPG photo 760-31.*

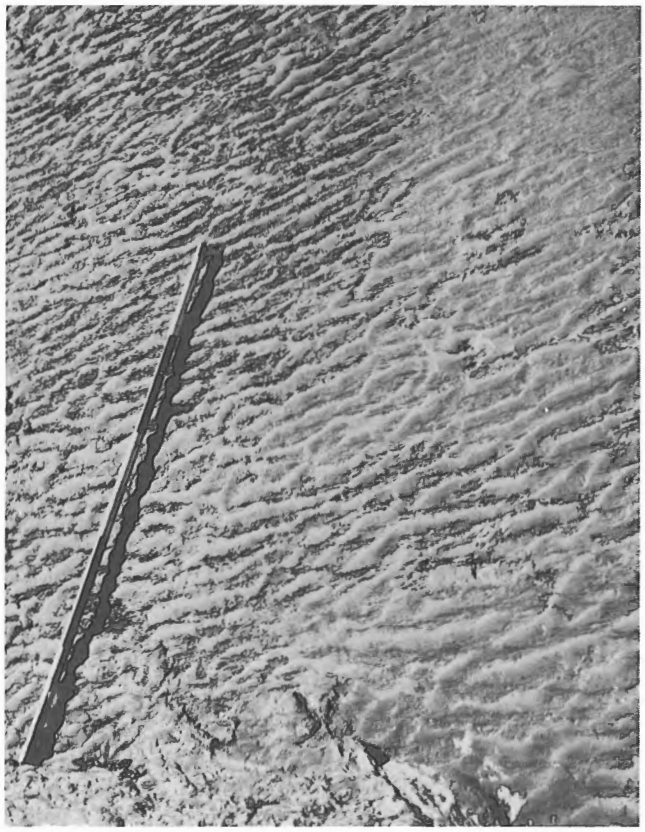


Figure A-22. *Ripple marks in parted lime mudstone lithofacies, Pika Formation, Mount Whiterose (Section AC–100). GSC photo 1-8-63.*

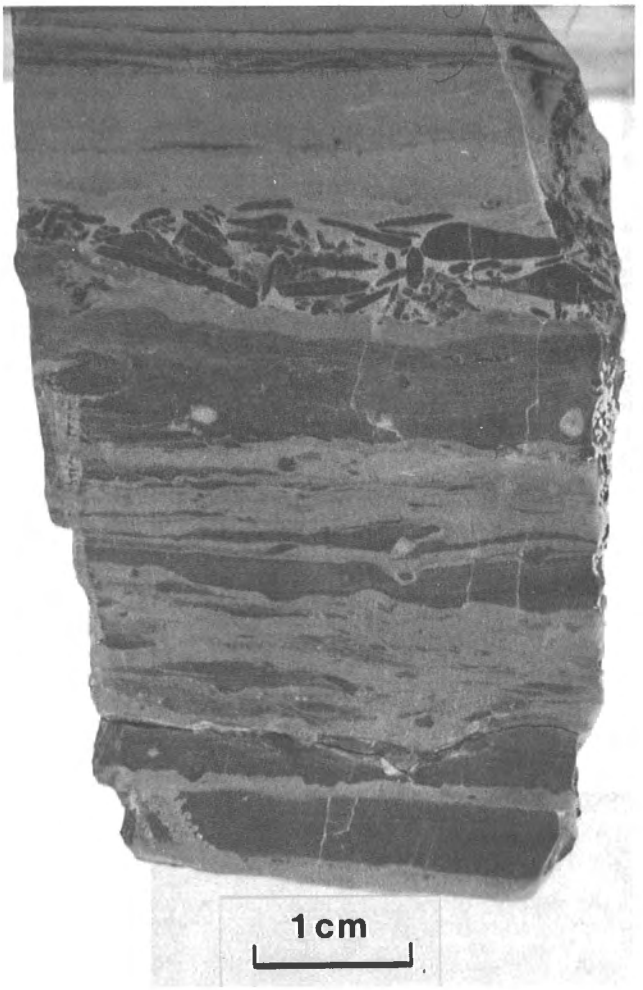


Figure A-23. *Parted lime mudstone, Pika Formation, Mount McDonald (Section AC–94); note the mudstone intraclasts in a dolomite parting. Etched slab. GSC photo 2-2-65.*

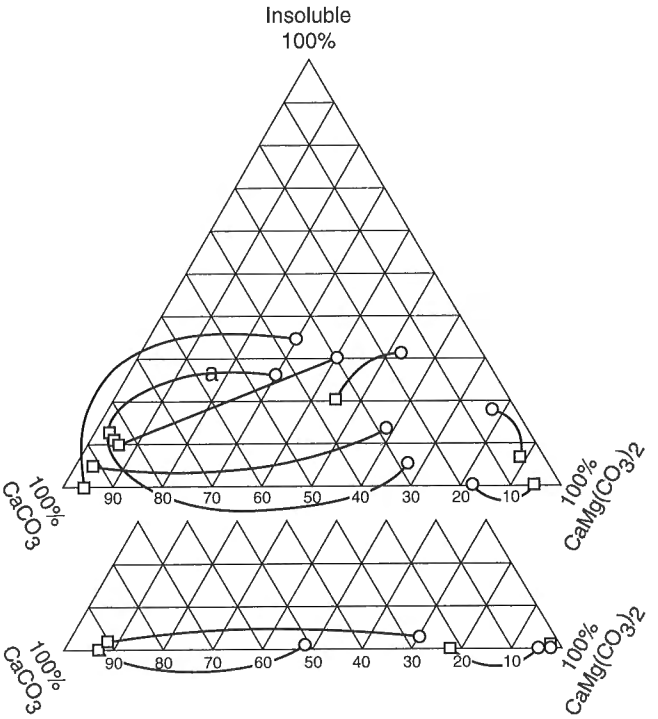


Figure A-24. *Triangular plot of compositions of representative burrow-mottled and parted lime mudstones. Insoluble content determined gravimetrically; ratio of calcite to dolomite by X-ray diffraction. Squares: lime mudstone or its successor in completely dolomitized rocks. Circles: dolomite of partings and mottlings. Lines connect the two phases of a single specimen. Relative proportions of carbonate phases are approximate only in specimens with more than 90 per cent calcite or dolomite. Analysts: G. Pouliot, A.G. Heinrich.*

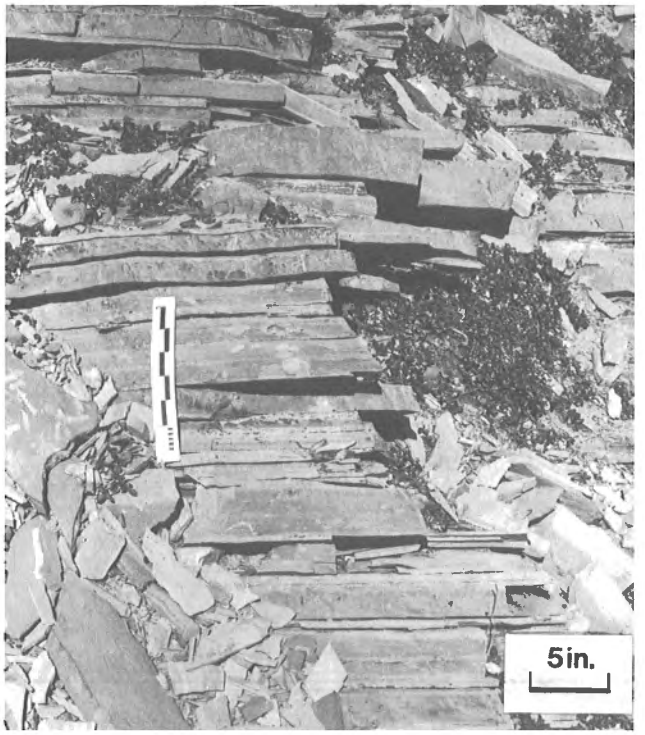


Figure A-25. *Characteristic flaggy outcrop of ribbon-bedded lime mudstone lithofacies, Eldon Formation, Whitehorn Mountain (Section AC–166), Mount Robson district. GSC photo 5-13-66.*

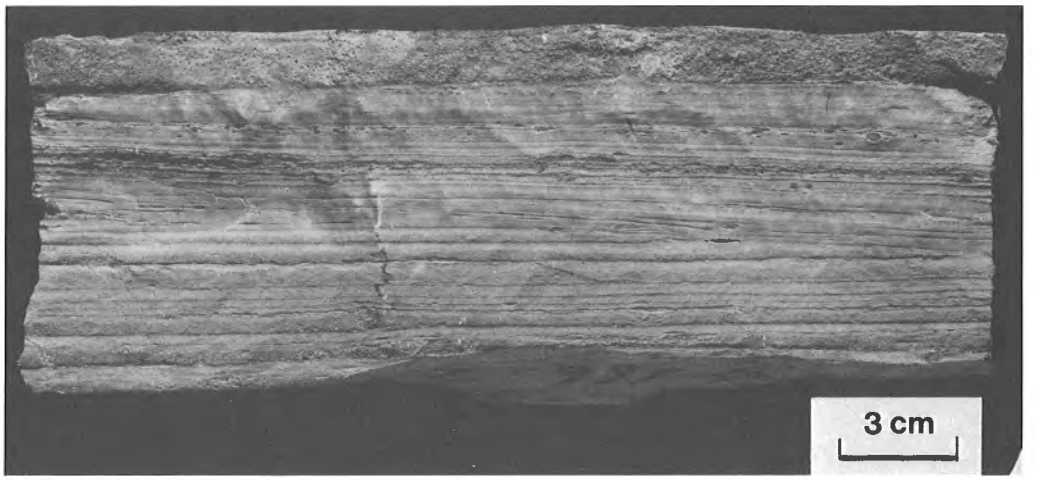


Figure A-26. *Ribbon-bedded lime mudstone. Same locality as Figure A-25. Hand specimen. Note the erosional surface truncating the laminae. Bedding (lamination) is unusually thin in this specimen. ISPG photo 786-8.*

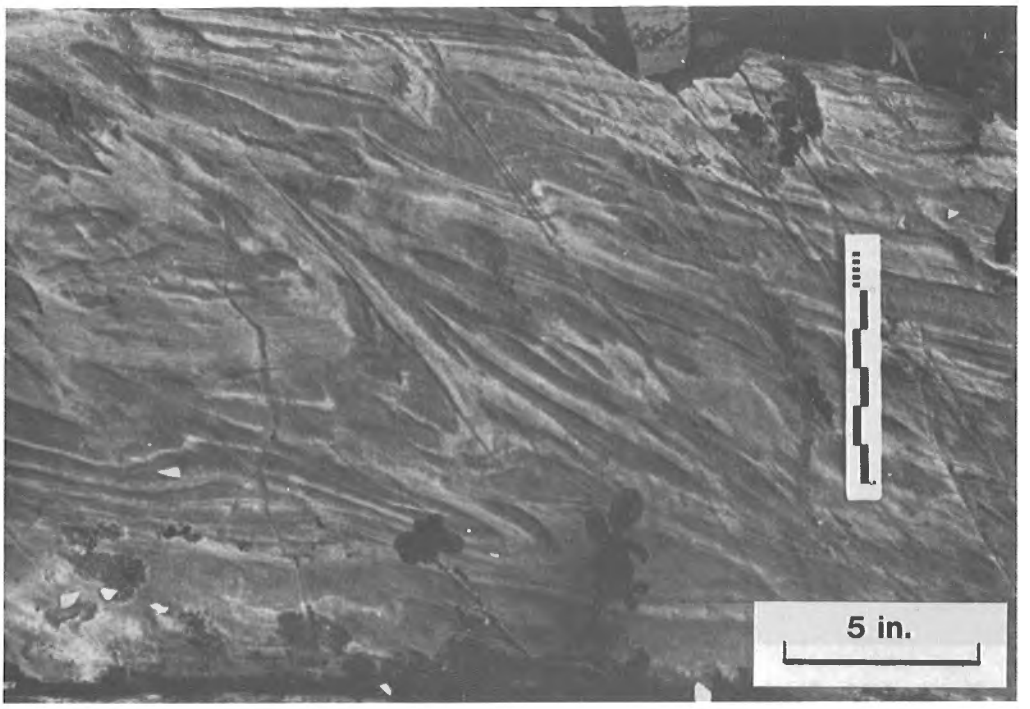


Figure A-27. *Slump-folds in ribbon-bedded lime mudstone lithofacies, Eldon–Pika (undifferentiated), Mount Mather. GSC photo 3-29-66.*

Figure A-28. *Ribbon-bedded lime mudstone onlapping the nose or toe of a mass of debris-flow breccia, Eldon–Pika (undifferentiated), Mount Duchesnay (Section AC–130). GSC photo 15-24-65.*

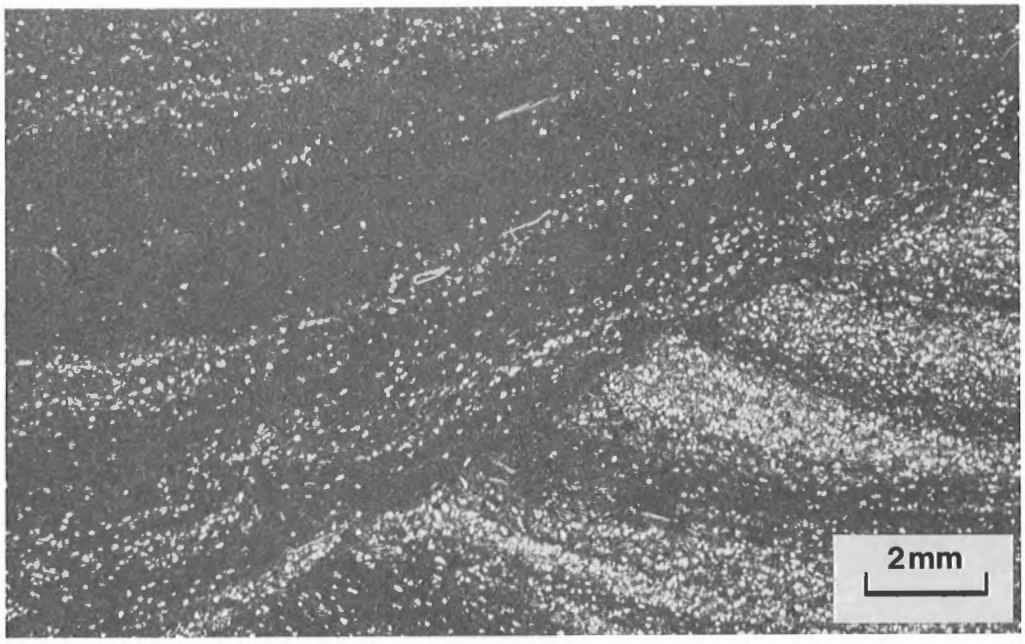


Figure A-29. *Ripple crosslaminae in calcisiltite, Naiset Formation, Mount Stephen (Section AC–114). Thin-section photomicrograph. Note content of quartz silt (bright specks); some laminae are quartz siltstone. ISPG photo 760-37.*

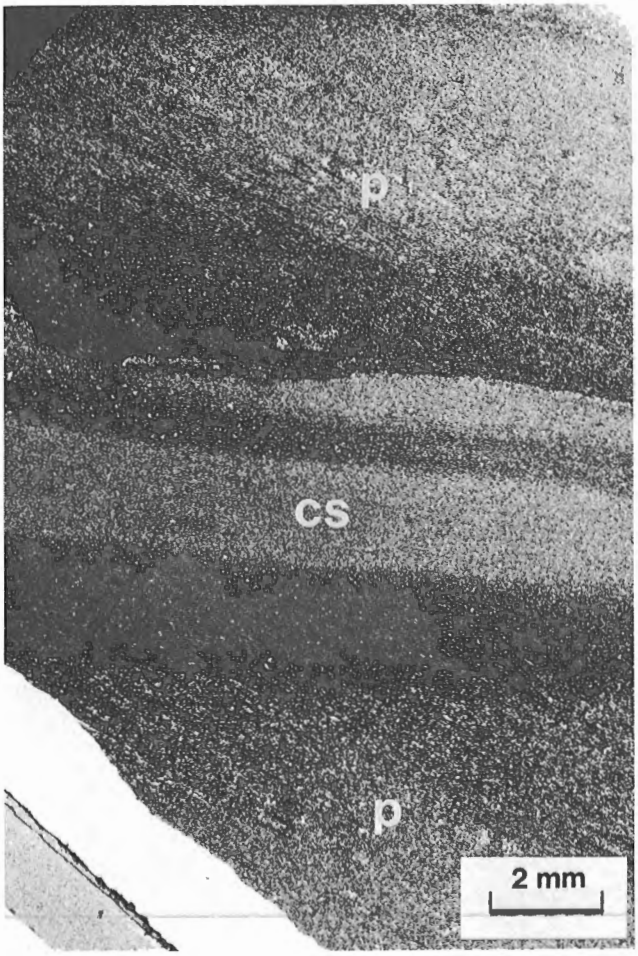


Figure A-30. *A lamina of calcisiltite in a unit assigned to the parted lime mudstone lithofacies, Narao Member of the Stephen Formation, Kicking Horse Pass roadcuts (Section AC–123). Thin-section photomicrograph. Note the scour-and-fill. Incipient cleavage is developed in the argillaceous parting material (p), but not in the calcisiltite (cs). Quartz-silt content is estimated at 10 per cent. ISPG photo 760-54.*

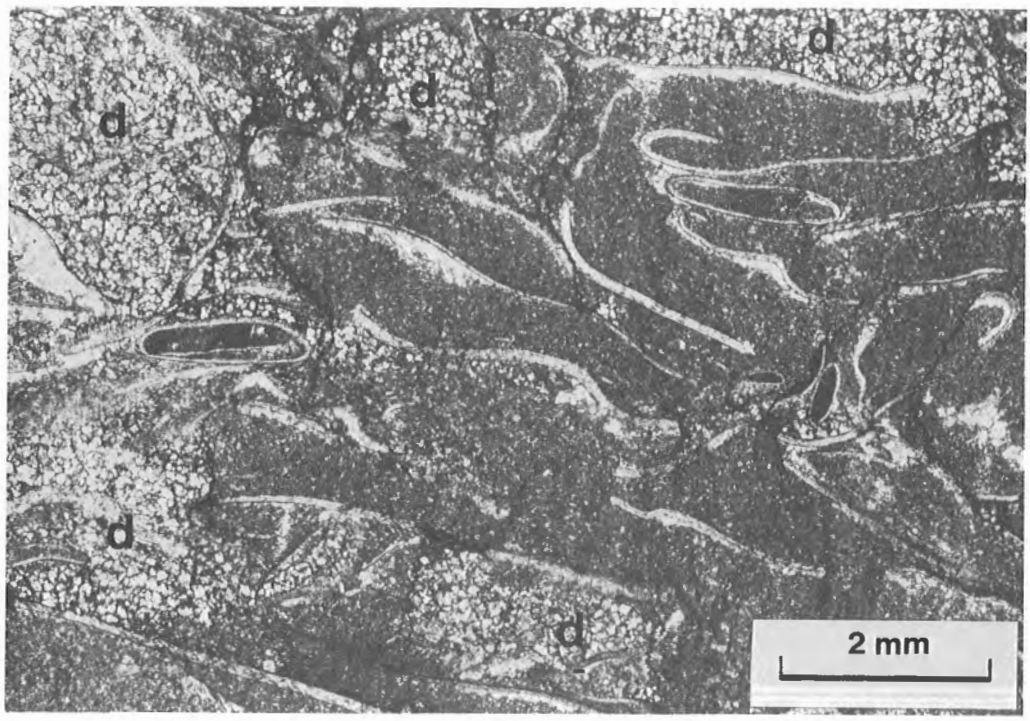


Figure A-31. *Trilobite wackestone, Stephen Formation, Mount McDonald (Section AC–94). Thin-section photomicrograph. Note the geopetal shelter cavities and irregular replacement by very fine crystalline dolomite (d), commonly bounded by trilobite tests. ISPG photo 760-25.*

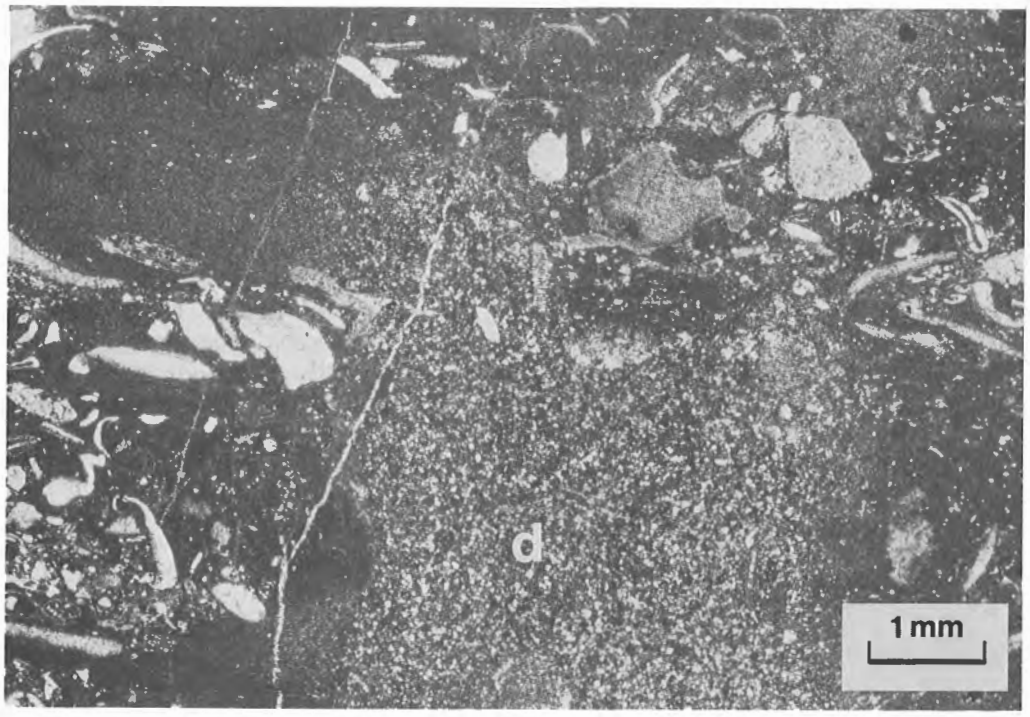


Figure A-32. *Skeletal wackestone, Waputik Member of the Stephen Formation, Kicking Horse Pass roadcuts (Section AC–123). Thin-section photomicrograph. Skeletal grains (some silicified) are trilobite and echinoderm fragments. The patch of very fine crystalline dolomite (d) may be localized by a burrow, but its edges are a diffuse replacement front. Note the relative resistance of skeletal grains to dolomitization. ISPG photo 760-70b.*

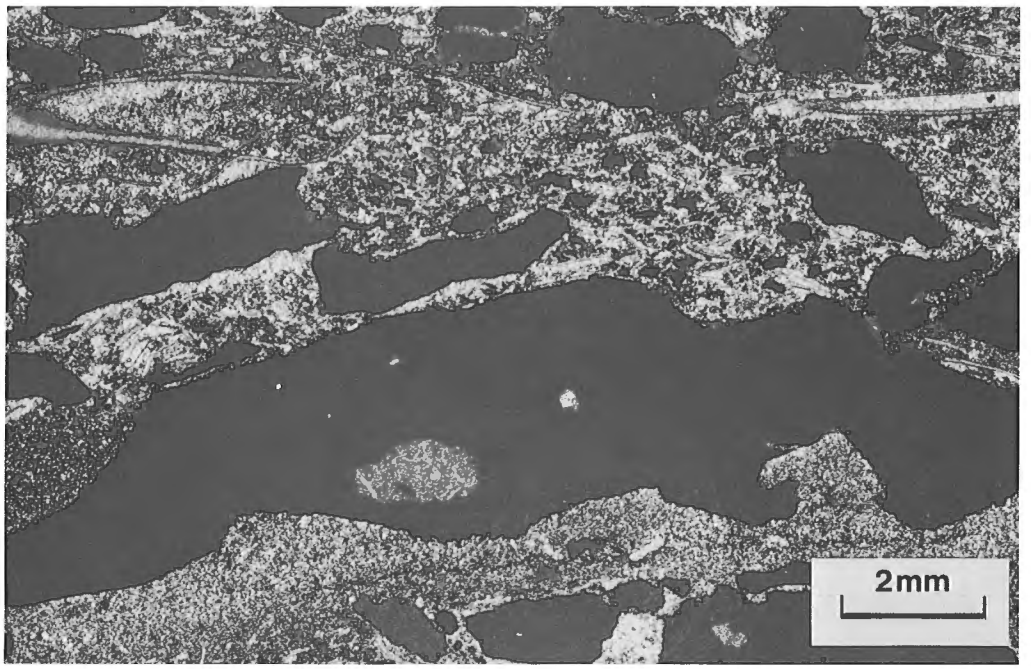


Figure A-33. *Intraclast wackestone/skeletal grainstone. Same locality as Figure A-32. Thin-section photomicrograph. The embayed (bored?) intraclasts are lime mudstone. ISPG photo 760-59.*

Figure A-34. *Oncoid (intraclast) wackestone or packstone, Eldon Formation, Windy Point (Section AC–39, North Saskatchewan River. Thin-section photomicrograph. Only five of the allochems shown bear evidence of an accretionary origin; such components are easily mistaken for intraclasts. ISPG photo 760-24.*

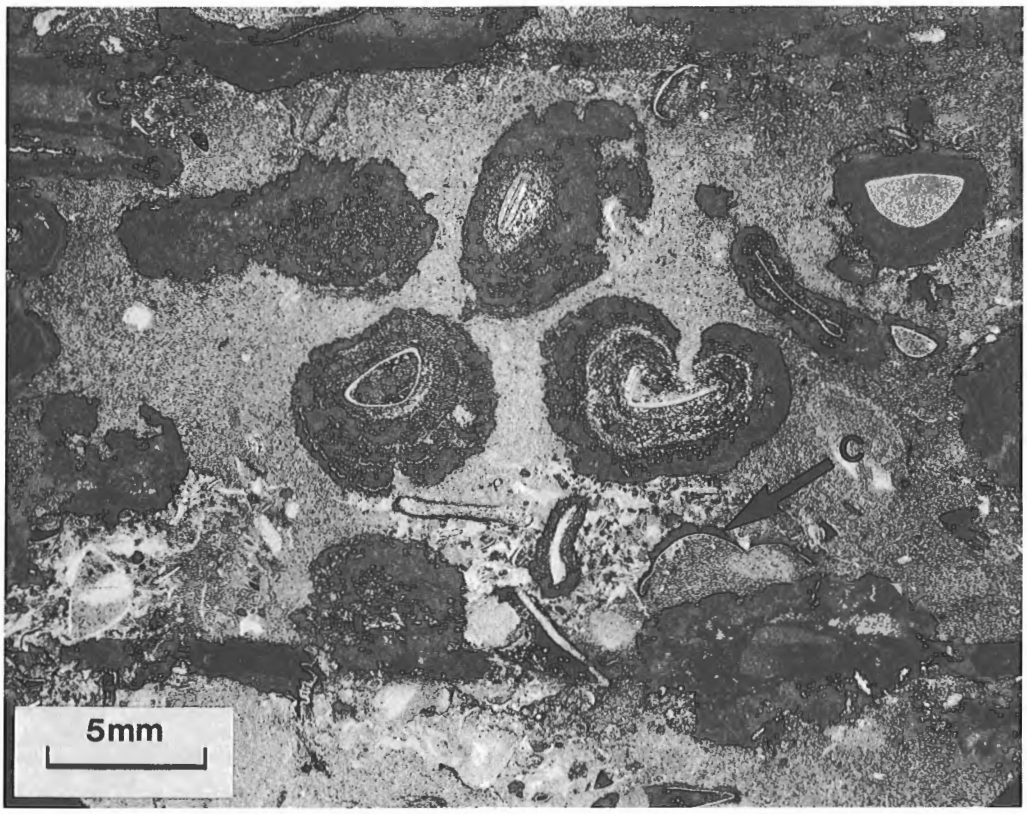


Figure A-35. *Oncoid wackestone (floatstone), top of Narao Member of the Stephen Formation, Beauty Creek (Section AC–48). Thin-section photomicrograph. The oncoids are irregular; the irregular protuberances on some, and the stromatolitic capping of a trilobite test (C) testify to periods of decreased turbulence when the allochems were at rest. ISPG photo 1603-5.*

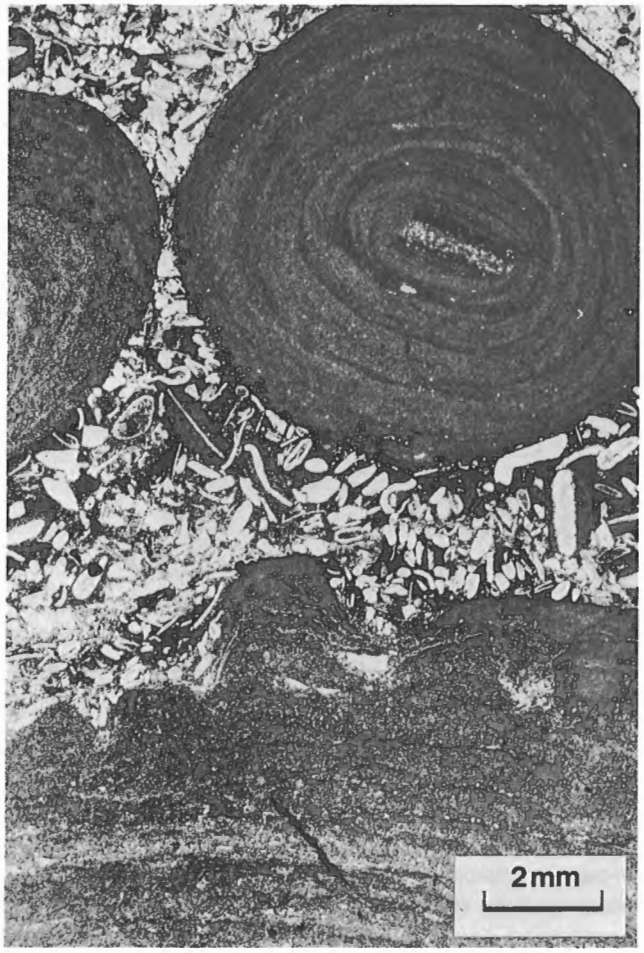


Figure A-36. *Oncoid wackestone (packstone?)/ skeletal packstone, Waputik Member of the Stephen Formation, Kicking Horse Pass roadcuts (Section AC–123). Thin-section photomicrograph. The matrix is skeletal (trilobite, echinoderm) packstone, with "washed" patches (grainstone). The object at the bottom of the photograph is a stromatolite in situ. ISPG photo 760-64.*

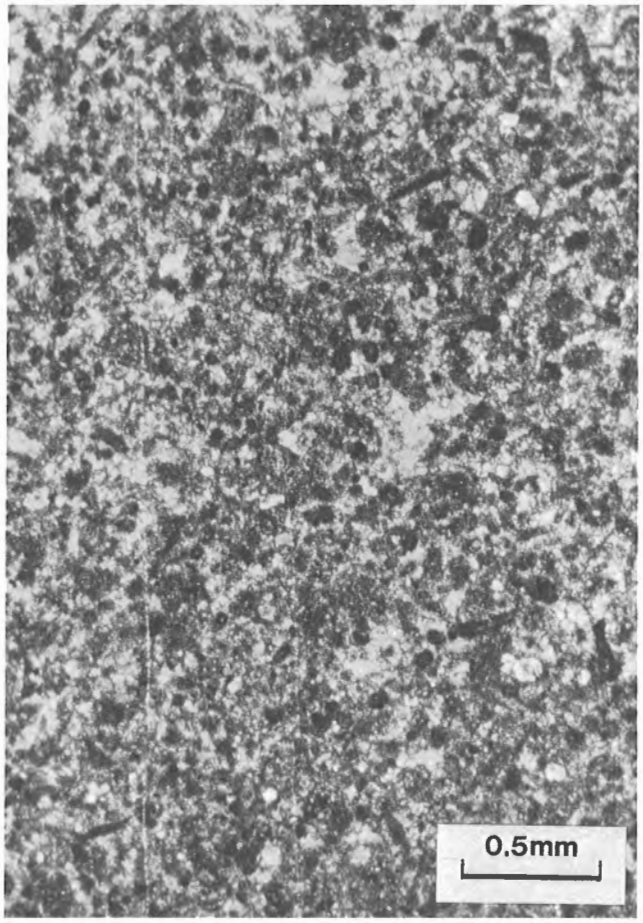


Figure A-37. *Dark-pellet grainstone, Takakkaw Tongue of the Cathedral Formation, type section. Thin-section photomicrograph. Rod-like objects are spicules. ISPG photo 760-17.*

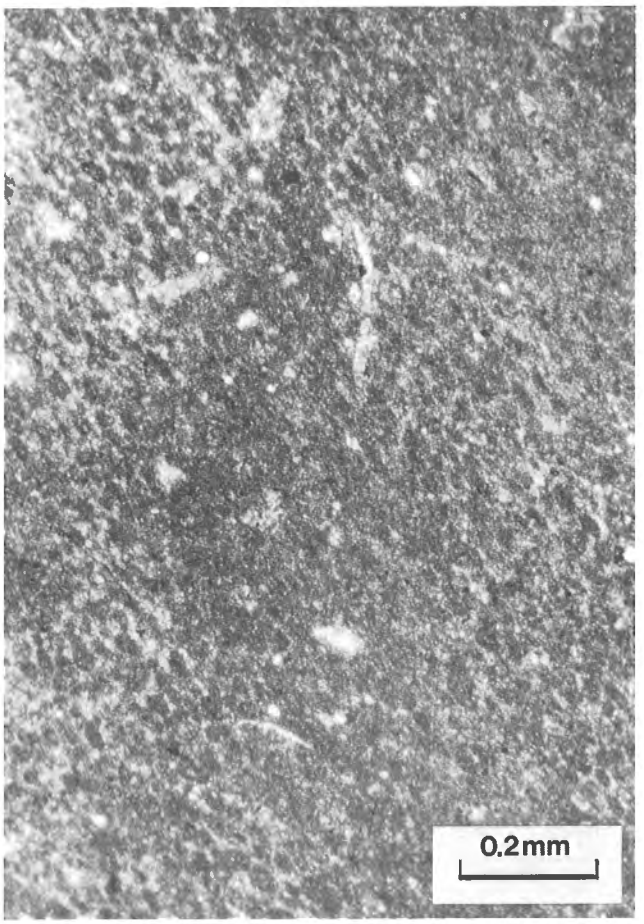


Figure A-38. *Pale-pellet grainstone, Cathedral Formation, Windy Point (Section AC-39), North Saskatchewan River. Thin-section photomicrograph. The patches of "lime mudstone" with indistinct boundaries are considered to be clumps of merged pellets. ISPG photo 760-19.*

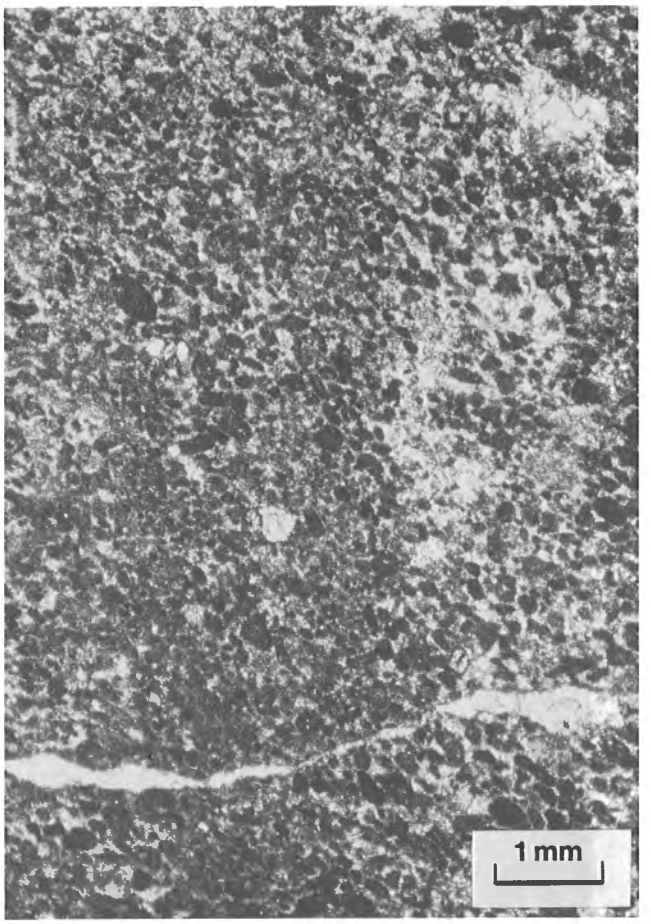


Figure A-39. *Pale-pellet grainstone. Same locality as Figure A38. Thin-section photomicrograph. ISPG photo 760-8.*

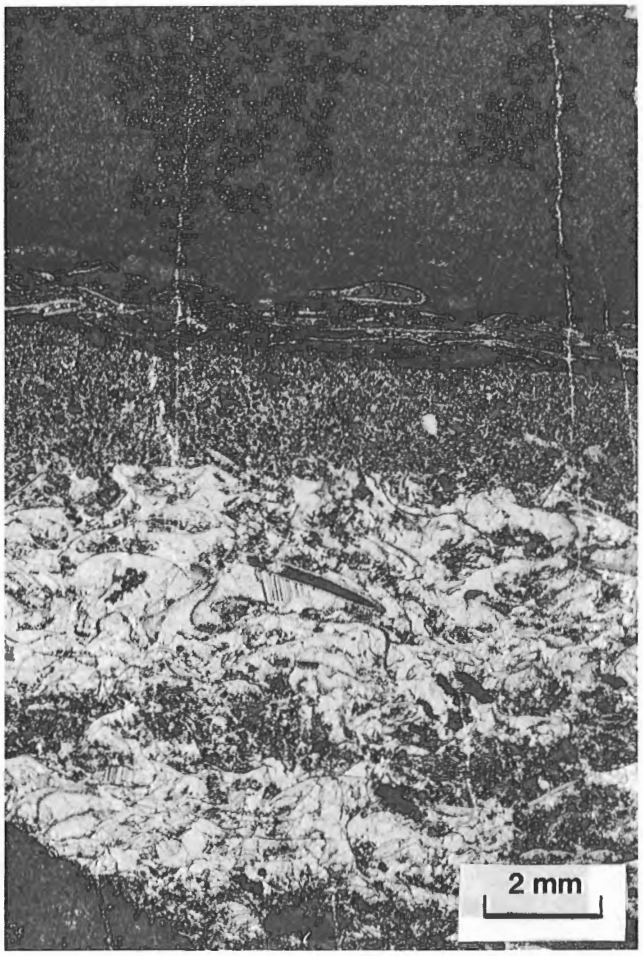


Figure A-40. *Grainstone, packstone, and dolomitized mudstone, Narao Member of the Stephen Formation, Kicking Horse Pass roadcuts (Section AC–123). Thin-section photomicrograph. Bottom half of the photo is trilobite grainstone (note high initial porosity), with median and capping laminae of pellet grainstone. These are overlain by a thin lamina of trilobite packstone, then dolomite of 50–80 μm grain (ex-pelleted lime mudstone?). Rare intraclasts and the mud-filled trilobite at centre must be reworked from an underlying bed. ISPG photo 760-55.*

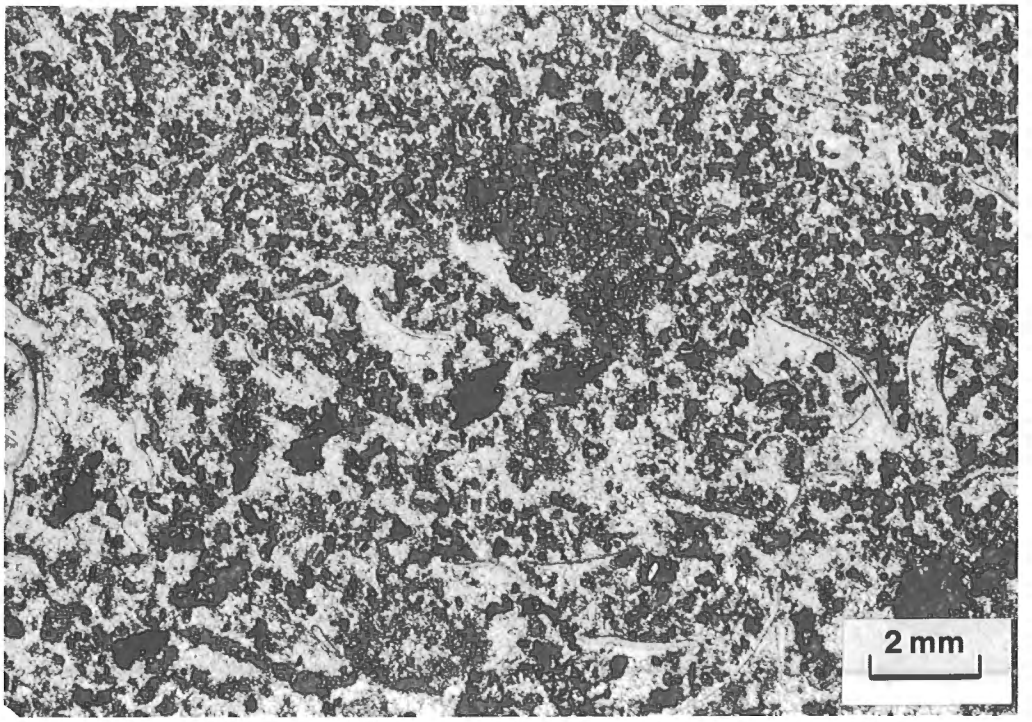


Figure A-41. *Pellet–skeletal grainstone, Takakkaw Tongue of the Cathedral Formation, type section. Thin-section photomicrograph. Note the delicate shards of trilobite test, supporting pellets in "snow on the roof" fashion. The ragged intraclasts are probably fragments of cryptalgal laminite. ISPG photo 760-22.*

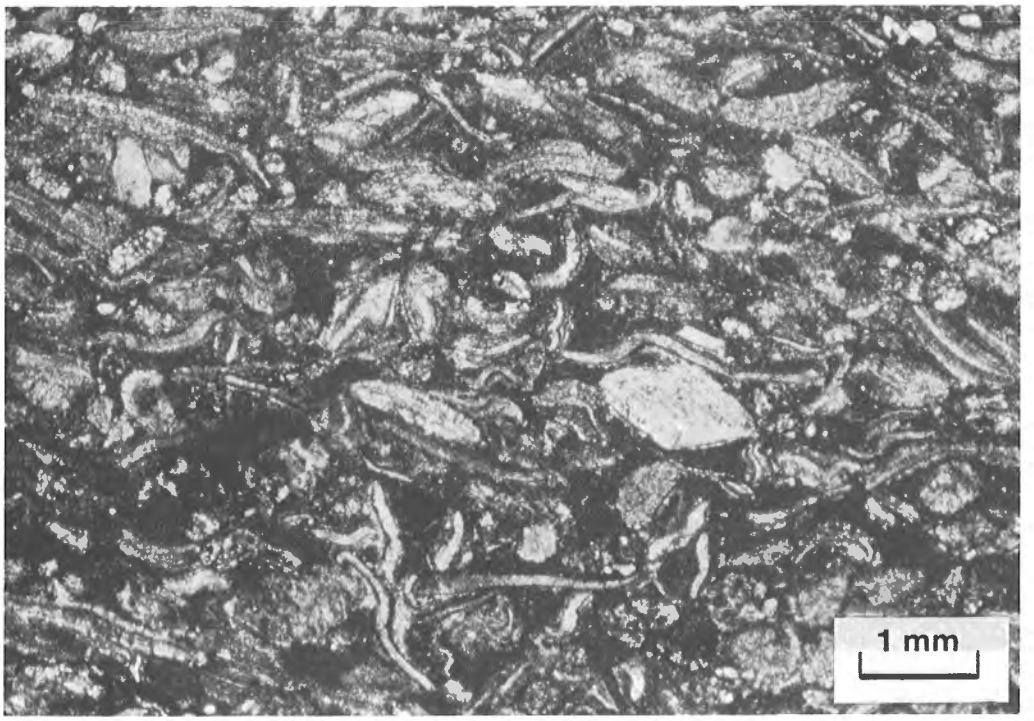


Figure A-42. *Trilobite–echinoderm packstone, Pika Formation, Windy Point (Section AC-39), North Saskatchewan River. Thin-section photomicrograph. Matrix is slightly chloritic calcisiltite. ISPG photo 760-3.*

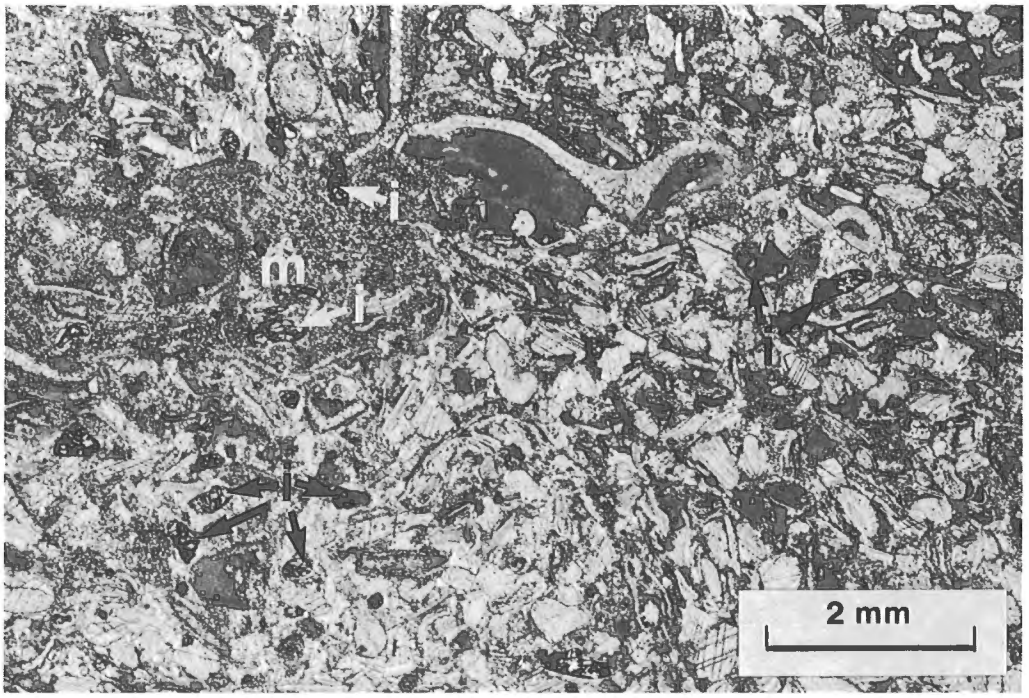


Figure A-43. *Echinoderm–trilobite packstone, Wapta Member of the Stephen Formation, Mount Stephen (Section AC–114). Thin-section photomicrograph. Some abrasional rounding of echinoderm grains is evident. m–patch of dolomitized lime mud; i–intraclasts (lithoclasts of dolomite). ISPG photo 760-21.*

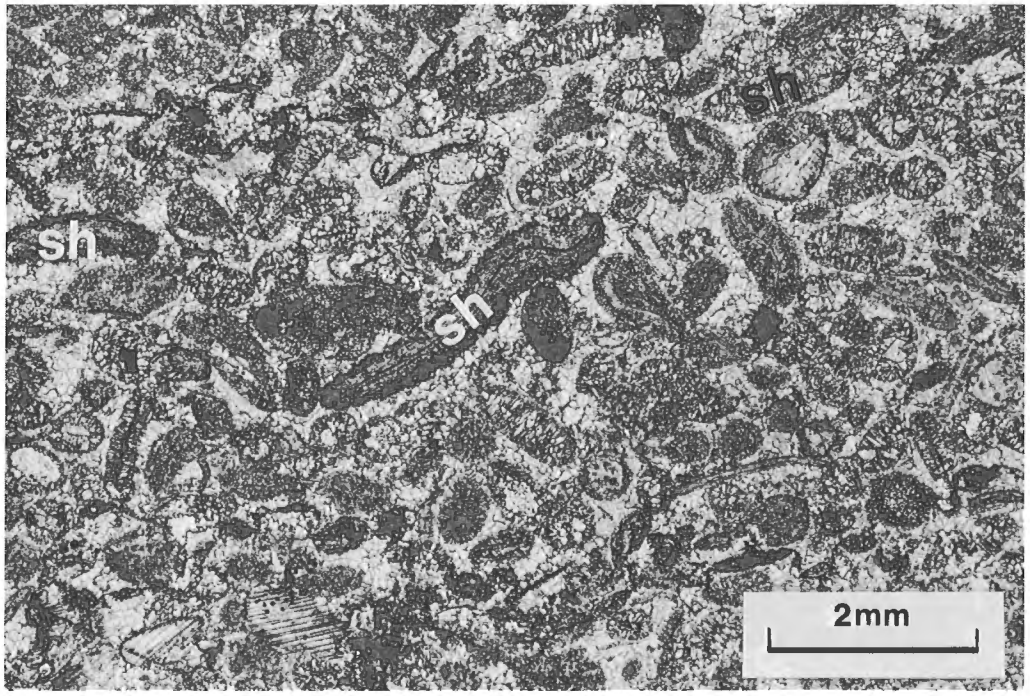


Figure A-44. *Oolitic, echinoderm–trilobite grainstone. Same locality as Figure A43. Thin-section photomicrograph. Note the mixture of trilobite fragments with oolitic sheaths (sh), unsheathed fragments, and scattered spheroidal to spherical ooids. Substantial recrystallization and replacement have not obliterated primary sediment character. Ten per cent of the allochems are dolomitized, and much late-diagenetic, ferroan calcite is present. ISPG photo 760-23.*

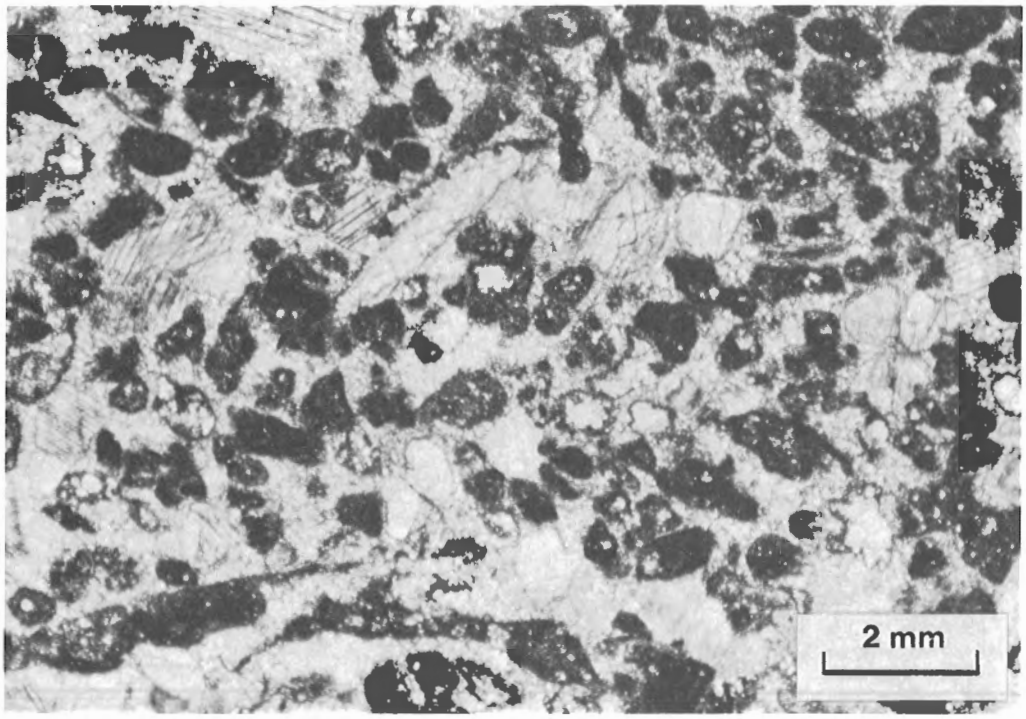


Figure A-45. *Intraclast–skeletal grainstone, Takakkaw Tongue of the Cathedral Formation, type section. Thin-section photomicrograph. ISPG photo 760-14.*

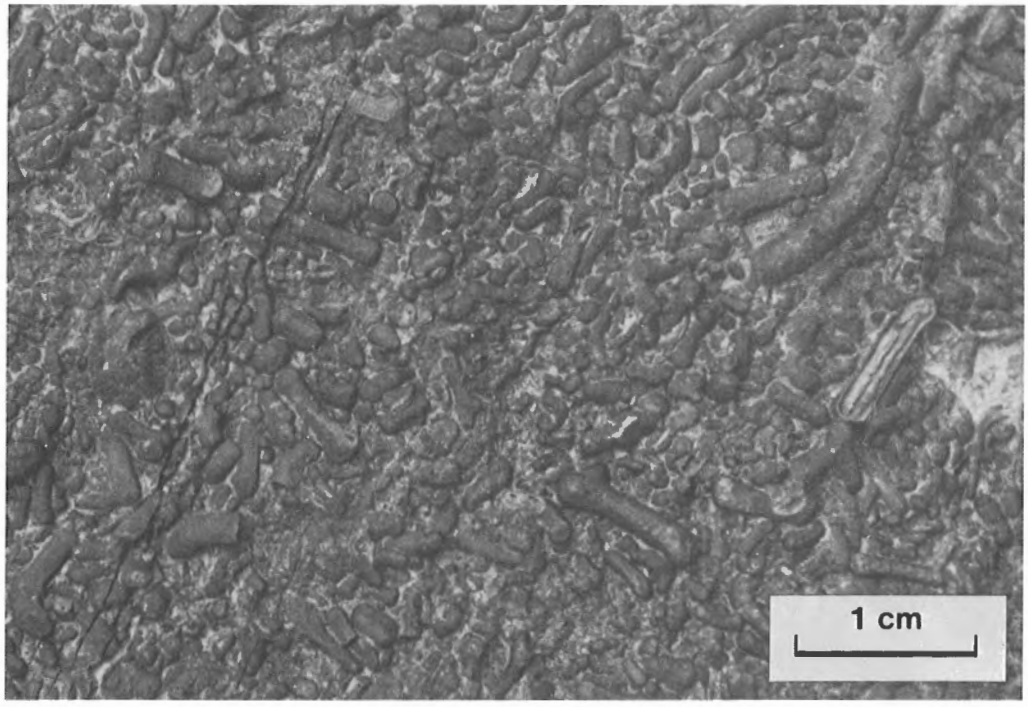


Figure A-46. *Ooids with trilobite fragment cores, Chephren Member of the Mount Whyte Formation, Beauty Creek (Section AC–48). Exhumed upper surface of bed. ISPG photo 1762-3.*

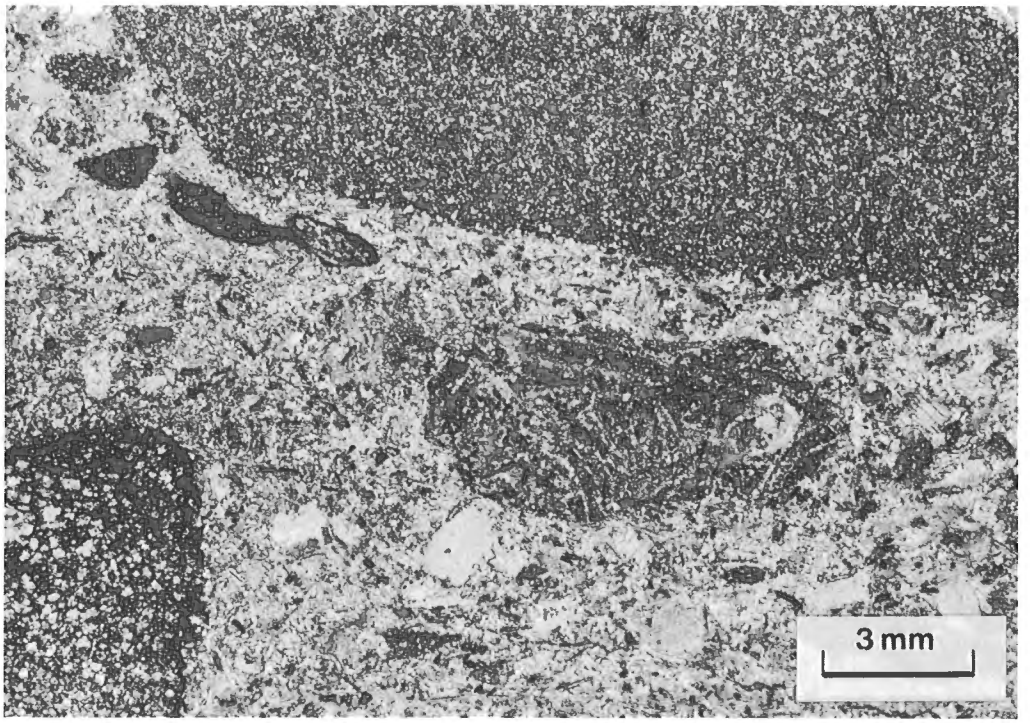


Figure A-47. *Dolomite, ex-skeletal, intraclast grainstone/intraclast floatstone, Tershishner Member of the Pika Formation, type section. Thin-section photomicrograph. Despite complete dolomitization, the characteristic shapes of trilobite fragments (especially in the intraclast at centre), and the monocrystalline character of echinoderm grains are clearly recognizable, as are clear areas after sparry calcite cement. ISPG photo 760-30.*

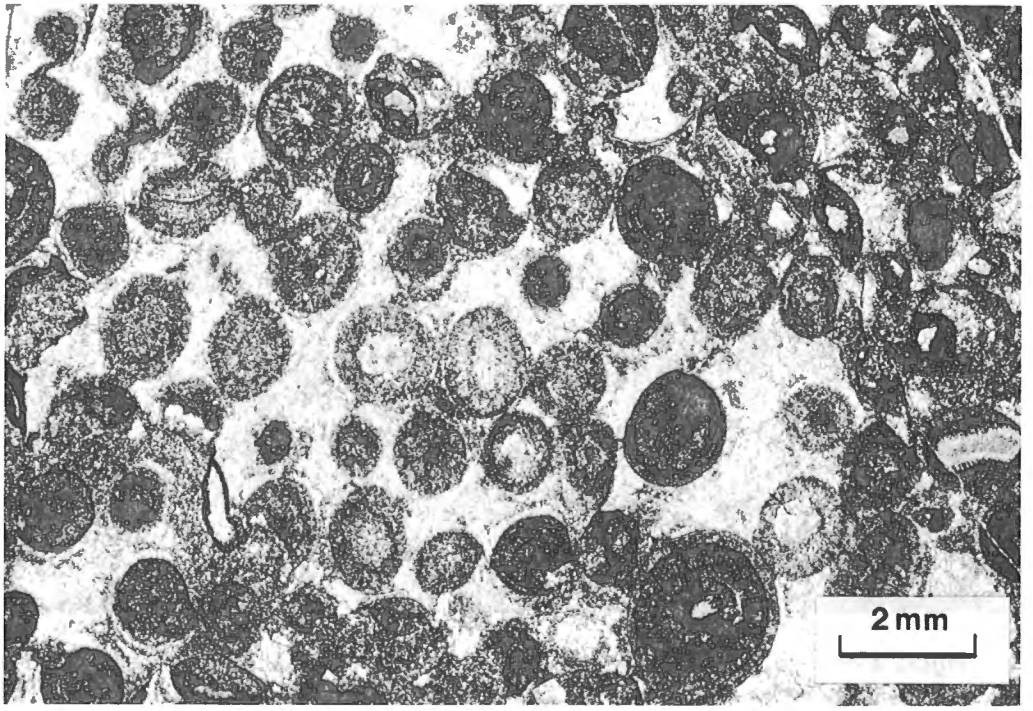


Figure A-48. *Ooid grainstone, Narao Member of the Stephen Formation, Kicking Horse Pass roadcuts (Section AC–23). Thin-section photomicrograph. Some infilling of primary porosity by lime mud (recrystallized) is evident at lower left and upper right. Note the variable degree of neomorphic destruction of ooid detail. Nuclei are echinoderm and trilobite fragments. ISPG photo 760-69.*

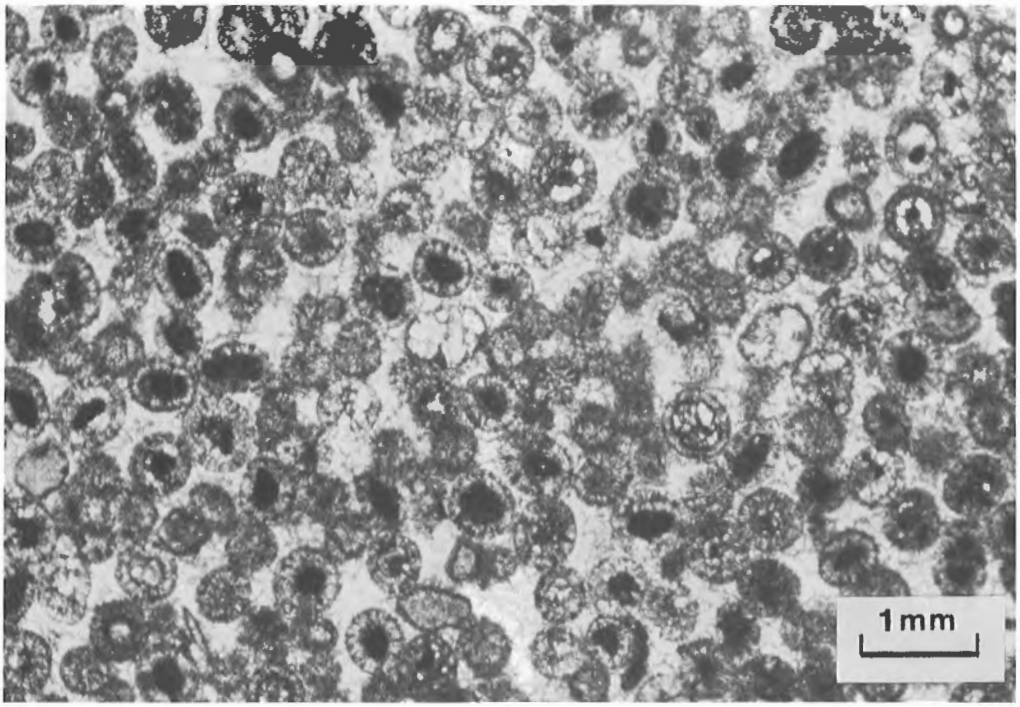


Figure A-49. *Ooid grainstone, top of the Naiset Formation, Mount Field. Thin-section photomicrograph. Most ooids are of the superficial type, with intraclast and lithoclast nuclei. ISPG photo 760-12.*

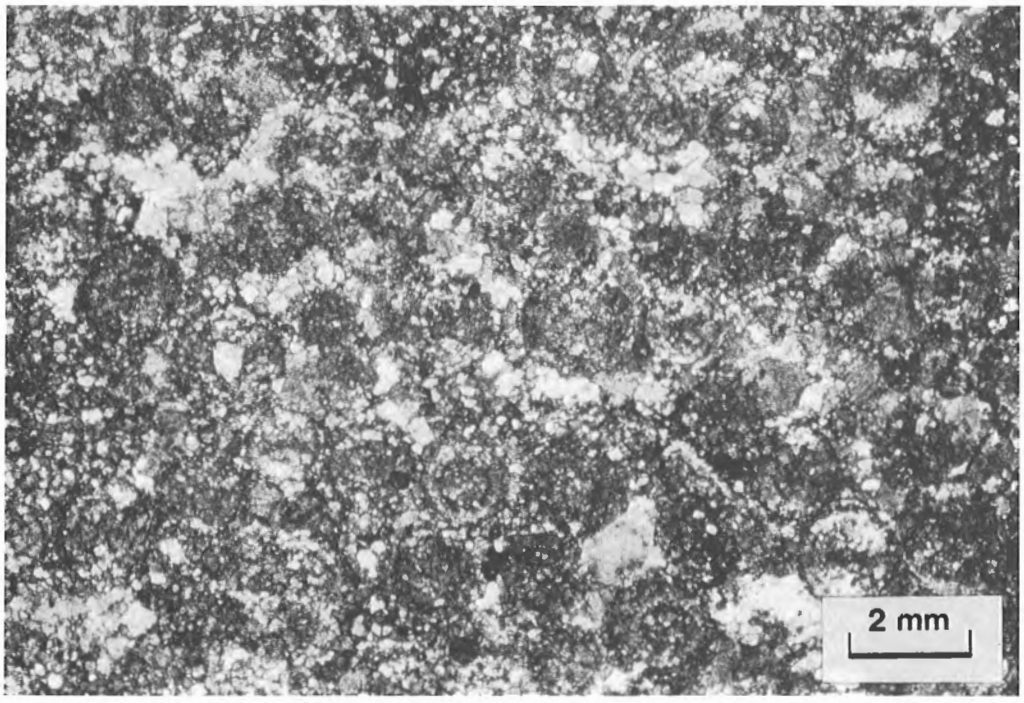


Figure A-50. *Dolomite, ex-ooid packstone, Tershishner Member of the Pika Formation, type section. Thin-section photomicrograph. Detection of perfectly spherical, accretionary shells of ooids requires close examination. Lack of colour-contrast between ooids and their surroundings suggests the presence originally of lime mud matrix; white areas are interpreted as shelter cavities. Specimen was recognized as "ex-oolite" in the field. ISPG photo 760-2.*

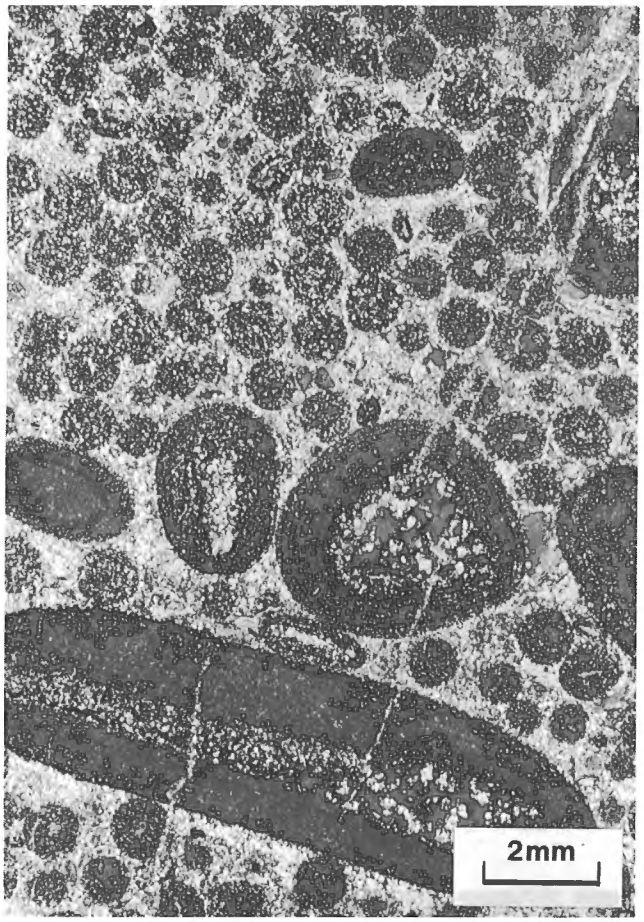


Figure A-51. *Dolomite, ex-ooid-oncoid grainstone/ oncoid floatstone. Same locality as Figure A-50. Thin-section photomicrograph. Ooids are interpreted on the basis of their nuclei and high degree of sphericity. ISPG photo 760-28.*

Figure A-52. *Dolomite, ex-oolite, Eldon Formation, Mount Weed (Section AC–171). Weathered hand specimen. Discontinuous, near-black laminae are dolomite, ex-lime mudstone. ISPG photo 786-14.*

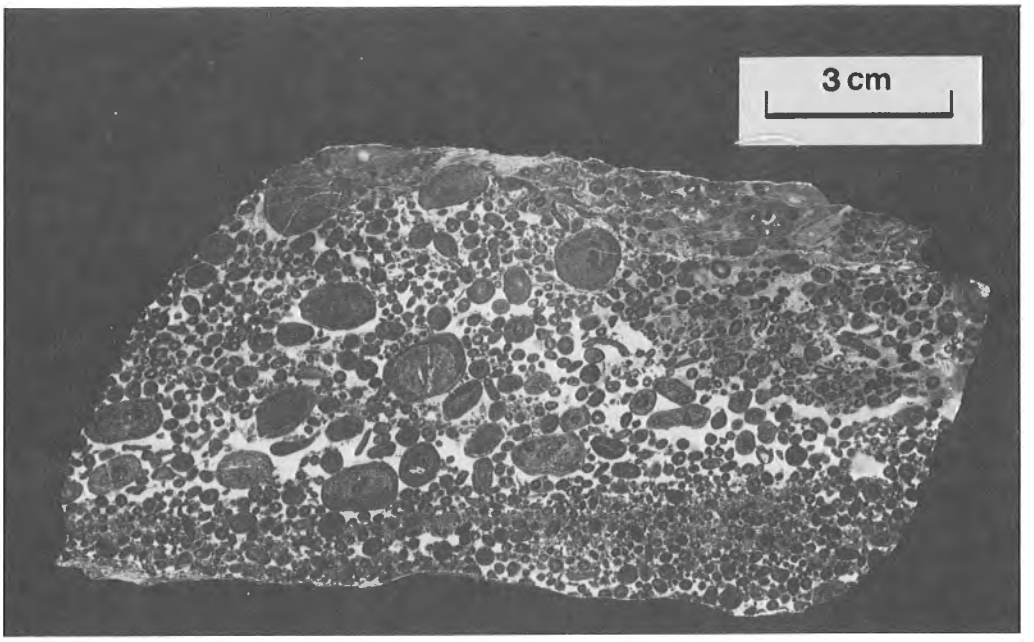


Figure A-53. *Oncoid grainstone/packstone, Waputik Member of the Stephen Formation, Loudon Creek (Section AC–45). Polished slab. ISPG photo 786-16.*

Figure A-54. *Ooid-intraclast grainstone/oncoid rudstone, Peyto Formation, Banff National Park boundary, North Saskatchewan River (Section AC–41). Thin-section photomicrograph. Nearly all the intraclasts are thin shards and have "cryptalgal" fabric; they have apparently spalled from oncoids. The lower oncoid has, as a nucleus, an intraclast (lithoclast?) of ooid packstone. ISPG photo 1627-2.*

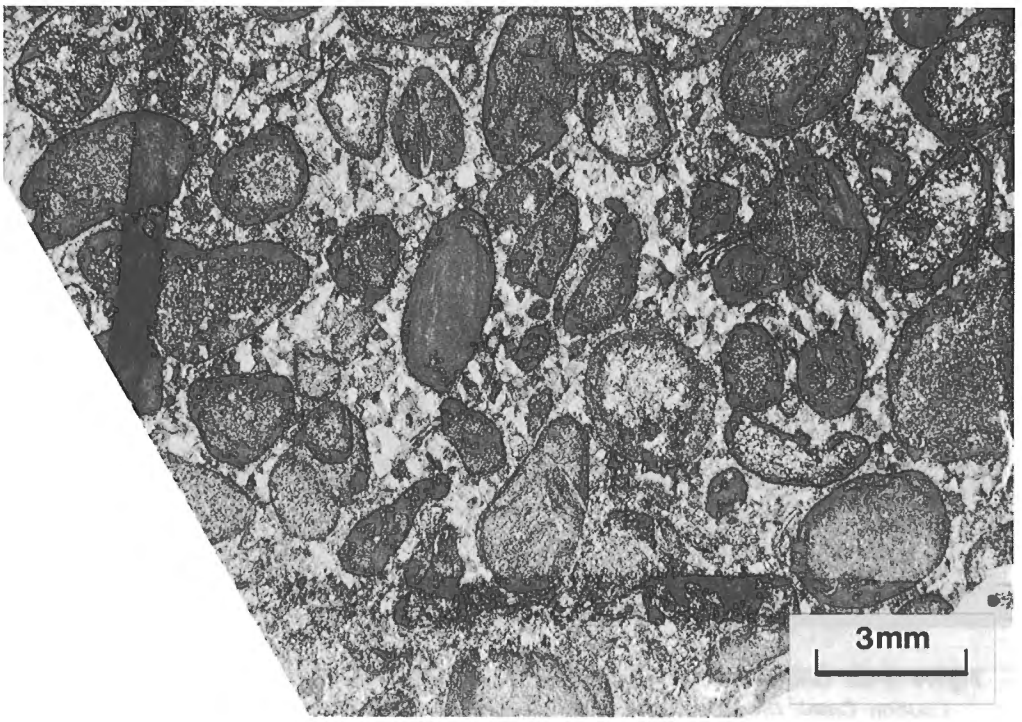


Figure A-55. *Oncoid-intraclast grainstone, Cathedral Formation, Ghost River (Section AC–28). Thin-section photomicrograph. Note that most oncoids appear to be intraclasts with only one or two accreted laminae, and that some intraclasts(?) are uncoated. Compound oncoid at lower left. See also Figures A34 to A36. ISPG photo 1603-7.*

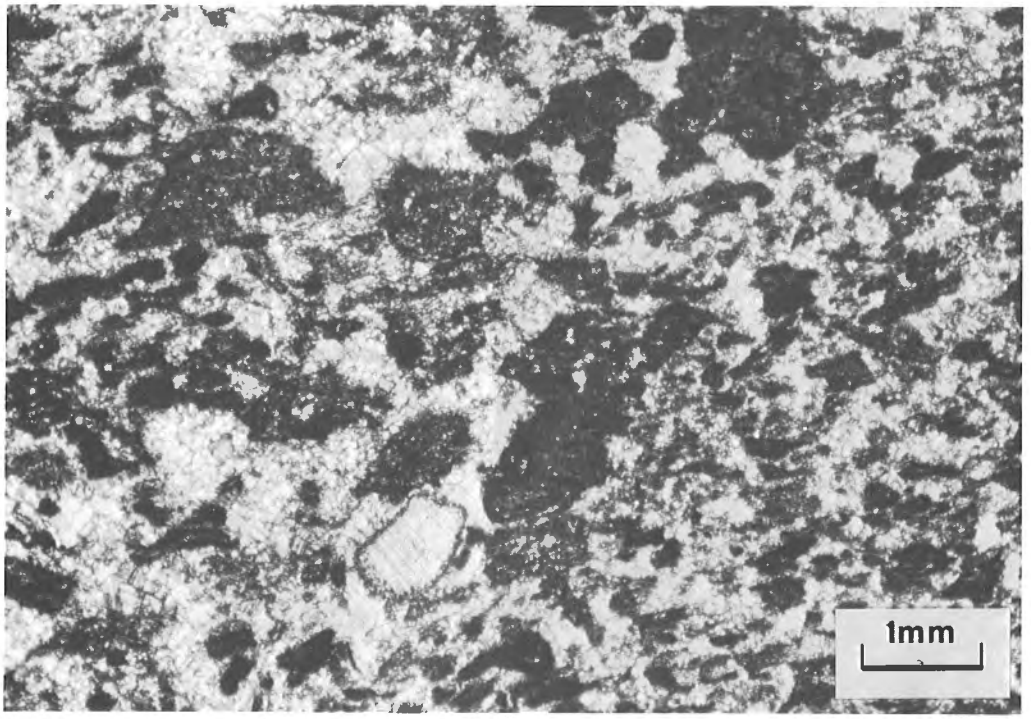


Figure A-56. *Intraclast–skeletal grainstone, Takakkaw Tongue of the Cathedral Formation, type section. Thin-section photomicrograph. The embayed, indistinctly pelleted intraclasts are of the kind considered to be fragments of cryptalgal laminite. The syntaxial overgrowth on the echinoderm grain post-dates a micritized rim (dark). The planar, secondary fabric is an incipient cleavage. ISPG photo 760-11.*

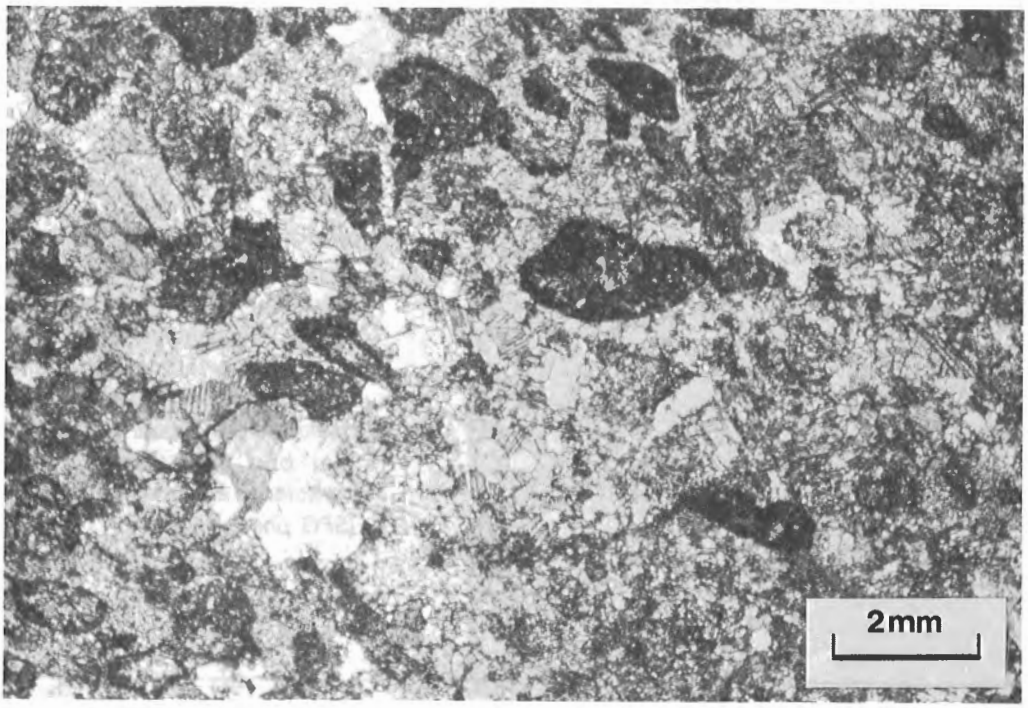


Figure A-57. *Intraclast grainstone, Eldon Formation, Windy Point (Section AC-39), North Saskatchewan River. Thin-section photomicrograph. Despite substantial recrystallization and the growth of scattered crystals of dolomite (not evident in the photograph), both the character and shape of the intraclasts and the presence of primary, sparry calcite cement are easily seen. ISPG photo 760-4.*

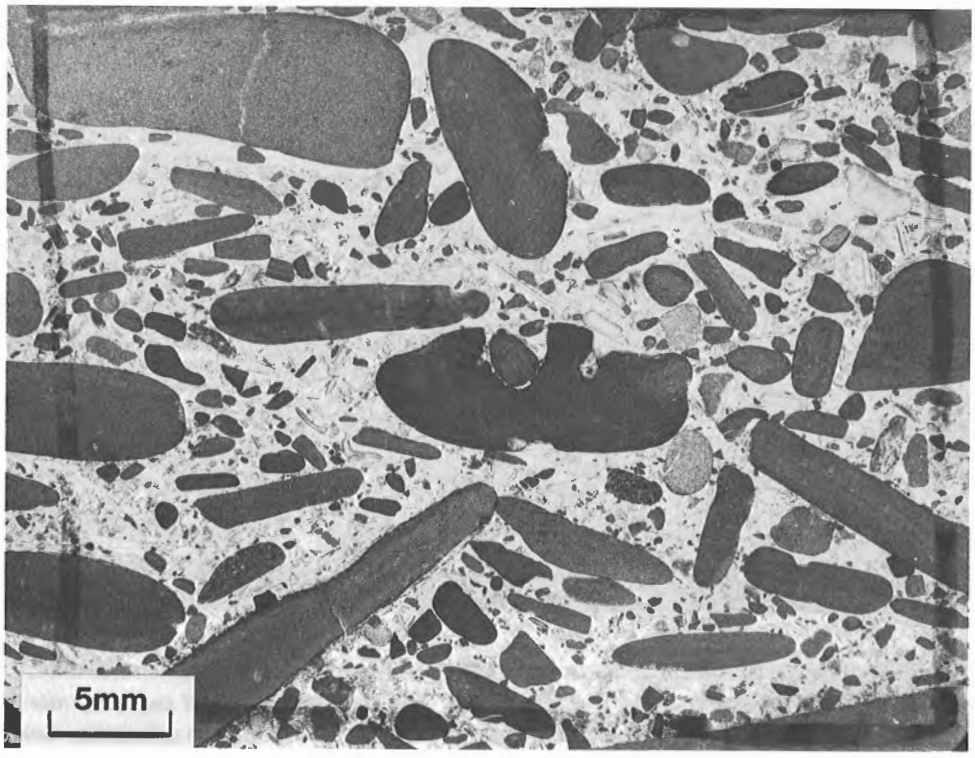


Figure A-58. *Intraclast–skeletal grain-rudstone, Pika Formation, Beauty Creek (Section AC–48). Thin-section photomicrograph. Grain-support among intraclasts is debatable. The matrix is skeletal grainstone. The intraclasts are polymict, and several have embayed (bored?) outlines. ISPG photo 1603-2.*

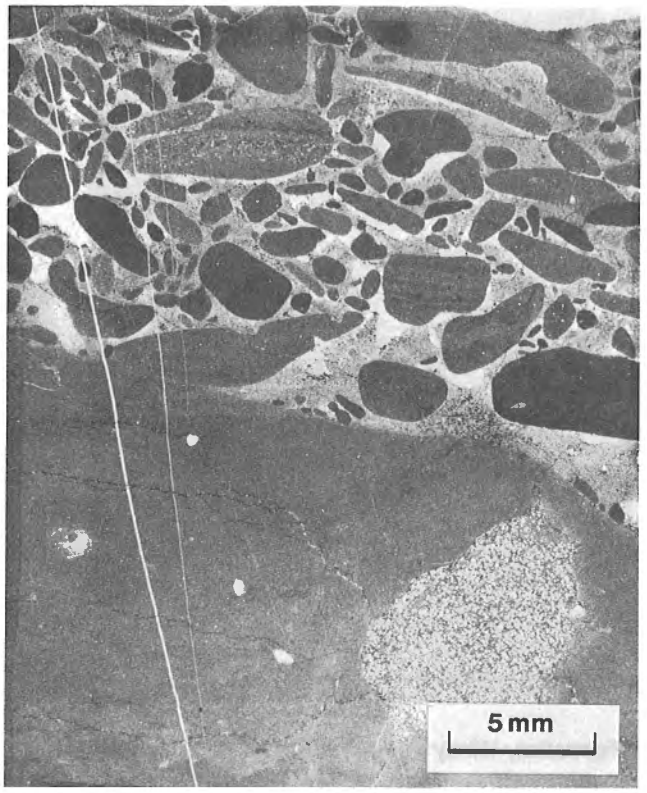


Figure A-59. *Intraclast rudstone/packstone, base of Pika Formation, Mount Dalhousie (Section AC–97). Thin-section photomicrograph. The pebbles obviously were initially grain-supported; the prominent shelter cavities demonstrate that the mud matrix postdates the pebble fabric. The base of this thin bed is erosional. Note that the intraclasts are polymict, c.f. Figure A-58. ISPG photo 1603-6.*

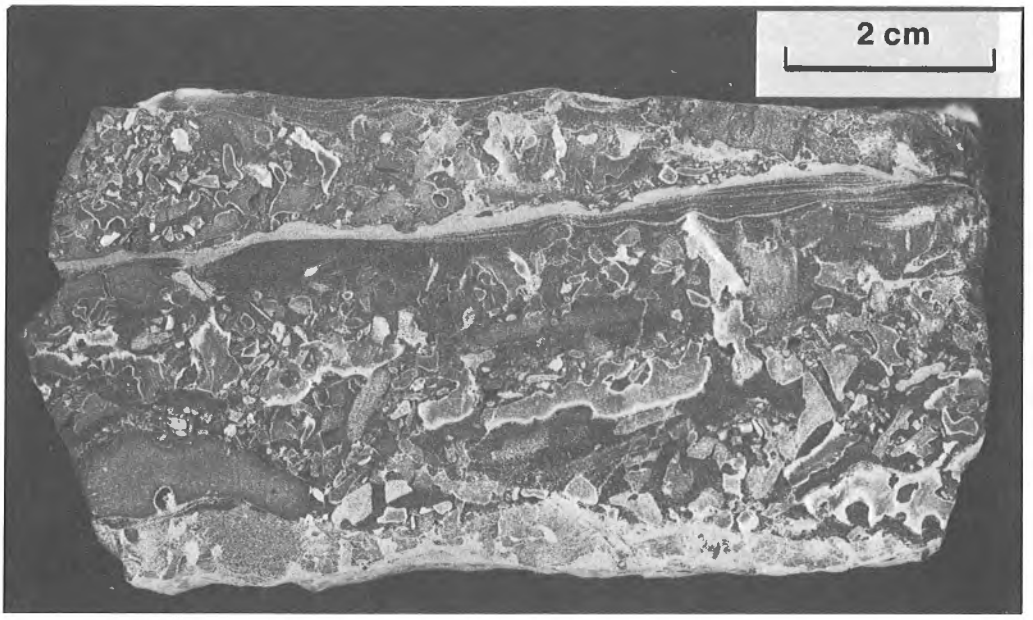


Figure A-60. *Intraclast packstone/rudstone, Waputik Member of the Stephen Formation, Beauty Creek (Section AC–48). Etched slab. The strongly embayed pebbles, many with a pale silicified rim, form a grain-supported framework infilled with calcisiltite. Note erosionally truncated crosslamination at upper right. ISPG photo 786-24.*

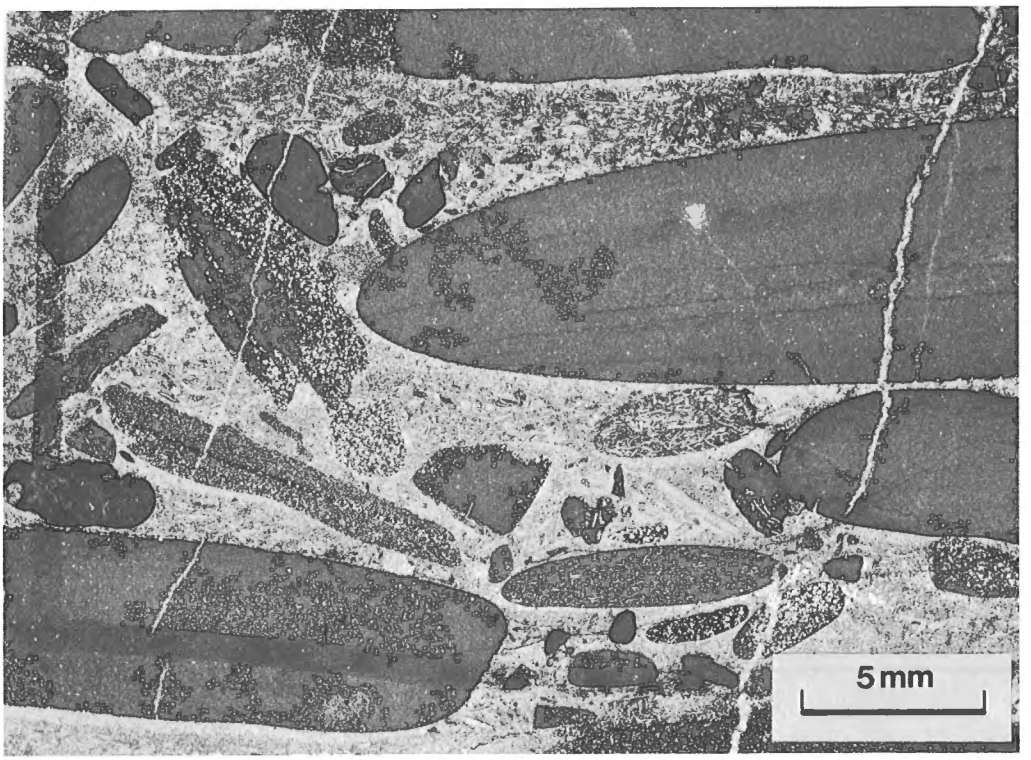


Figure A-61. *Rudstone/floatstone, Wapta Member of the Stephen Formation, Mount Stephen (Section AC–114). Thin-section photomicrograph. Matrix is skeletal packstone with calcisiltite matrix. The pebbles are polymict. ISPG photo 1603-3.*

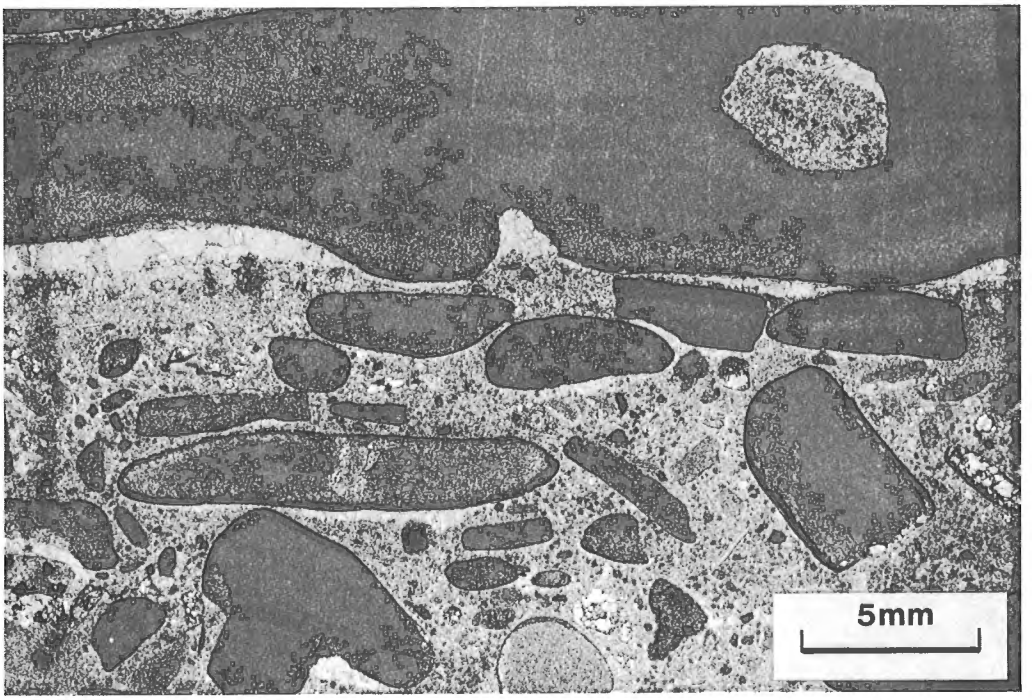


Figure A-62. *Rudstone, Pika Formation, Beauty Creek (Section AC–48). Thin-section photomicrograph. Matrix is skeletal intraclast packstone. Prominent dark rims of pebbles are partly alteration (micritization) and partly accretionary. Note the bored pebbles and one boring with geopetal fill. This rock is easily interpreted, despite a marked neomorphic fabric. ISPG photo 1604-3.*

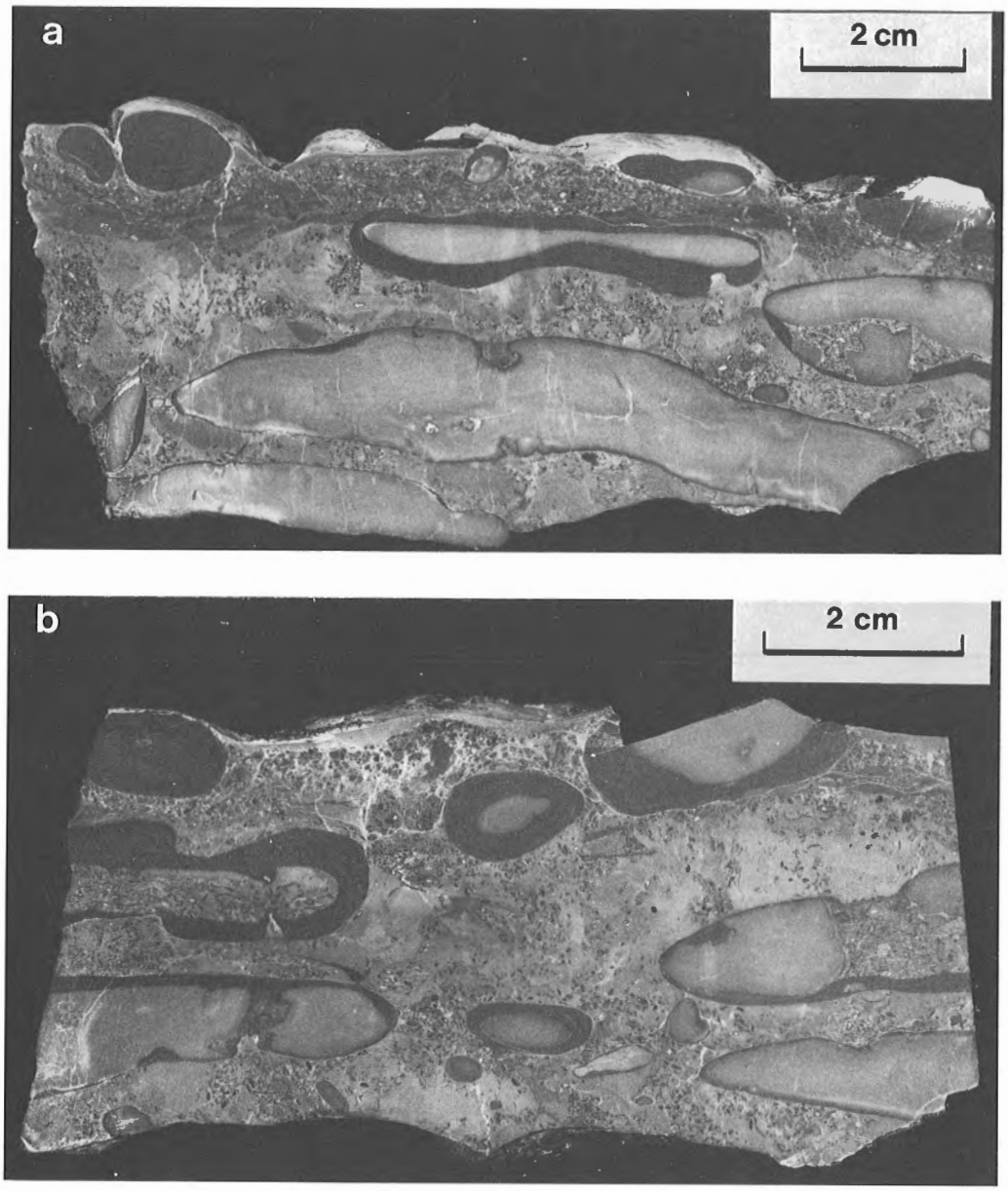


Figure A-63 (a, b). *Floatstone, Waputik Member of the Stephen Formation, Ross Lake (polished slab). Matrix is "churned" burrowed skeletal wackestone. Note the bored and compound intraclasts, in part of rock type identical to the matrix. Some of the oncoidal coatings are abraded, others inverted. The top layer of pebbles provides a substrate for small domal stromatolites composed of* ***Girvanella****. This bed required a long period of residence at and near the sediment-water interface for its formation; it is a submarine hardground. ISPG photos 786-28, 786-30.*

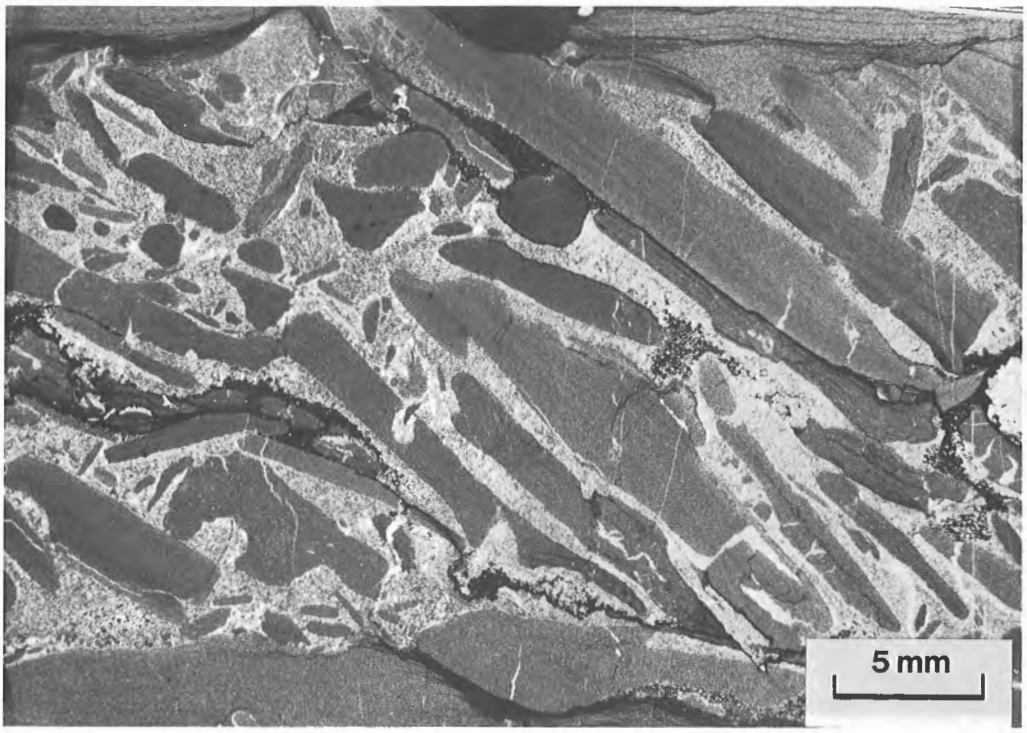


Figure A-64. *Flat-pebble rudstone (packstone), Pika Formation, Ghost River. Thin-section photomicrograph. Pebbles (intraclasts) are monomict. Matrix is pellet-intraclast packstone with shelter cavities. ISPG photo 1604-1.*

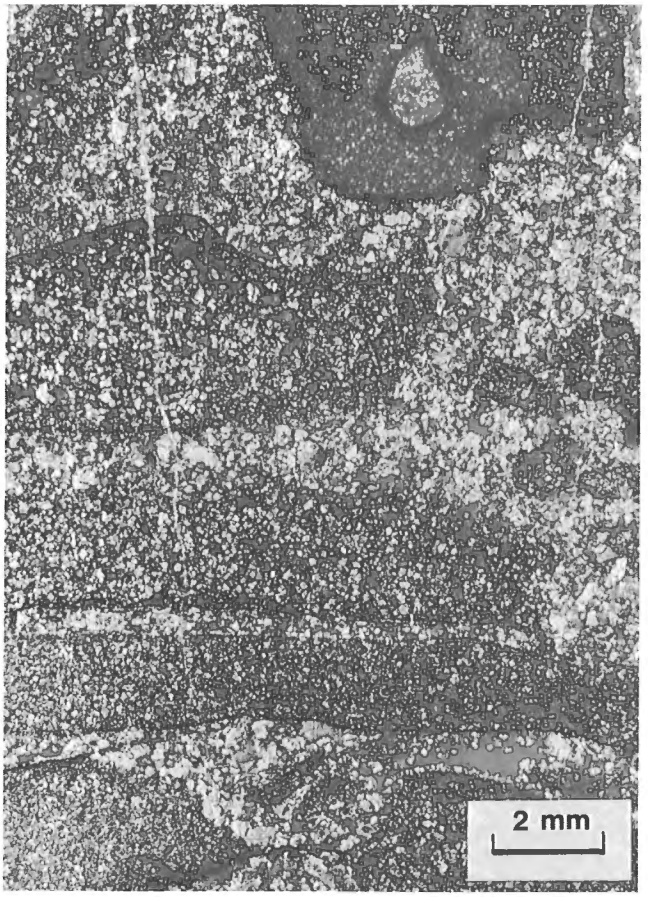


Figure A-65. *Dolomite, ex-flat-pebble rudstone, Tershishner Member of the Pika Formation, type section. Thin-section photomicrograph. Grey, equicrystalline dolomite between pebbles is interpreted as matrix rather than cement. Despite complete dolomitization, such details as the bored pebble and the dark rims of pebbles (micritized?) are preserved. Interpretation of the protolith is straightforward, both in thin section and in the field. ISPG photo 760-29.*

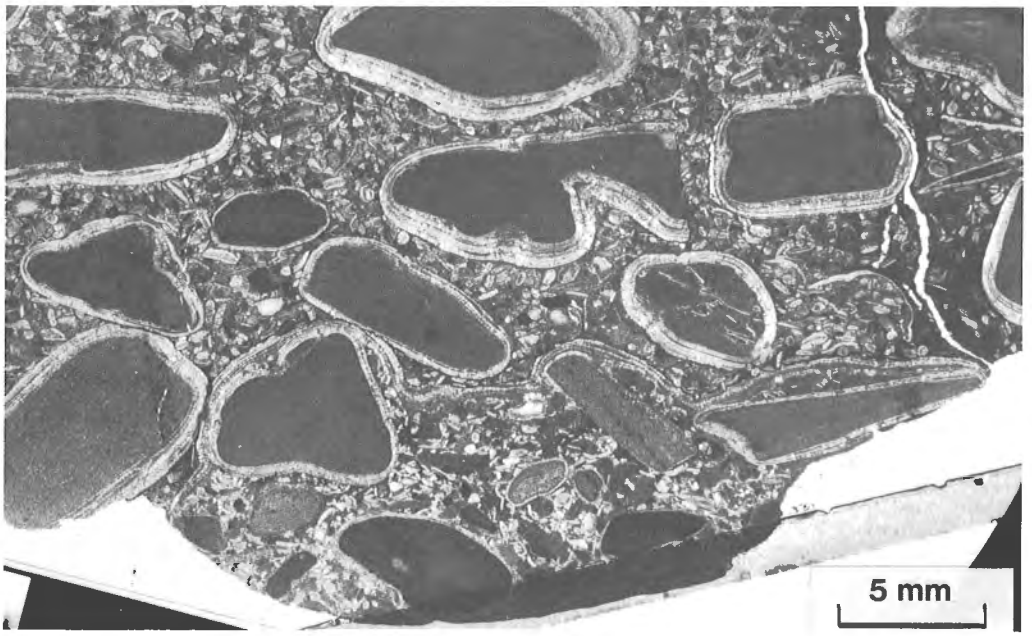


Figure A-66. *Equant-pebble rudstone, Waputik Member of the Stephen Formation, Beauty Creek (Section AC–48). Thin-section photomicrograph. Most of the pebbles, some red, some bored, are calcisiltite. Each is completely coated with finely and evenly laminated calcite with radial-fibrous texture. The compound pebble at the bottom of the photo is of over-packed, echinoderm–trilobite-intraclast grainstone, in which the grains are not coated. All characteristics of the bed imply prolonged residence at or near the sediment-water interface; it is a submarine hardground. ISPG photo 1627-1.*

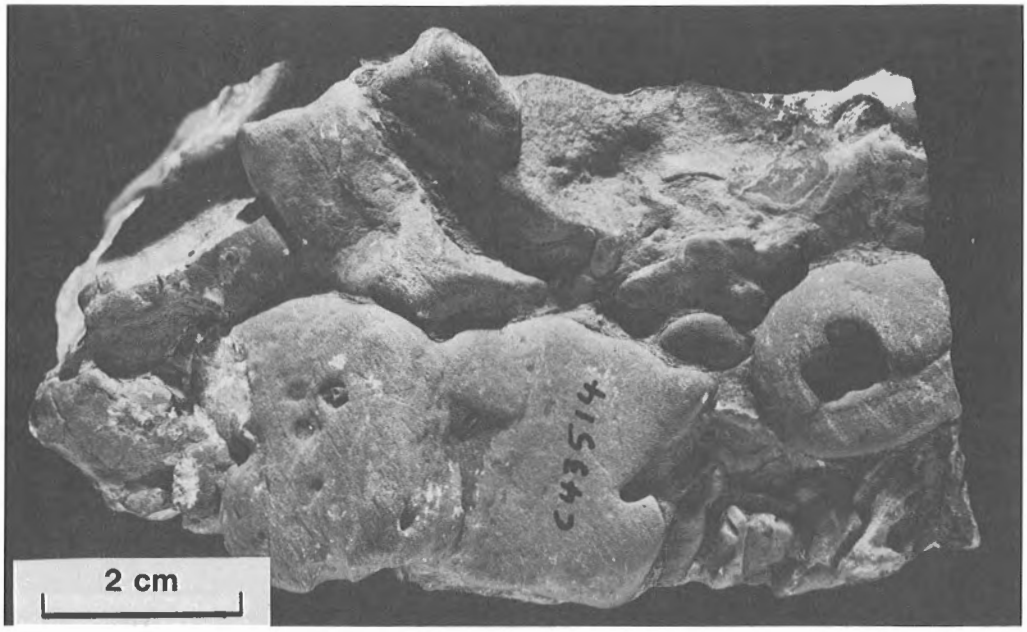


Figure A-67. *Rudstone (hardground). Same locality as Figure A-66. Note the bored and embayed pebbles. This is the exhumed upper surface of a bed. ISPG photo 786-9.*

Figure A-68. *Stromatolites. Same locality as Figures A-66 and A-67. Note the interference ripple-marks, which demonstrate the synoptic relief. GSC photo 11-23-44.*

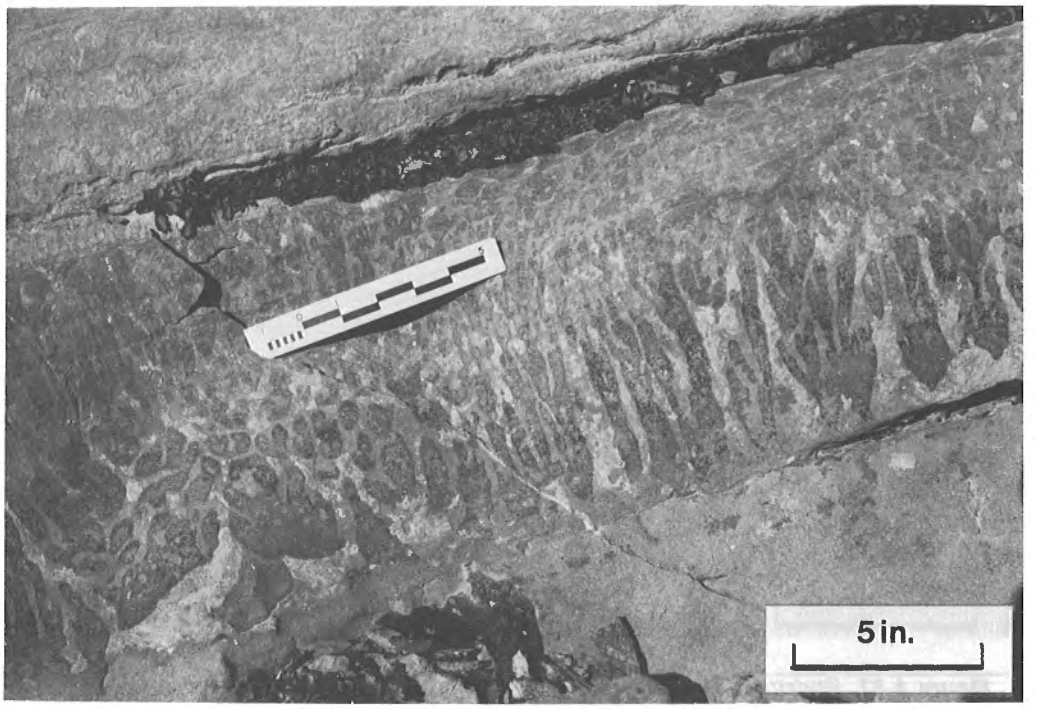


Figure A-69. *Columnar-branching stromatolites, Pika Formation, Chaba River (Section AC–142). This occurrence is significant in that it is in one of the most westward sections of the Pika Formation, and thus is supportive evidence for the existence of the Kicking Horse Rim. GSC photo 5-21-65.*

Figure A-70. *Thrombolites, Waputik Member of the Stephen Formation, Mount Weed (Section AC–171). ISPG photo 1569-7.*

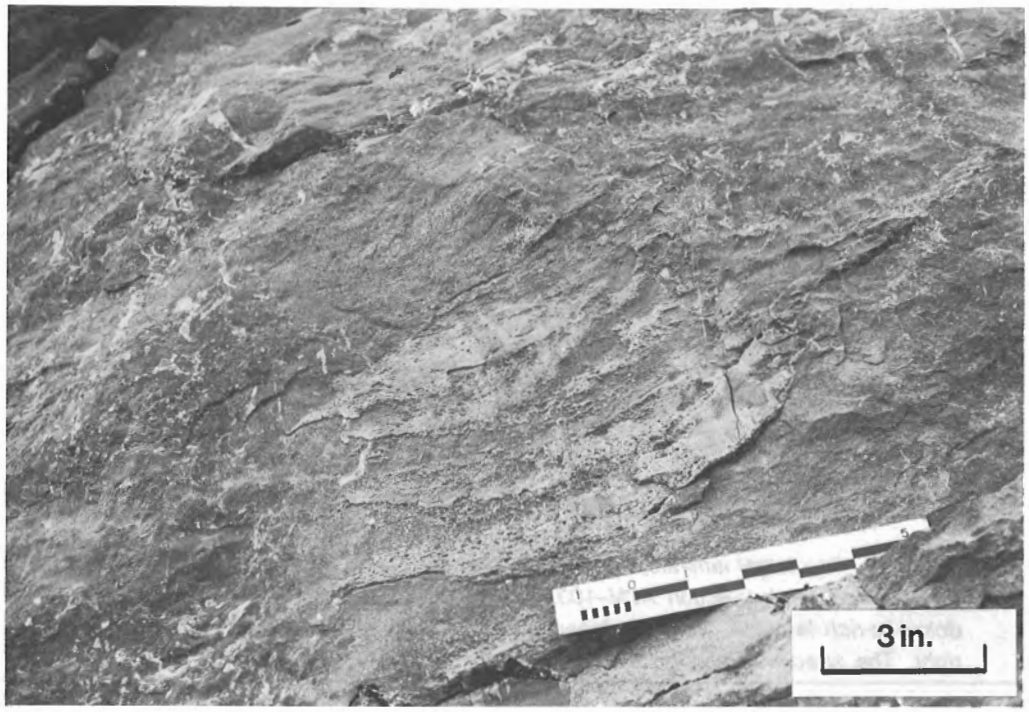


Figure A-71. *"Channel" filling of intraclast grainstone between extensive tabular thrombolites, top of Eldon Formation, Chaba River (Section AC–142). GSC photo 5-17-65.*

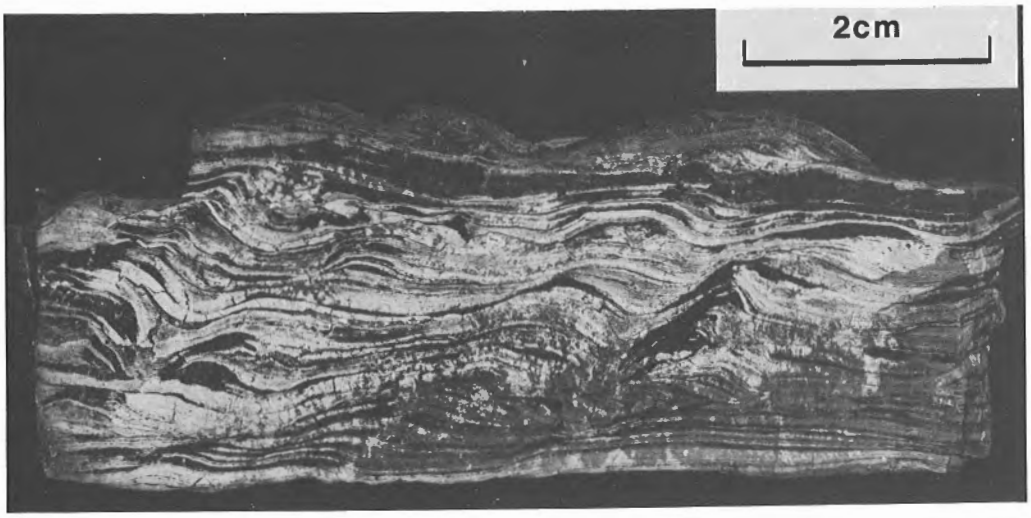


Figure A-72. *Cryptalgal laminite and laterally linked stromatolites, Narao Member of the Stephen Formation, Kicking Horse Pass roadcuts (Section AC–123). Etched slab. Alternate laminae are calcitic (dark) and dolomitic (pale). The blister-like stromatolites are assumed to have grown preferentially against the dominant water flow. ISPG photo 786 20.*

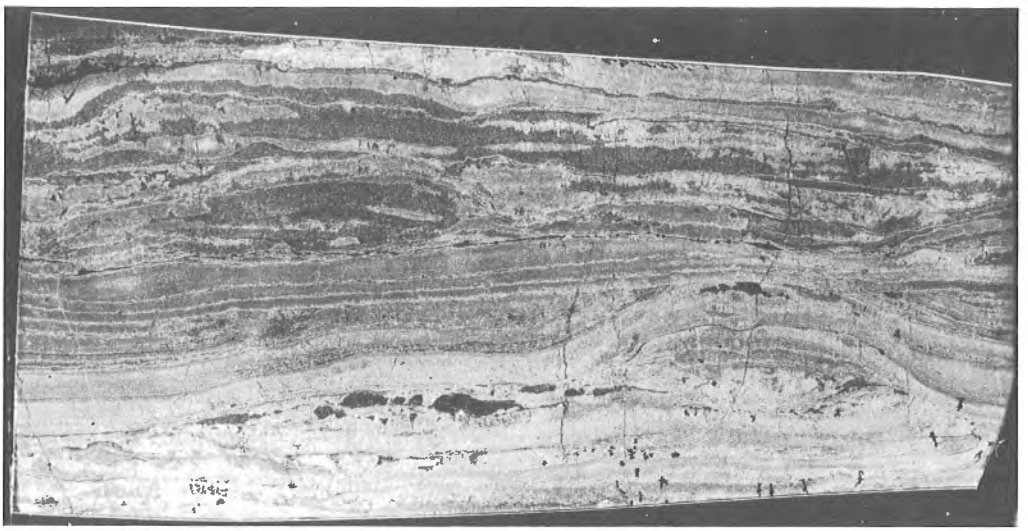


Figure A-73. *Cryptalgal laminite, upper Cathedral Formation (Narao Member equivalent), Wedgewood Peak (Section ACV–103). Peel print. Calcite-rich laminae alternate with dolomite-rich laminae. Note the fenestrae and the small, domal stromatolite at lower right. The specimen shows about 2.5 cm of strata. GSC photo 113759-A.*

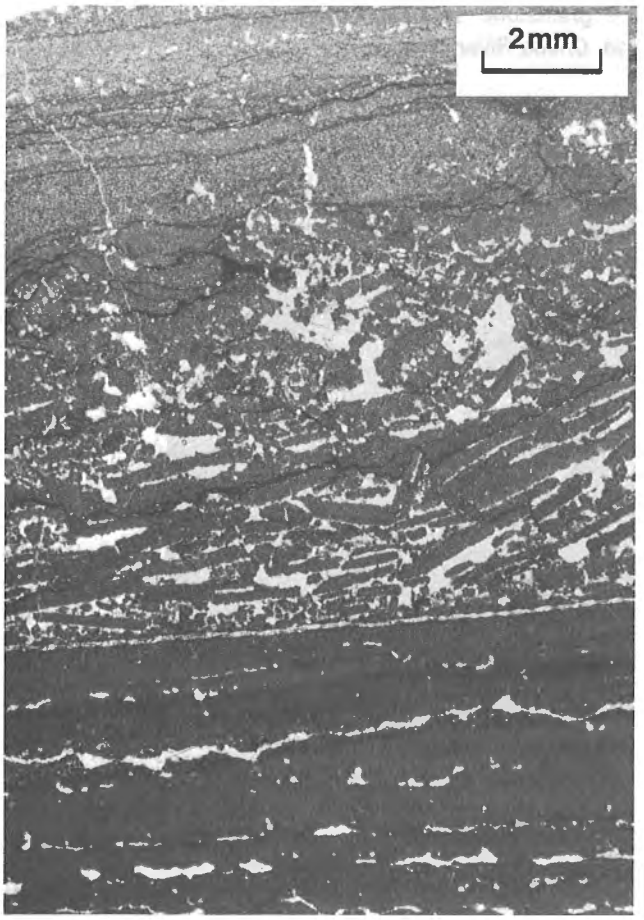


Figure A-74. *Fenestral cryptalgal laminite with flakestone. Same locality as Figure A-72. Thin-section photomicrograph. ISPG photo 760-51.*

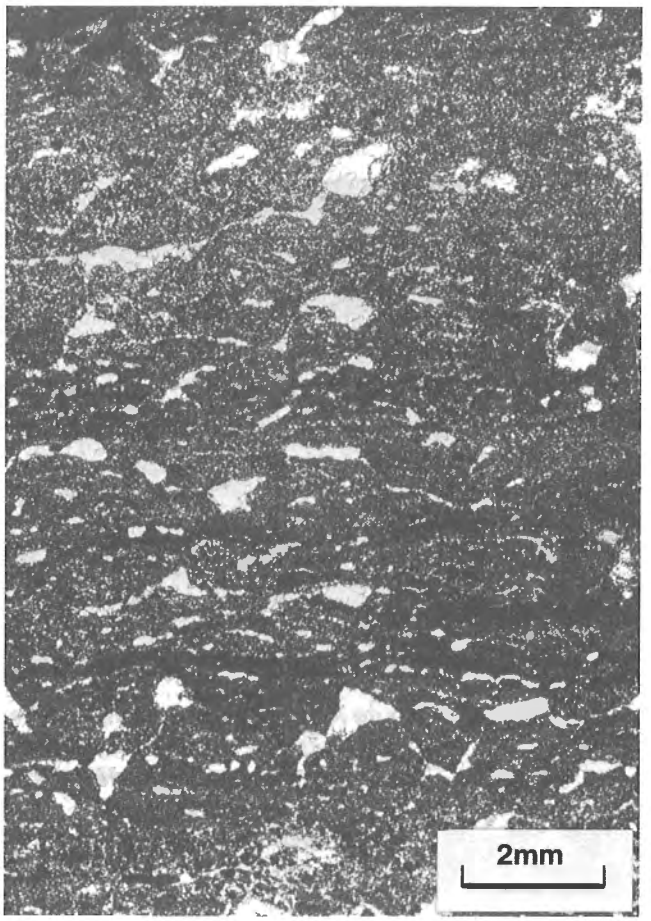


Figure A-75. *Fenestral cryptalgal laminite. Same locality as Figure A-72. Thin-section photomicrograph. Note the pelleted ("spongiostromatid") fabric of the indistinct laminae. ISPG photo 760-63.*

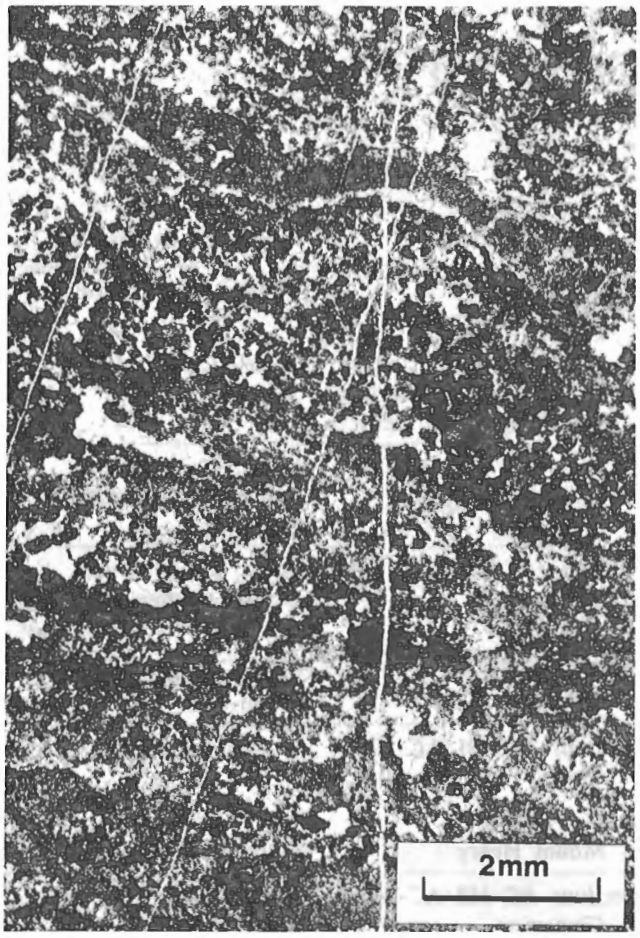


Figure A-76. *"Spongiostromatid" fabric in fenestral cryptalgal laminite. Same locality as Figures A-72. Thin-section photomicrograph. The rock consists of irregular pellets or peloids, cemented by sparry calcite. ISPG photo 760-56.*

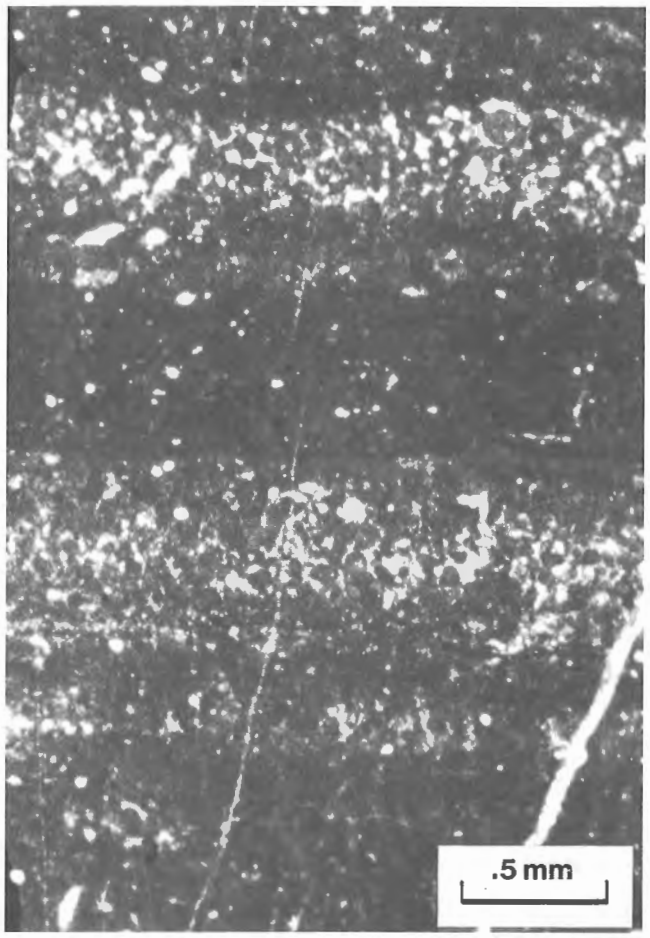


Figure A-77. *Pelleted ("spongiostromatid") fabric in cryptalgal laminite, top of Cathedral Formation, Mount McDonald (Section AC–94). Thin-section photomicrograph. The rock is about 50 per cent dolomite, but primary fabric is well preserved. Note the inverse grading of pellets. ISPG photo 760-18.*

APPENDIX B

DESCRIPTIONS OF MEASURED SECTIONS

Contents

Locality	Formations described
Section AC-24 Helena Ridge (Castle Mountain)	Mount Whyte, Cathedral, Stephen, Eldon, and Pika
Sections AC-26/AC-28/AC-109 Ghost River (composite)	Mount Whyte, Cathedral, Stephen, Eldon, and Pika
Section AC-39 Windy Point, North Saskatchewan River	Cathedral, Stephen, Eldon, and Pika
Section AC-41 Park Boundary, North Saskatchewan River	Peyto, Mount Whyte, Cathedral, Stephen, and Eldon
Section AC-48 Beauty Creek/Trinity Lakes	Peyto, Mount Whyte, Cathedral, Stephen, Eldon, and Pika
Sections AC-53/AC-55 Vermilion Pass (composite)	Cathedral, Stephen, and Eldon-Pika
Sections AC-86/AC-87 Miette Range (composite)	Snake Indian, Eldon, and Pika
Section AC-89 Chetamon Mountain	Peyto, Snake Indian, Eldon, and Pika
Section AC-94 Mount McDonald	Peyto, Mount Whyte, Cathedral, Stephen, Eldon, and Pika
Section AC-102 Eon Mountain	Stephen, Eldon, and Pika
Section AC-103 Mount Wedgwood	Naiset and Cathedral
Sections AC-112/AC-114 Mount Stephen, North Gully and Fossil Gully	Naiset, Cathedral, and Stephen
Sections AC-122/AC-123 Kicking Horse Pass roadcuts	Peyto, Mount Whyte, Cathedral, Stephen, and Eldon
Sections AC-142/AC-143 Chaba River	Peyto, Mount Whyte, Cathedral, Stephen, Eldon, and Pika
Section AC-160 Tokumm Creek	Cathedral, Stephen, and Eldon-Pika
Sections AC-161/AC-162 Mount Field	Stephen and Eldon
Section AC-164 Mount Henry	Peyto, Snake Indian, Eldon, and Pika
Sections AC-165/AC-166 Cinnamon Peak/Whitehorn (Mount Robson District)	Hota, Chetang, Tatei(?), Eldon, and Pika
Section AC-171 Mount Weed	Peyto, Mount Whyte, Cathedral, Stephen, and Eldon
Section AC-172 Ross Lake	Peyto, Mount Whyte, and Cathedral

SECTION AC-24

Type section of the Eldon and Pika formations at Helena Ridge (Castle Mountain massif)

(lat. 51°18′52″N, long. 115°54′08″W)
(For access see Appendix C)

ARCTOMYS FORMATION

The Arctomys Formation is markedly recessive weathering relative to the underlying Pika Formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Section continues upward.		
5	Covered		
4	**Shale**: purple-red, with calcareous, greenish white spots; weakly fissile	1 (0.3)	12 (3.7)
3	Covered	6 (1.8)	11 (3.4)
2	**Dolomite**: grey, dense, argillaceous; in green weathering beds, 1 to 2.5 cm thick	4 (1.2)	5 (1.5)
1	**Shale** (60%) and **dolomite** (40%) Shale: greenish grey, dolomitic. Dolomite: as above, in 2 cm thick beds.	1 (0.3)	1 (0.3)
	Abrupt contact. Relief of 1 ft (30 cm) or more follows the outline of underlying stromatolites.		

PIKA FORMATION
(522.5 ft/159.3 m)
(Type Section)

Units 16 to 25 are moderately to strongly cliff forming. Stylolites, subparallel to bedding, are strongly developed and imply postdepositional thinning of the formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
27	**Limestone**: grey, fragmental, vuggy	1.5 (0.5)	522.5 (159.3)
26	**Dolomite**: grey, microcrystalline, laminated, platy; infilling relief of stromatolites	1 (0.3)	521 (158.8)
25	**Dolomite**: microcrystalline, dark grey. In the middle, vuggy and brecciated. At the top, stromatolitic mounds of pale grey, microcrystalline dolomite, with diameters up to 5 ft (1.5 m), and a relief of more than 1 ft (30 cm)	4 (1.2)	520 (158.5)
24	**Dolomite**: cryptalgal laminite with laminoid fenestral vugs; dark grey, weathers pale brown, prickly; microcrystalline (aphanitic). Minor chert, in a black, nodular, 2 cm thick bed. Faint pinkish and greenish colours appear 40 ft (12.2 m) above the base	57.5 (17.5)	516 (157.3)
23	**Dolomite**: dark grey, weathers pale grey, pitted; microcrystalline, massive, scattered small vugs (cf. Unit 24)	7.5 (2.3)	458.5 (139.8)
22	**Dolomite**: cryptalgal laminite; pale grey, weathers very pale brown; microcrystalline (aphanitic). Minor zones with small vugs; these are quartz filled above. Thin breccias common on bedding planes. Bedding joints spaced 5 to 40 cm; blocky fracture	29 (8.8)	451 (137.5)
21	**Dolomite**: as Unit 19, largely ex-parted and ex-burrow-mottled lime mudstone. Rare intervals, 1 ft (30 cm) or less thick, are dominated by intraclast grain/rudstone	138 (42.1)	422 (128.6)
20	**Dolomite**: ex-intraclast grain/rudstone and ex-pellet grainstone	9 (2.7)	284 (86.5)
19	**Dolomite**: dark brownish grey, very fine crystalline, in regular, 5 to 20 cm thick beds	16 (4.9)	275 (83.8)
18	**Dolomite**: ex-parted lime mudstone, in 1 cm thick beds; grey, weathers pale brown, flaggy; very fine crystalline. A few, massive, 30 cm thick beds of mottled lime mudstone. Forty-four feet (13.4 m) above the base, a 5 cm thick bed of intraclast grain/rudstone. Sixty feet (18.3 m) above the base, a 30 cm thick massive bed of ex-oolite. Eighty-one to eighty-two feet (24.7 to 25 m) above the base, ex-oolite interbedded with ex-mudstone	82 (25)	259 (78.9)
17	**Dolomite**: largely flat-pebble rudstone with "edgewise" fabric; grey, very fine crystalline; ex-oolite in top 20 cm	8 (2.4)	177 (53.9)
16	**Dolomite**: pale grey, yellow weathering; microcrystalline, finely laminated (?cryptalgal)	15 (4.6)	169 (51.5)

Units 1 to 15 support a ledgy topographic profile.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	Covered Shale (in float): as below	5 (1.5)	154 (46.9)
14	**Dolomite**: dark grey, microcrystalline, laminated, largely platy, with 15 cm of dark grey, sheared shale in the middle	3 (0.9)	149 (45.4)
13	**Dolomite**: dark brownish grey, weathers grey and pale brown; very fine crystalline, partly laminated; bedding joints spaced 15 to 13 cm. Probably the same lithofacies as Unit 12, but dolomitized	30 (9.1)	146 (44.5)
12	**Limestone**: parted lime mudstone; beds regular, about 2 cm thick; weathers dark grey, cliff forming. In upper part, ripple crosslamination and burrows. Immediately north of the section, this unit is dolomitized	18 (5.5)	116 (35.4)
11	**Limestone**: parted lime mudstone, in beds 0.5 to 1 cm thick. Top 3 ft (1 m) of unit are generally altered to dolomite: very pale brown, very fine crystalline	6 (1.8)	98 (29.9)
10	**Shale**: olive, as below, very weakly fissile, with abundant small (0.5–2.5 cm) limestone nodules	6 (1.8)	92 (28)
9	**Limestone**: burrow-mottled lime mudstone. At the top, 0.3 ft (10 cm) of intraclast grainstone/packstone	3 (0.9)	86 (26.2)
	GSC loc. 52569 (2.5 to 3 ft/0.8 to 1.1 m above the base) *Modocia* spp. *Marjumia* spp.		
8	**Shale**: olive, soft, calcareous, weakly fissile, with 20 per cent beds and lenses of grey, microcrystalline limestone, 0.5 to 1 cm thick	4 (1.2)	83 (25.3)
7	Covered: recessive (?)Shale as above	12.5 (3.8)	79 (24.1)
6	**Limestone**: ooid packstone with skeletal bands; ooids are completely dolomitized; weathers dark grey, brown specked; massive	2 (0.6)	66.5 (20.3)
5	**Limestone**: parted lime mudstone; irregular, discontinuous beds, 1 to 2.5 cm thick; dolomite partings constitute 40 per cent of unit	9.5 (2.9)	64.5 (19.7)
4	Covered Probably shale: as higher in section	6 (1.8)	55 (16.8)
3	**Dolomite**: ex-parted lime mudstone; grey, fine crystalline, with partings and mottlings of dolomite: dark grey, very fine crystalline, argillaceous	19.5 (5.9)	49 (14.9)
2	**Dolomite**: cryptalgal laminite; local crosslamination; dark grey, fine crystalline at base, dark grey, aphanitic above; bedding planes have black coating	8.5 (2.6)	29.5 (9)
1	**Dolomite**: ex-parted lime mudstone; very fine crystalline, grey to dark grey, beds 2.5 to 5 cm thick; partings are dark argillaceous dolomite at base, grading to tan shale at top.	21 (6.4)	21 (6.4)
	Concordant contact.		

ELDON FORMATION

(893 ft/272.2 m)
(Type section)

The Eldon Formation forms steep slopes and cliffs, pale in colour. Resistance to weathering varies, but not sharply from unit to unit.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
12	**Dolomite**: stromatactoid; laminae of coarse white dolomite are vuggy; minor intervals of dolomite: dark grey, with white mottling. Spongy silicification common in uppermost 22 ft (6.7 m)	72 (21.9)	893 (272.2)
11	**Dolomite**: grey, weathers very pale grey, pitted; fine to medium crystalline, massive; fair to good vuggy porosity throughout; strongly cliff forming	24 (7.3)	821 (250.2)
10	**Dolomite**: brownish grey, locally dark grey, weathers grey, pitted to cavernous; fine crystalline; clear traces of relict, coarse, particulate fabric; crossbedded, in sets 15 to 30 cm thick. Unit is remarkably uniform. Contact at top gradational	100 (30.5)	797 (242.9)
9	**Dolomite**: ex-burrow-mottled lime mudstone; grey, weathers grey, pitted; fine crystalline, mottled by darker, finer dolomite; several vuggy zones in medium crystalline dolomite; bedding joints stylolitic	29 (8.8)	697 (212.4)
8	**Dolomite**: grey, weathers grey, cavernous; fine crystalline, crossbedded and crosslaminated (i.e., ex-particulate limestone), beds 30 cm and thicker, fair vuggy porosity	28 (8.5)	668 (203.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
7	**Dolomite**: grey, weathering grey, cavernous; medium crystalline, in part finely mottled with white dolomite; beds 30 cm and thicker, crossbedding common; patches of poor to fair, vuggy porosity	27.5 (8.4)	640 (195.1)
	Upward line of measurement offsets 300 m to the west, to reach better outcrops.		
6	**Dolomite**: dark grey to black, mottled by white in vermicular fashion (i.e., ex-fenestral fabric); fine and medium crystalline; bedding joints, spaced 5 to 20 cm, have strong development of stylolites; fenestrae die out upward; dolomite grades to ex-parted lime mudstone	161.5 (49.2)	612.5 (186.7)
5	**Dolomite**: ex-parted lime mudstone; dark brownish grey, partly mottled in shades of grey; very fine crystalline; darker laminae preserve very thin (1–2.5 cm) bedding. Thin beds of ex-particulate dolomite (as below) occur at about 5 ft (1.5 m) intervals, and at 2 ft (60 cm) intervals in the uppermost 110 ft (33.5 m). Unit weathers dark brownish grey, recessive in uppermost 75 ft (22.9 m)	139 (42.4)	451 (137.5)
4	**Dolomite**: ex-burrow-mottled lime mudstone; dark grey, normally faintly mottled in paler and darker grey, weathers dark brownish grey, pitted; fine and very fine crystalline; local 1 ft (30 cm) thick zones mottled with coarser, white dolomite; massive, with bedding suggested by aligned mottlings; rare vuggy zones associated with white mottling. Thirty-two to forty-two feet (9.8 to 12.8 m) above the base is a lens of dolomite: pale pinkish grey, weathering pale brown; fine and medium crystalline; with many vuggy zones, 2.5 to 5 cm thick, commonly associated with breccia (?collapse breccia) along bedding planes. A distinctly crossbedded unit, coarsely particulate, with dark intraclasts in a white matrix, occurs 117 to 120 ft (35.7 to 36.6 m) above the base. Crosslamination is fairly common	130 (39.6)	312 (95.1)
	At this point, a west-side-down normal fault, with displacement estimated at 300 to 400 ft (91 to 122 m) is encountered. The contact between units 3 and 4 was relocated west of the fault, on the slope above Tower Lake, with a probable accuracy of ±15 ft (5 m).		
3	**Dolomite**: a massive, laterally persistent body; dolomite grades upward from dark grey to black and fine crystalline at the base, to dark grey, medium crystalline, prominently mottled by white, for most of the unit (?ex-burrow-mottled lime mudstone); becomes vuggy and cavernous upward, the vugs are associated with the white dolomite, which clearly postdates the dark phase. The unit forms a persistent, nearly white cliff	21 (6.4)	182 (55.5)
2	**Dolomite**: pale grey, partly mottled in pale and darker grey, mottlings less prominent than below, weathers dark grey; very fine crystalline; largely laminated, partly cross-laminated; strong development of stylolites has thinned the unit appreciably	82 (25)	161 (49.1)
1	**Dolomite**: dark grey, pale brown weathering, very fine crystalline; very regular, very thin and thin beds; prominent feeding burrows, about 1 cm wide; a cliff forming unit.	79 (24.1)	79 (24.1)

STEPHEN FORMATION
(237 ft/72.2 m)

The Stephen Formation supports a clearly demarcated, recessive weathering, ledged slope between the cliff formers above and below.

Waputik Member
(142 ft/43.3 m)
(Units 7 to 14)

14	Covered	20 (6.1)	237 (72.2)
13	**Limestone**: largely ooid grainstone/packstone, subordinate lime mudstone; irregularly very thin bedded, grey weathering, with scattered, orange weathering, dolomitized blotches	4 (1.2)	217 (66.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
12	**Shale**: green-grey, fissile	10 (3)	213 (64.9)
11	**Limestone**: skeletal grainstone/packstone; medium bedded, with minor interbeds of shale (as below)	7.5 (2.3)	203 (61.9)
10	**Shale**: olive-green, silty, moderately fissile, with a variable content (locally up to 10 per cent), of 0.5 to 1 cm thick beds of pink weathering lime mudstone. Beds of flat-pebble rudstone, 10 to 15 cm thick, occur at about 5 ft (1.5 m) intervals in the basal 15 ft (5 m)	42.5 (13)	195.5 (59.6)
9	**Limestone**: calcisiltite; laminated and crosslaminated, very thin and thin bedded, with argillaceous partings. At the top, a bed of flat-pebble rudstone 10 cm thick	15 (4.6)	153 (46.6)
8	**Shale**: grey, weathering brownish grey, silty, very calcareous, weakly fissile. Limestone: lime mudstone, in beds 1 cm thick, forms 20 per cent at the base, increasing upward to 80 per cent at the top	22.5 (6.9)	138 (42.1)
7	**Shale**: dark grey, minor brown, fissile; rare laminae of calcareous siltstone, 5 to 10 mm thick. Two 30 cm thick beds of coarse, skeletal grainstone/packstone, the upper of these capped with a layer of small rounded pebbles. At the top, a bed of flat-pebble rudstone, 5 cm thick	20.5 (6.2)	115.5 (35.2)

Narao Member
(95 ft/29 m)
(Units 1 to 6)

The Narao Member has its usual topographic expression of a double cliff with medial and basal recessive weathering ledges (two cycles).

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Limestone**: grading from parted lime mudstone at the base to burrow-mottled lime mudstone at the top, with progressive upward thickening of bedding from very thin to thick bedded; scattered fragments of trilobites; cliff forming	26.5 (8.1)	95 (29)
5	**Shale**: dark grey, fissile, recessive weathering	0.5 (0.2)	68.5 (20.9)
4	**Limestone**: parted lime mudstone; laminated to thin bedded, partly lenticular bedded; from 18 ft (5.5 m) upward, bedding increases to medium bedded, with intrabed lamination. At the base, a 5 cm thick bed of flat-pebble rudstone. The top 2 ft (60 cm) of the unit are altered to calcareous dolomite: very fine crystalline, weathering pale orange-brown (this is a laterally persistent zone)	40 (12.2)	68 (20.7)
3	**Limestone** (70%) and **dolomite** (30%) Limestone: parted lime mudstone; very thin, lenticular beds; dolomite occurs as partings of very argillaceous dolomite. Some beds are cross-laminated (?calcisiltite). At the base, a single thin bed of flat-pebble rudstone. *Glossopleura*? sp. occurs in the interval 9 to 12 ft (2.1 to 3.7 m) above the base	13 (4)	28 (8.5)
2	Poorly exposed: recessive weathering **Shale:** soft, olive-green, weathering pale brown, with nodules of grey, microcrystalline limestone	9.5 (2.9)	15 (4.6)
1	**Dolomite**: ex-parted lime mudstone; dark grey, weathers grey, fine crystalline, thin bedded.	5.5 (1.7)	5.5 (1.7)

Gradational, conformable contact.

CATHEDRAL FORMATION
(954 ft/290.8 m)

The Cathedral Formation forms a major cliff, broken only by the slight notch of the Ross Lake Member.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
23	**Dolomite**: ex-burrow-mottled lime mudstone; mainly white, fine and medium crystalline, mottled by dark grey, very fine crystalline; mainly massive, with bedding indicated only by aligned mottling; minor intervals of thin and medium bedding, in which the dark grey phase is dominant. Unit weathers pale brownish orange overall	184 (56.1)	954 (290.8)
22	**Dolomite**: stromatactoid	11.5 (3.5)	770 (234.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	**Dolomite**: (?)ex-cryptalgal laminite; interlaminated dark grey, microcrystalline dolomite, and grey, fine crystalline. Some crosslamination and apparent ripple forms. Weathers interlaminated pale brownish grey and pale pinkish brown	21.5 (6.6)	758.5 (231.2)
20	**Dolomite**: as below, except that the mottling does not define bedding planes; weathers mottled pinkish pale brown and grey	20 (6.1)	737 (224.6)
19	**Dolomite**: grey mottled with dark grey and white, weathers grey with patches of pinkish pale brown, fine crystalline; spacing of bedding joints suggests that the unit is ex-parted lime mudstone at the base, grading upward to ex-burrow-mottled lime mudstone	75 (22.9)	717 (218.5)
18	**Dolomite**: as above, weathering pinkish pale brown; bedding joints spaced 3 to 8 cm apart suggest that the unit is ex-parted lime mudstone	64.5 (19.7)	642 (195.7)
17	**Dolomite**: mainly white, fine crystalline, uniform, weathering pinkish pale brown; mottled by elongate blebs of dark grey, very fine crystalline dolomite; alignment of dark mottlings along planes, and the 2 to 3 cm spacing of these planes, suggests parted lime mudstone as the precursor. Stromatactoid dolomite occurs at the following heights above the base: 15 ft (4.6 m); 25 to 30 ft (7.6 to 9.1 m); 105 to 106 ft (32 to 32.3 m); and 111 to 115 ft (33.8 to 35.1 m)	120.5 (36.7)	577.5 (176)
16	**Dolomite**: mottled in shades of grey, weathering grey, fine crystalline; alignment of dark blebs, as in Unit 15, shows indistinct bedding, but bedding joints are mostly lacking	85 (25.9)	457 (139.3)
15	**Dolomite**: ex-parted lime mudstone; grey, weathers grey and pale brown, very fine crystalline, very thin bedded, with darker, argillaceous mottling on bedding planes	17 (5.2)	372 (113.4)
14	**Limestone**: parted lime mudstone; nearly black, dark grey weathering. *Albertella* sp. occurs throughout the unit	13 (4)	355 (108.2)
	Unit 14 was described 300 m north of the line of section; on the line of section, it is dolomite: as Unit 15.		
	Ross Lake Shale Member (18 ft/5.5 m) (Units 11 to 13)		
13	Covered (?)shale	13 (4)	342 (104.2)
12	**Shale**: grey, grey weathering, fissile, splintery	3 (0.9)	329 (100.3)
11	**Dolomite**: grey, weathering pale orange, recessive; calcareous, fine crystalline; contains trilobite fragments, including *Albertella* sp.	2 (0.6)	326 (99.4)
10	**Dolomite**: mottled as below, but mainly with wavy laminae giving a thin bedded appearance of varying distinctness; prominent stylolitic bedding joints are spaced from 30 to 100 cm apart. Eighty-four feet (25.6 m) above the base, a 15 cm thick bed of stromatactoid dolomite occurs	150 (45.7)	324 (98.8)
9	**Dolomite**: (?)cryptalgal laminite; pale grey, microcrystalline, laminated	2 (0.6)	174 (53)
8	**Dolomite**: mottled, as below; bedding joints are spaced 10 to 30 cm apart at the base, but the unit becomes very thick bedded upward; bedding planes are stylolitic	61 (18.6)	172 (52.4)
7	**Limestone**: as below; partly intraclast grain/rudstone; upper contact with dolomite crosses the bedding. Thirty metres west of the line of section, the limestone passes entirely into dolomite	9 (2.7)	110 (33.8)
6	**Dolomite**: mottled, ex-parted lime mudstone: blebs of dark grey, very fine crystalline, argillaceous dolomite in nearly white, fine crystalline, pink weathering dolomite; basal contact with limestone locally crosses the bedding	5 (1.5)	102 (31.1)
5	**Limestone**: mainly parted lime mudstone; nearly black, weathering very dark grey, flaggy. Near the base, a few beds of ooid grainstone/packstone, and scattered oncoids	33 (10.1)	97 (29.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Limestone**: parted lime mudstone; very thin, flaggy beds; recessive weathering	11 (3.4)	64 (19.5)
3	**Limestone**: argillaceous lime mudstone, with varve-like laminae 1 to 12 mm thick; weathers striped grey and pale brown	13 (4)	53 (16.2)
2	**Limestone**: parted lime mudstone, argillaceous; in part oncoid and intraclast wackestone and floatstone; flaggy, weathers dark grey. Seventeen to eighteen feet (5.2 to 5.5 m) above the base, a bed with oncoids up to 2.5 cm diameter	30 (9.1)	40 (12.2)
1	**Limestone**: oncoid packstone, in part with dolomitized matrix; thin bedded, flaggy.	10 (3)	10 (3)
	Concordant contact.		

MOUNT WHYTE FORMATION
(308 ft/93.9 m)

The Mount Whyte Formation is recessive weathering overall, supporting a slope with minor, resistant ribs (limestone beds). Where it crosses the nose of Helena Ridge, it is eroded to form a broad saddle between the resistant strata above and below.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
5	**Sandstone** and **shale** (70%), and **limestone** (30%) Sandstone and shale: as below, entirely calcareous. Limestone: flaggy, oolitic, and oncoidal, as below, mainly in units 1 to 3 ft (0.3 to 1 m) thick. Trilobite fragments are widespread, but preservation is poor	24 (7.3)	308 (93.9)
4	**Sandstone** (60%) and **shale** (40%) (interbedded) Sandstone and shale: as below; burrows and feeding trails are well developed. Beds of ooid grainstone/packstone, about 15 cm thick, occur at a spacing of 5 to 10 ft (1.5 to 3 m). Twenty-nine feet (8.8 m) above the base, a 30 cm thick bed of oncoid grainstone/packstone occurs, with abundant, large, trilobite free cheeks on its upper surface. Thirty-two feet (9.8 m) above the base, an 8 cm thick bed of very coarse oncoid grainstone/packstone occurs, with oncoids up to 2 cm in diameter. At the top, a single massive bed of grainstone/packstone occurs, alternately oolitic and oncoidal	49 (14.9)	284 (86.6)
3	**Sandstone** (90%) and **shale** (10%) Sandstone: very pale grey, very fine grained, argillaceous, rust specked, in thin and very thin, irregularly lenticular, intensely bioturbated beds. Shale: olive; as below. Burrows and feeding traces abundant and prominent. Beds of skeletal, ooid grainstone/packstone, 2.5 to 5 cm thick, occur at 22 and 25 ft (6.7 and 7.6 m) above the base. Similar beds, 30 to 45 cm thick, occur 30, 35, and 39 ft (9.1, 10.7, and 11.9 m) above the base	40 (12.2)	235 (71.6)
2	**Shale** (90%) and **limestone** (10%) Shale: mainly olive, very fissile, olive weathering. Limestone: argillaceous, silty lime mudstone. At the base, the limestone occurs as nodules 5 x 7.5 cm and, higher up, mainly as 1 cm thick beds. Unit is thoroughly bioturbated, with abundant trace fossils	40 (12.2)	195 (59.4)
1	**Shale**: grey, olive, and brown, silty, micaceous, platy, with 10 per cent laminae, 6 to 12 mm thick, of siltstone: pale brown, slightly calcareous, weathering rusty-orange. Ninety feet (27.5 m) above the base, siltstone increases to 30 per cent, shale becomes very silty, and feeding traces become prominent. In the interval 120 to 140 ft (36.6 to 42.7 m) above the base, the tops of several resistant siltstone laminae are littered with trilobite free cheeks.	155 (47.2)	155 (47.2)
	Concordant contact.		

GOG GROUP

	Sandstone (orthoquartzite): mainly white, pink at the top; mainly very thick bedded, massive, resistant.	(not measured)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

COMPOSITE SECTION AC-26/AC-28/AC-109

Ghost River
(the centre of this cluster of sections is at Phantom Crag)

(lat. 51°17′34″N, long. 115°12′04″W)
(For access see Appendix C)

The following section is adapted from Aitken (1968) and recast into the lithological terms of this report.

ARCTOMYS FORMATION (incomplete)

The Arctomys Formation is recessive weathering relative to the Pika and forms a ledged slope partly covered with yellow to orange weathering talus.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	Poorly exposed **Shale** (80%) and **dolomite** (20%): as below. Shale is greenish grey to grey, fissile	14 (4.3)	45 (13.7)
3	**Dolomite**: pale grey, yellow weathering, very fine crystalline, silty; beds 2 cm and less thick, platy, with common 1 cm laminae of greenish grey shale. In uppermost 7 ft (2.1 m), shale is 50 per cent, in subunits up to 30 cm thick	15 (4.6)	31 (9.4)
2	Covered: recessive weathering	14.5 (4.4)	16 (4.9)
1	**Conglomerate**: grey; pebbles of fine crystalline dolomite and clay, rounded. A single, massive bed.	1.5 (0.5)	1.5 (0.5)

Contact concordant, abrupt.

SECTION AC-26

PIKA FORMATION
(320 ft/97.5 m)

The Pika Formation overall is less resistant than the underlying Eldon and weathers pale brown and pale yellow-brown. The basal, 51 ft (15.5 m) thick unit forms a cliff less steep than that of the Eldon and set back from the latter as a distinct ledge. The overlying units to about the midpoint of the formation form a ledged slope. This slope steepens upward in the upper half of the formation, which is moderately resistant.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

Tershishner Member
(50 ft/15.2 m)
(Unit 11)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Dolomite**: as below; weakly resistant and poorly exposed; abundant beds of flat-pebble rudstone. Fifteen-centimetre-thick beds of dolomite, ex-oolite, occur 6 ft (1.8 m) and 20 ft (6.1 m) below the top. Unit weathers very pale yellow-brown	50 (15.2)	320 (97.5)
10	**Dolomite**: brownish grey to brown, very fine crystalline, commonly mottled with darker, finer dolomite. Style of bedding and mottling identical to those of the underlying limestones. Relict masses of undolomitized limestone (as Unit 9) in the lower half of the unit. Unit is moderately resistant and weathers brownish grey	44 (13.4)	270 (82.3)
	Irregular, replacement contact.		
9	**Limestone**: as Unit 7	28 (8.5)	226 (68.9)
8	**Limestone**: burrow-mottled lime mudstone; massive, resistant; aligned mottling suggests thin bedding	11 (3.4)	198 (60.4)
7	**Limestone**: parted lime mudstone, partly calcisiltite; thin bedded, flaggy; bedding planes marked with abundant burrows, feeding traces, and gut casts. Three 5 to 15 cm thick beds of flat-pebble rudstone. Unit resistant, weathers grey striped, and is mottled with pale yellow-brown	41 (12.5)	187 (57)
6	Covered	7 (2.1)	146 (44.5)
5	**Limestone**: as Unit 7. At the top, a bed of flat-pebble rudstone, 2.5 cm thick	39 (11.9)	139 (42.4)
4	**Shale**: brown, micaceous, fissile, slightly calcareous; abundant thin beds, nodular beds and lenses of calcisiltite and trilobite wackestone, partly argillaceous; recessive weathering	16 (4.9)	100 (30.5)
3	Covered: recessive weathering	4 (1.2)	84 (25.6)
2	**Limestone**: as below, with fairly common beds of flat-pebble rudstone up to 10 cm thick. Lowest occurrence of trilobite fragments noted is 8 ft (2.4 m) below the top	29 (8.8)	80 (24.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Limestone**: parted lime mudstone, partly calcisiltite; weathers grey striped and mottled with pale yellow-brown; forms a cliff less steep than that of the Eldon below, and set back from the latter as a distinct ledge.	51 (15.5)	51 (15.5)
	Contact gradational.		

SECTION AC–28

ELDON FORMATION
(776 ft/236.5 m)

The Eldon Formation forms a single, continuous, nearly vertical, grey cliff, incised by major gullies; the latter provide the only routes for examination of the formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Limestone**: as below; very little dolomite. Unit becomes coarsely flaggy and less strongly cliff forming in the uppermost 30 ft (9.1 m)	50 (15.2)	776 (236.5)
10	**Limestone** (90%) and **dolomite** (10%) Limestone: as below. Dolomite: pale brown and grey-brown, fine crystalline, mottled with very fine crystalline, darker dolomite, in the style of burrow-mottled lime mudstone, and occurring as beds 15 to 60 cm thick. Unit weathers grey, and forms a steep cliff continuous with the lower units	59 (18)	726 (221.3)
9	**Limestone**: mainly burrow-mottled lime mudstone and minor pellet grainstone; nonbedded, massive; thin bedding suggested by alignment of mottling	23 (7)	667 (203.3)
8	**Limestone** (70%) and derived **dolomite** (30%) Limestone: burrow-mottled lime mudstone. Dolomite: brown, fine crystalline, mottled. Limestones of this unit are markedly recrystallized	22 (6.7)	644 (196.3)
7	**Limestone**: burrow-mottled lime mudstone; massive; minor intraclast grainstone and secondary dolomite	30 (9.1)	622 (189.6)
6	**Limestone** and derived **dolomite** (interbedded) Limestone: burrow-mottled lime mudstone as above. Dolomite: brown, fine equicrystalline, mottled with very fine crystalline, darker dolomite	40 (12.2)	592 (180.4)
5	**Dolomite**: as below, with minor relict masses of limestone: burrow-mottled lime mudstone and minor pellet grainstone. This unit is mainly limestone on nearby, inaccessible cliffs	46 (14)	552 (168.2)
4	**Dolomite**: partly brown, very fine crystalline, mottled; partly grey to white, fine equicrystalline, with relict particulate texture. Minor subunits of limestone: as below	24 (7.3)	506 (154.2)
3	**Limestone**: beds of burrow-mottled lime mudstone (up to 50 per cent dolomite mottlings), 10 to 30 cm thick, alternating with beds of non-mottled pellet grainstone 2.5 to 5 cm thick	40 (12.2)	482 (146.9)
2	**Limestone**: parted lime mudstone, grading to burrow-mottled lime mudstone; becomes flaggy on prolonged weathering. Unit forms a steep, grey cliff	426 (129.8)	442 (134.7)
1	**Limestone**: parted lime mudstone; dark, argillaceous, thin bedded, flaggy; minor beds of trilobite wackestone (calcisiltite) near the base; weathers dark grey, moderately resistant; slope steepens upward.	16 (4.9)	16 (4.9)
	Contact gradational.		

STEPHEN FORMATION
(71 ft/21.6 m)

The Stephen Formation is recessive weathering and forms a distinct, commonly vegetated ledge.

Waputik Member
(37 ft/11.3 m)
(Units 7 to 9)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	Slumped outcrop: rock type as below	17 (5.2)	71 (21.6)
8	**Shale**: as below, with several 5 to 15 cm thick lenticular beds of massive, ooid grainstone/packstone	5.5 (1.7)	54 (16.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
7	**Shale**: grey at base, deep green, waxy, highly fissile above. At the top, a thin stratum of purple-red shale. In the basal 3 ft (1 m), three 5 cm thick beds of flat-pebble rudstone. Unit is recessive weathering	14.5 (4.4)	48.5 (14.8)

Narao Member
(34 ft/10.4 m)
(Units 1 to 6)

6	**Limestone**: parted lime mudstone, mainly calcisiltite and skeletal (trilobite) wackestone; partly argillaceous, flaggy to platy. At several levels, the upper surfaces of beds are littered with cranidia, pygydia, and free cheeks of *Glossopleura*. At the base, the trace fossil *Bergaueria* is well developed. Unit is moderately resistant, and weathers pale yellow-grey	17 (5.2)	34 (10.4)
	GSC locs. 55323, 55328, 55329 (from 7, 12, and 14 ft (2.1, 3.7, and 4.3 m) above the base		
5	Covered: recessive weathering	2 (0.6)	17 (5.2)
4	**Shale**: yellowish grey, weathers pale yellow-brown, soft, earthy, recessive; very calcareous; rare trilobite fragments	1 (0.3)	15 (4.6)
3	**Limestone**: parted lime mudstone; yellow-grey, very argillaceous, very thin bedded, platy; partings are grey, yellow weathering calcareous shale; scattered pygidia of *Glossopleura*	6 (1.8)	14 (4.3)
2	Covered: recessive weathering	7 (2.1)	8 (2.4)
1	**Limestone**: mainly calcisiltite and skeletal (trilobite) wackestone, with scattered intraclasts; thin bedded.	1 (0.3)	1 (0.3)

Contact abrupt, conformable.

CATHEDRAL FORMATION
(522 ft/159.1 m)

The Cathedral Formation forms a continuous, nearly vertical grey cliff, broken only by the ledge underlain by the Trinity Lakes Member.

7	**Limestone**: mainly burrow-mottled lime mudstone, with subordinate pellet and intraclast grainstone; massive, resistant, forming grey weathering cliffs mottled with pale brown. Bedding, visible at a distance, is the alternation of strongly mottled and weakly mottled beds	292 (89)	522 (159.1)
6	**Limestone**: mainly pellet and intraclast grainstone, minor burrow-mottled lime mudstone; medium and thick bedded, massive, cliff forming	40 (12.2)	230 (70.1)
5	**Limestone**: mainly parted lime mudstone; massive, resistant; minor pellet and intraclast grainstone	27 (8.2)	190 (57.9)
4	**Limestone**: calcisiltite, skeletal wackestone and lime mudstone; in regular, thin and very thin beds with thin partings of dolomite (as above); flaggy. Unit weathers dark grey, moderately resistant, steepening upward	8 (2.4)	163 (49.7)
	GSC loc. 55344 *Glossopleura* sp. *Inglefieldia*? sp.		

Trinity Lakes Member
(20 ft/6.1 m)
(Unit 3)

3	Covered: recessive weathering Unit yields float of shale, flat-pebble rudstone, and trilobite wackestone	20 (6.1)	155 (47.2)
2	**Limestone**: mainly burrow-mottled lime mudstone; bedding indistinct; massive. Unit forms grey weathering cliffs	85 (25.9)	135 (41.1)
1	**Limestone**: parted lime mudstone, grading upward to burrow-mottled lime mudstone. At the base, largely intraclast and pellet grainstone. Unit forms dark grey weathering cliffs.	50 (15.2)	50 (15.2)

Contact gradational.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

SECTION AC-109

MOUNT WHYTE FORMATION (incomplete)

The Mount Whyte Formation is recessive weathering and exposed only locally (see Appendix C).

5	Very poorly exposed **Shale:** recessive weathering, deep green, with abundant nodules of grey, microcrystalline limestone; rare beds of flat-pebble rudstone	37 (11.3)	72 (21.9)
4	**Limestone**: as Unit 2, but shale present only as partings	2.5 (0.8)	35 (10.7)
3	**Limestone**: burrow-mottled lime mudstone; massive, resistant	1.5 (0.5)	32.5 (9.9)
2	**Limestone**: lime mudstone; in fracture cleaved, nodular, thin beds, with interbeds of shale: brown, calcareous	8 (2.4)	31 (9.4)
	GSC loc. 58857 *Albertella* cf. *A. levis* Walcott *Vanuxemella* sp.		
1	**Limestone**: parted lime mudstone, partly calcisiltite, partly argillaceous; massive, moderately resistant, weathers grey mottled with orange.	23 (7)	23 (7)
	Unit 1 overlies faulted outcrop of shale: green, highly sheared, with scattered thin beds of sandstone: green, rust specked, dolomitic, glauconitic, very fine to medium grained. Burrows are prominent. Near the top of this disturbed unit are two thick beds of dolomite-mottled lime mudstone, with minor skeletal grainstone.		

SECTION AC-39

Reference section for the Pika Formation, and type section of its Tershishner Member, at Windy Point, North Saskatchewan River

(lat. 52°16′21″N, long. 116°25′00″W)

The following description is adapted from Aitken (1968).

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

ARCTOMYS FORMATION

The Arctomys Formation is recessive weathering relative to the upper Pika, and its outcrop is characterized by yellow, orange, and red.

Section continues upward.

4	**Siltstone** and **shale** (alternating subunits) Siltstone: as below. Shale: olive-green, hard, fissile. Salt crystal casts	17.5 (5.3)	72.5 (22.1)
3	**Shale** and **siltstone** (interbedded) Shale: as above, green Siltstone: partly pale green, dolomitic, partly silicified, hard, and partly yellow, calcareous, soft, earthy, porous Ten feet (3 m) below the top, a 2.5 cm thick bed of flat-pebble rudstone	27 (8.2)	55 (16.8)
2	**Shale** and **siltstone** (interbedded) Shale: green above, purple below, fissile, with siltstone-filled mudcracks. Siltstone: pinkish green to pale yellow-brown, calcareous, laminated and crosslaminated, pyritic, vuggy, platy to flaggy. Unit forms a ledgy outcrop	25.5 (7.8)	28 (8.5)
1	Covered: recessive weathering.	2.5 (0.8)	2.5 (0.8)
	Contact covered, concordant.		

PIKA FORMATION
(318.5 ft/97.1 m)
(Reference section)

Tershishner Member
(69.5 ft/21.2 m)
(Type section, Units 13 to 18)

The Tershishner Member forms moderately resistant yellowish outcrops lacking the marked variation in resistance between units seen in the sub-Tershishner beds.

18	**Dolomite**: partly ex-dark-pellet grainstone; pale grey to brown, weathers pale orange; fine crystalline, medium bedded, massive. Uppermost bed (5 cm thick) has abundant oncoids up to 5 cm in maximum diameter	15 (4.6)	318.5 (97.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
17	**Dolomite** and **shale** At the base, 1 ft (0.3 m) of shale: grey to olive, dolomitic, fissile, khaki weathering, grading up through very argillaceous, dense rubbly dolomite to dolomite: grey-brown, partly mottled, fine crystalline, slightly silty, slightly argillaceous, thin bedded (ex-parted lime mudstone). Moderately resistant	8 (2.4)	303.5 (92.5)
16	**Dolomite**: ex-parted lime mudstone; mottled pale brown and brown, weathers mottled grey and orange, very fine crystalline, silty, argillaceous, thin bedded, flaggy, partly rubbly; moderately resistant. Six feet (1.8 m) above the base, a 30 cm thick, massive bed of dolomite (ex-intraclast grainstone)	13 (4)	295.5 (90.1)
15	**Dolomite**: ex-ooid and oolitic skeletal grainstone; coarse below, fine above; pale brown, very fine crystalline, massive, resistant	4.5 (1.4)	282.5 (86.1)
14	**Dolomite** Seventy-five per cent dolomite and ex-rudstone: as below. Twenty-five per cent medium beds of dolomite: ex-ooid and pellet grainstone; fine crystalline. Rudstones in part have oolitic matrix	29 (8.8)	278 (84.7)
13	**Dolomite** Seventy-five per cent dolomite: as below, irregularly thin bedded, flaggy (ex-parted lime mudstone). Twenty-five per cent thin and medium beds of dolomite: ex-flat-pebble rudstone; fine and very fine crystalline. Sixteen feet (4.9 m) above the base, a 10 cm thick bed of ex-oolite, with scattered oncoids	42 (12.8)	249 (75.9)
12	**Dolomite**: brown, weathers grey-brown, fine and very fine crystalline, mosaic, locally laminated, largely mottled in the style of burrow-mottled lime mudstone; partly ex-dark-pellet grainstone in the basal 5 ft (1.5 m); medium bedded, massive, moderately resistant; poorly exposed in upper half	25.5 (7.8)	207 (63.1)
11	**Dolomite**: grey, pale brown, weathers smooth, pale yellow brown; fine and very fine crystalline, argillaceous, silty; bedding style and mottling as in underlying limestone; forms a small cliff	16.5 (5)	181.5 (55.3)
10	Mainly covered 1.5 ft (0.5 m) of thin bedded limestone: as below, 3 ft (0.9 m) above the base. Clay-rich talus suggests shale	10 (3)	165 (50.3)
9	**Limestone**: parted lime mudstone; bedding-plane traces as below. One 7.5 cm thick bed of flat-pebble rudstone near the top	28 (8.5)	155 (47.2)
8	Mainly covered 1 ft (0.3 m) of thin bedded limestone: as below, 3 ft (0.9 m) above the base. Float of grey, fissile shale and parted lime mudstone	11 (3.4)	127 (38.7)
7	**Limestone**: calcisiltite and trilobite wackestone (calcisiltite matrix); thin bedded, flaggy to platy; weakly resistant	6 (1.8)	116 (35.4)
	GSC loc. 52577 *Bolaspidella* sp. *Americare* sp. *Rowia* sp. *Rowia*? sp. *Parehmania* sp.		
6	Covered	8 (2.4)	110 (33.5)
5	**Limestone**: parted lime mudstone (calcisiltite and skeletal wackestone); very thin bedded, flaggy; trace fossils prominently developed on bedding planes; weathers grey striped with pale tan; forms a small cliff	31 (9.4)	102 (31.1)
4	Covered Talus of dark grey, fissile shale	14 (4.3)	71 (21.6)
3	Poorly exposed **Limestone**: recessive weathering; calcisiltite and skeletal (trilobite) wackestone; very thin bedded, flaggy, with interbeds of grey shale; abundant burrows; minor rudstone	14 (4.3)	57 (17.4)
	GSC loc. 52576 *Marjumia* spp. *Modocia* sp. *Modocia*? spp.		
2	**Limestone**: as below, but irregularly bedded, beds 1 to 15 cm thick; minor cliff former, weathering pale brown	22 (6.7)	43 (13.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Limestone**: parted lime mudstone (partly calcisiltite); scattered pellets and intraclasts; in regular, 2 cm thick, flaggy beds, with thin partings of pale brown, very fine crystalline dolomite. Forms a series of small ledges; weathers pale brown.	21 (6.4)	21 (6.4)
	Gradational contact.		

ELDON FORMATION
(781.5 ft/238.2 m)

The Eldon Formation is much more massive and resistant than the overlying Pika; furthermore, at this locality, the pale weathering beds of pale-pellet grainstone near the top of the Eldon provide a marked contrast to the sombre colours of the Pika outcrops.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
22	**Limestone**: intraclast grainstone and burrow-mottled lime mudstone; thick bedded, massive, brown weathering, resistant	10.5 (3.2)	781.5 (238.2)
21	**Limestone**: pale-pellet and intraclast grainstone; dolomitic, nonbedded, massive, resistant; discontinuous laminae of dolomite locally pass into patches of dolomite: very pale grey, medium equicrystalline, mosaic. Unit weathers very pale grey	73 (22.3)	771 (235)
20	**Limestone**: as above, with mottling, filigree, and patches of pale dolomite	13 (4)	698 (212.8)
19	**Dolomite**: pale grey, weathers cream; fine and medium equicrystalline, mosaic, nonbedded, massive	32 (9.8)	685 (208.8)
18	**Limestone** (70%) and **dolomite** (30%) Limestone: pale-pellet grainstone; nonbedded, massive. Dolomite: grey, fine crystalline, in widely spaced, 1 to 2 ft (0.3 to 0.6 m) thick subunits and irregular masses	65 (19.8)	653 (199)
17	**Limestone**: pale-pellet and pale-pellet-intraclast grainstone. In the basal third, a few thick beds of brown lime mudstone and dark intraclast grainstone. Massive and resistant	130 (39.6)	588 (179.2)
16	**Dolomite**: very calcareous, pale grey-brown, very fine crystalline, with relict intraclasts	7 (2.1)	458 (139.6)
15	**Limestone**: pale-pellet grainstone; nonbedded, massive, resistant; weathers very pale grey	15 (4.6)	451 (137.5)
14	**Dolomite**: as Unit 16	3 (0.9)	436 (132.9)
13	**Limestone**: pale-pellet and "pale intraclast" grainstone, with scattered clots of pale, coarse dolomite crystals; nonbedded, very massive, resistant. Thickness of unit in doubt because of structural disturbance	95 (29)	433 (132)
12	**Limestone** A heterogeneous unit of lime mudstone and intraclast grainstone, with minor beds of oncoid grainstone. Partly replaced by dolomite: calcareous, pale brownish grey, fine equicrystalline, sucrosic, brown weathering. Unit is massive	44 (13.4)	338 (103)
11	**Limestone**: dark-pellet and intraclast grainstone; thin and medium bedded, slightly dolomite mottled	17.5 (5.3)	294 (89.6)
10	**Limestone**: parted lime mudstone; thin bedded, massive; subordinate medium beds of dark-pellet and intraclast grainstone. Unit weathers grey, resistant	23.5 (7.2)	276.5 (84.3)
9	**Limestone**: mainly dark-pellet grainstone; medium bedded, massive	8 (2.4)	253 (77.1)
8	**Limestone**: mainly dolomite-mottled lime mudstone; nonbedded, massive; minor subunits of dark-pellet grainstone	38 (11.6)	245 (74.7)
7	**Limestone**: parted lime mudstone; slightly recessive weathering	9 (2.7)	207 (63.1)
6	**Limestone**: burrow-mottled lime mudstone; nonbedded, massive. Large, spongy patches of dolomite: pale brown, very fine crystalline	23 (7)	198 (60.4)
5	**Limestone**: as Unit 6; aligned mottling suggests bedding; many mottlings are notably cylindrical (i.e., burrows)	33 (10.1)	198 (60.4)
4	**Limestone**: lime mudstone; flaggy, parted lithofacies at the base, grading upward to burrow mottled, massive; weathers pale grey, with dolomite partings and mottlings in relief	109 (33.2)	142 (43.3)
3	Covered	9.5 (2.9)	33 (10.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	**Limestone**: as below, but dolomite partings are less prominent and less persistent; beds 1 to 5 cm thick; rare trilobite fragments. Unit forms a small cliff	15.5 (4.7)	23.5 (7.2)
1	**Limestone**: parted lime mudstone, partly calcisiltite; very thin bedded. Silty, argillaceous dolomite partings locally form 50 per cent of the rock mass. Unit is somewhat sheared, weakly resistant.	8 (2.4)	8 (2.4)
	Contact covered.		

STEPHEN FORMATION
(214 ft/65.2 m)

The Stephen Formation forms a distinct, recessive weathering notch between the resistant Cathedral and Eldon formations.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
14	Covered	45 (13.7)	214 (65.2)
13	**Slate**: pale greenish grey, calcareous, fissile, sheared; nodules of microcrystalline limestone	4.5 (1.4)	169 (51.5)
12	Covered	47.5 (14.5)	164.5 (50.1)
11	**Shale**: pale green, partly noncalcareous, very fissile, partly calcareous, weakly platy. Widely spaced, 2.5 cm thick beds of siltstone: green, calcareous, laminated, with abundant feeding traces. Eight feet (2.4 m) below the top, a 5 cm thick bed of skeletal (trilobite) grainstone: glauconitic, conglomeratic	26 (7.9)	117 (35.7)
10	**Shale**: green, very calcareous, weakly platy, partly glauconitic, with a few, 1 cm thick laminae of siltstone: green, calcareous, brown weathering	12 (3.7)	91 (27.7)
9	Covered	5 (1.5)	79 (24.1)
8	**Siltstone**: grey, calcareous, partly dolomitic, laminated; partings of grey shale	3 (0.9)	74 (22.6)
7	Covered: recessive weathering Float of greenish grey shale	31 (9.4)	71 (21.6)
6	**Shale**: green, very fissile, with very minor laminae (0.5 cm thick) of siltstone: as above	1.5 (0.5)	40 (12.2)
5	**Limestone**: skeletal (trilobite) ooid grainstone, partly conglomeratic; in very irregular, lenticular, 2.5 to 15 cm thick beds interbedded with siltstone (as above) and shale: grey to brown	2.5 (0.8)	38.5 (11.7)
4	**Shale**: olive to pale yellow green, fissile, glauconitic, silty; highly sheared	12 (3.7)	36 (11)
3	Covered	11 (3.4)	24 (7.3)
2	**Limestone**: calcisiltite, laminated, platy, with partings of very fine crystalline dolomite	1 (0.3)	13 (4)
1	Covered: recessive weathering.	12 (3.7)	12 (3.7)
	Contact covered.		

CATHEDRAL FORMATION
(483 ft/147.2 m, incomplete)

The Cathedral Formation is cliff forming throughout.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Limestone**: burrow-mottled lime mudstone; nonbedded, massive, resistant, cliff forming; thin bedding appears toward the top	269 (82)	483 (147.2)
5	**Limestone**: parted lime mudstone; lenticular bedded. Proportion of dolomite (partings) increases upward, locally to 50 per cent. Unit weathers slightly recessive	66.5 (20.3)	214 (65.2)
4	**Limestone**: burrow-mottled lime mudstone; as Unit 6. The cylindrical, branching form of the dolomite masses (burrows) is especially evident	3.5 (1.1)	147.5 (45)
3	**Limestone**: mainly burrow-mottled lime mudstone; nonbedded, massive, with minor, non-mottled beds of intraclast grainstone; resistant unit	44 (13.4)	144 (43.9)
2	**Dolomite**: grey to very pale grey, fine inequicrystalline, calcareous, partly shattered, nonbedded, massive. Several relict masses of limestone: as below	35 (10.7)	100 (30.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Limestone**: pale-pellet and pale-pellet-intraclast grainstone; nonbedded, massive; scattered, resistant clots of coarse, pale dolomite crystals. Unit weathers pale grey, resistant.	65 (19.8)	65 (19.8)
	Section continues downward in highly disturbed outcrops.		

SECTION AC–41

Park Boundary, North Saskatchewan River

(lat. 52°01′31″N, long. 116°40′14″W)
(For access see Appendix C)

ELDON FORMATION
(1156.5 ft/352.5 m)

The Eldon Formation is a major cliff former, generally unscalable. Our route of measurement followed a fracture-controlled gully or large crack, angled steeply upward and westward, some hundreds of metres west of the nose formed by the intersection of the south and east faces of the mountain.

In this section the Eldon consists of two major divisions, easily visible at a distance. Units 1 to 13 weather dull orange to pinkish pale brown; Units 14 to 21 weather very pale grey to cream.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	**Dolomite:** mottled brown and white, weathers very pale brown, cavernous; medium crystalline, extremely vuggy, massive. This unit forms the upper part of the "reef-like mass". The lateral transition to bedded dolomite is abrupt, with very little intertonguing. The reef-like mass expands upward and develops faint bedding in the upper 135 ft (41.1 m). Thickness of the top 15 ft (4.6 m) is an estimate because the Pika is weathered far back to leave a top-of-Eldon dip slope	230 (70.1)	1156.5 (352.5)
20	**Dolomite**: mottled, fine and medium crystalline, massive, grey weathering, few vugs. This is the lower part of a reef-like mass	58 (17.7)	926.5 (282.4)
19	**Dolomite**: ex-fenestral lime mudstone; cf. Unit 15	5 (1.5)	868.5 (264.7)
18	**Dolomite**: massive, medium and coarse crystalline (megacrystalline facies)	37 (11.3)	863.5 (263.2)
17	**Dolomite**: stromatactoid; local patches of ex-fenestral lime mudstone appear to be unreplaced relics, suggesting that the stromatactoid lithofacies records an event subsequent to the first dolomitization. The stromatactoid dolomite passes laterally to megacrystalline dolomite	82 (25)	826.5 (251.9)
16	**White dolomite** A mass or lens of megacrystalline, white dolomite; cavernous weathering	14 (4.3)	744.5 (226.9)
15	**Dolomite** and **white dolomite** Unit comprises two rock types. The groundmass is dolomite, fine crystalline, with a distinctive pattern of white, irregular, millimetre-scale spots in a black background (locally the reverse); this is ex-fenestral lime mudstone, in beds 5 to 30 cm thick. This bedded dolomite is interrupted by masses, metres to tens of metres across, of stromatactoid and megacrystalline white dolomite. The two rock types intertongue over distances of 3 to 5 cm	79 (24.1)	730.5 (222.7)
14	**Dolomite**: pale grey, medium crystalline, with white veins and patches; massive, vuggy	62 (18.9)	651.5 (198.6)
13	**Dolomite**: mottled, thin bedded (as below), but massive	38 (11.6)	589.5 (179.7)
12	**Dolomite**: pale grey, fine crystalline; mottled with dark grey, very fine crystalline; very regularly bedded, very thin beds (2.5 to 5 cm thick)	77 (23.5)	551.5 (168.1)
11	**Limestone**: mottled, massive, as Unit 9. This unit passes entirely to dolomite downdip (WSW)	25 (7.6)	474.5 (144.6)
10	**Dolomite**: white and nearly white, fine and medium crystalline, partly mottled, massive (ex-burrow-mottled lime mudstone); becomes thin bedded toward the top	21 (6.4)	449.5 (137)
9	**Limestone**: burrow-mottled lime mudstone; very massive. Several tongues of dolomite extend into the unit from the downdip direction. At one abrupt termination of a dolomite tongue, the equivalence of the dark grey phase in dolomite to the dolomitized burrows in limestone can be verified	47 (14.3)	428.5 (130.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Unit 9 passes entirely to dolomite, downdip.		
8	**Dolomite**: as below, but very massive; bedding is merely suggested in favourable exposures by aligned mottling	49 (14.9)	381.5 (116.3)
	Irregular contact at top crosses bedding.		
7	**Dolomite**: ex-burrow-mottled lime mudstone; mottlings of grey, very fine crystalline dolomite, in a matrix of pale cream-grey, fine crystalline dolomite. On weathering, bedding joints develop, spaced at 5 to 10 cm	33.5 (10.2)	332.5 (101.3)
	Downdip (WSW), all of the Unit 7 dolomite passes into Unit 6 limestone.		
6	**Limestone**: as below, but bedding is less distinct; massive, weathers pale grey	32.5 (9.9)	299 (91.1)
5	**Limestone**: as below, but gradational from parted to burrow-mottled lime mudstone; many beds are 7 to 10 cm thick	60 (18.3)	266.5 (81.2)
	Seven feet (2.1 m) above the base, an isolated bioherm mass 4 ft (1.2 m) high is built of numerous domal stromatolites.		
4	**Limestone**: parted lime mudstone; weathering massive, rather than flaggy, in these steep cliffs. Forty feet (12.2 m) above the base, a single set of crossbeds, composed of pellet grainstone, forms a 20 cm thick bed	60 (18.3)	206.5 (62.9)
3	**Dolomite**: as below, but thin bedded intervals are interrupted by non-bedded subunits (ex-burrow-mottled lime mudstone). No particulate texture recognized	20 (6.1)	146.5 (44.7)
	At this point, the line of measurement is offset downdip, to the west. Traced downdip, the dolomite units described below pass to limestone, down to a level equivalent to 91 ft (27.7 m) above the base of Unit 1. In these limestones, isolated beds of pellet grainstone occur at irregular intervals. Indistinct oncoids occur here and there (oncoid wackestone/rudstone). A biostrome of algal stromatolites, 15 to 20 cm high, occurs at a level equivalent to 5 ft (1.5 m) below the top of Unit 2. A second biostrome of stromatolites (possibly thrombolites) occurs at a level equivalent to the top of Unit 3; individual domes extend through the entire, 5 ft (1.5 m) thickness of the biostrome. This biostrome is missing on the previous line of section.		
2	**Dolomite**: mainly cream coloured and fine crystalline, with minor dark grey, very fine crystalline, laminated and irregularly mottled dolomite; beds are 2.5 to 7.5 cm thick; relict particulate texture is fairly common	28 (8.5)	126.5 (38.6)
1	**Limestone**: parted lime mudstone; beds are 2 to 4 cm thick in the basal 21 ft (6.4 m), 2 to 10 cm thick above that. A tongue of dolomite: grey, weathering very pale brown, very fine crystalline, and bedded as the enclosing limestone, occurs 37 to 39 ft (11.3 to 11.9 m) above the base. The distribution of limestone and dolomite masses in the cliff is seen to be highly irregular.	98.5 (30)	98.5 (30)
	Contact conformable, arbitrary.		

STEPHEN FORMATION
(419.5 ft/127.9 m)

Waputik Member
(283.5 ft/86.4 m)
(Units 10 to 23)

The Waputik Member is moderately recessive weathering; the succession of shale-based cycles is reflected in a rhythmically ledged slope.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
23	**Limestone**: ooid grainstone/packstone; in two massive beds separated by a 1 ft (30 cm) thick bed of grey, calcareous shale	7.5 (2.3)	419.5 (127.9)
22	Covered by snow on line of section, recessive weathering. Inaccessible nearby outcrops consist of green shale, possibly with minor limestone beds	11 (3.4)	412 (125.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	**Shale** to **limestone** (two cycles) Similar to those below, but the lower cycle is aborted, in parted lime mudstone 8 ft (2.4 m) above the base, with the reappearance of green shale with many 2 to 4 cm thick bedlets of siltstone: grey, brown weathering, calcareous. A massive bed of ooid grainstone/packstone, 12 cm thick, occurs 13.5 ft (4.1 m) above the base, marking the upper limit of siltstone	23.5 (7.2)	401 (122.2)
20	**Shale** to **limestone** (cycle): as below. Basal shale is 5.5 ft (1.7 m) thick, deep green, calcareous, and platy	11.5 (3.5)	377.5 (115.1)
19	**Shale** to **limestone** (cycle): as below. Basal shale is very calcareous, platy, weathers very pale brownish grey, and is 1.5 ft (0.5 m) thick. Cycle is capped by a 2.5 to 5 cm thick bed of flat-pebble rudstone: pebbles are greenish grey, aphanitic, up to 8 cm in maximum diameter, and are coated with a deep green, chloritic film	14 (4.3)	366 (111.6)
18	**Shale** to **limestone** (cycle): as below. Basal shale, below the level at which limestone becomes dominant, is 3 ft (1 m) thick. Minor shale recurs in middle of cycle. Beds of pinkish and greenish aphanitic limestone, 10 cm and 5 cm thick, occur 25 and 31 ft (7.6 and 9.4 m) above the base	35 (10.7)	352 (107.3)
17	**Shale** to **limestone** (cycle): as below. Basal shale: grey, very calcareous, weathers pale brown-grey. The shale rapidly acquires increasing numbers of thin beds and lenses of lime mudstone upward, and grades into parted lime mudstone. Top of cycle is a 20 cm thick bed of flat-pebble mudstone, capped in turn by a hummocky mass of ooid grainstone/packstone with isolated, ropy or brainlike masses of aphanitic, pale grey limestone. This may be a constructional surface (?boundstone) or a destructional one (?hardground)	19 (5.8)	317 (96.6)
16	**Limestone**: ooid grainstone/packstone; coarse at top. Upper surface hummocky, with 5 cm of relief	1 (0.3)	298 (90.8)
15	**Shale** to **limestone** (cycle): as below (includes Unit 16 at top). A 15 cm thick bed of ooid grainstone/packstone, with rudstone base, occurs 3 ft (1 m) above the base. Two thin beds of rudstone in upper 31 ft (9.4 m)	43.5 (13.3)	297 (90.5)
14	**Limestone**: lime mudstone; grey, very argillaceous, laminated, and hard	0.5 (0.2)	253.5 (77.3)
13	**Shale** to **limestone** (cycle): as below, but with very little rudstone. One bed near the base littered with trilobite free cheeks	49 (14.9)	253 (77.1)
12	**Shale** to **limestone** (cycle) Lime mudstone, thinly interbedded with pale brown, calcareous shale; limestone:shale ratio increases upward, as in previous cycle; bedding in part lenticular; minor rudstone. A few 0.3 to 1 ft (10 to 30 cm) thick beds of shale, as described	23 (7)	204 (62.2)
11	**Limestone** (upper part of cycle): parted lime mudstone; very thin bedded and laminated	16 (4.9)	181 (55.2)
10	**Shale** (lower part of cycle): grey, greenish where sheared, fissile, with 2 cm thick limy bands and nodules. The upper part is covered on the line of section	29 (8.8)	165 (50.3)

Narao Member
(136 ft/41.5 m)
(Units 1 to 9)

In this section the Narao Member has its characteristic topographic expression – two small cliffs of limestone, separated from each other and from the Cathedral Formation beneath by recessive weathering ledges.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	**Limestone**: as Unit 7 below; minor rudstone	9.5 (2.9)	136 (41.5)
8	**Limestone**: burrow-mottled lime mudstone; massive	1.5 (0.5)	126.5 (38.6)
7	**Limestone**: parted lime mudstone; as below	49.5 (15.1)	125 (38.1)

GSC loc. 55300 (6.5 ft/2 m above the base)
Amecephalus sp.
Chancia? sp.
Glossopleura templensis? Rasetti

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Shale**: grey, fissile, recessive weathering	2 (0.6)	75.5 (23)
5	**Limestone**: parted lime mudstone; very thin bedded and laminated; rare ripple marks. Toward the top, a few 5 cm thick beds appear; some of these are skeletal (trilobite) packstone/wackstone	42 (12.8)	73.5 (22.4)
4	Covered	13 (4)	31.5 (9.6)
3	**Limestone**: parted lime mudstone; mostly very thin bedded; burrows, feeding traces and (?)coprolites are well developed on bedding planes	7.5 (2.3)	18.5 (5.6)
2	Covered	4 (1.2)	11 (3.4)
1	**Limestone**: parted lime mudstone; in flaggy beds 2.5 to 8 cm thick.	7 (2.1)	7 (2.1)

Contact gradational. In offsetting the line of section from south facing cliffs to the nose between south- and east-facing cliffs, a few feet of Cathedral beds may have been missed.

CATHEDRAL FORMATION
(928 ft/282.9 m)

The Cathedral Formation forms grey, nearly vertical cliffs, interrupted only by the ledges of the thin Ross Lake and Trinity Lakes members. A local mass of orange-brown weathering, secondary dolomite provides outcrops sufficiently jointed and broken to allow passage, at the steep nose between south- and east-facing cliffs.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
28	**Limestone**: burrow-mottled lime mudstone; massive, with aligned mottlings outlining thin bedding. In the upper half, thin bedding and flaggy parting appear, in a gradation to parted lime mudstone. Weathers rubbly near the base, weakly cliff forming above	77 (23.5)	928 (282.9)
27	**Limestone**: cryptalgal laminite; dolomitic, grey weathering, resistant; lamination planar to mammilate (linked hemispheroids); layers of mat-chip breccia (flakestone) common	97 (29.6)	851 (259.4)
	Unit 26 passes laterally to limestone of Unit 27. Unit 26/Unit 27 contact was utilized to cross a vertical fault – minor error possible.		
26	**Dolomite**: as below, but predominantly thin bedded and laminated	15 (4.6)	754 (229.8)
25	**Dolomite**: mottled dark grey and cream, fine crystalline, and massive, passing upward into a mass of dolomite: grey, cream and white, mainly medium crystalline, vuggy (mega-crystalline facies). The interval from 29 to 25 ft (8.8 to 7.6 m) below the top consists of stromatactoid dolomite	83 (25.3)	739 (225.2)
24	**Limestone**: burrow-mottled lime mudstone; massive, with rare trilobite fragments, passing locally to dolomite as above. Dolomitization was apparently localized by fractures	13 (4)	656 (199.9)
23	**Limestone**: lime mudstone; dark grey, weathers grey, prickly; massive	35.5 (10.8)	643 (196)
22	**Dolomite**: ex-parted lime mudstone; pale grey to cream, mottled, thin bedded; traces of particulate fabric. Unit passes laterally to limestone	35.5 (10.8)	607.5 (185.2)
21	**Limestone**: mainly intraclast grainstone below, pellet grainstone above; medium bedded	8.5 (2.6)	572 (174.3)
20	**Limestone**: lime mudstone; thin bedded. Laterally, the basal 3 ft (1 m) of the unit consist of dolomite	45 (13.7)	563.5 (171.8)
19	**Limestone**: lime mudstone and oncoid wackestone; dark grey, grey weathering; thin bedded, with thin irregular partings of dolomite	50 (15.2)	518.5 (158)
18	**Limestone**: parted lime mudstone and skeletal (trilobite) wackestone; isolated intraclasts common. Unit is slightly recessive weathering, and grades at top into overlying cliff former	11 (3.4)	468.5 (142.8)

Trinity Lakes Member
(23 ft/7 m)
(Units 15 to 17)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
17	**Shale**: grey, soft, fissile; centimetre-scale nodules of limestone: grey, micro-crystalline	7 (2.1)	457.5 (139.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
16	**Limestone**: parted lime mudstone; one 30 cm thick massive, "lumpy" bed	11 (3.4)	450.5 (137.3)
15	covered: recessive weathering	5 (1.5)	439.5 (134)
14	**Limestone**: lime mudstone; thin bedded; intraclasts in some beds. This unit is a local relic; elsewhere, dolomite of Unit 13 extends to the base of the Trinity Lakes Member	1 (0.3)	434.5 (132.4)
13	**Dolomite**: pale grey to nearly white, largely strongly mottled, vuggy (ex-burrow-mottled lime mudstone), and dolomite: stromatactoid, vuggy	99 (30.2)	433.5 (132.1)
12	**Limestone**: fenestral lime mudstone; pale grey, weathering pale grey; massive; a relict lens surrounded by dolomite	7 (2.1)	334.5 (102)
11	**Dolomite**: grey, partly mottled; mottling suggests bedding about 5 cm thick; massive, weathers dull orange (ex-burrow-mottled lime mudstone). A strong cliff former	22 (6.7)	327.5 (99.8)
	Widely spaced vuggy zones about 5 ft (1.5 m) thick follow the bedding.		
10	**Dolomite**: grey, continuing the bedding style of the underlying limestone	4 (1.2)	305.5 (93.1)
9	**Limestone**: parted lime mudstone; very thin bedded, recessive weathering	17 (5.2)	301.5 (91.9)
	GSC locs. 55356, 55382 (basal 5 ft/ 1.5 m) *Paralbertella bosworthi* (Walcott), 1917 *Paralbertella limbata*? (Rasetti), 1951 *Paralbertella stenorhachis* (Rasetti), 1951 *Vanuxemella* sp. *Mexicella stator* (Walcott) *Volocephalina*? sp.		
	Contact with dolomite above crosses bedding.		

Ross Lake Member
(17.5 ft/5.3 m)
(Unit 8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
8	Covered Float of grey, fissile shale	17.5 (5.3)	284.5 (86.7)
7	**Dolomite**: ex-burrow-mottled lime mudstone; grey, weathers very pale brown, partly mottled, fine crystalline, massive. Local development of stromatactoid/megacrystalline dolomite. Basal contact follows bedding for 50 ft (15.2 m), then cuts across bedding	68.5 (20.9)	267 (81.4)
6	**Limestone**: parted lime mudstone, grading upward to burrow-mottled lime mudstone	39 (11.9)	198.5 (60.5)
5	**Limestone**: parted lime mudstone, with minor beds of dark-pellet grainstone	35 (10.7)	159.5 (48.6)
4	**Limestone**: dark-pellet (and ?intraclast) grainstone, medium bedded, massive	7 (2.1)	124.5 (37.9)
3	**Limestone**: parted lime mudstone, alternating with, and grading upward into, burrow-mottled lime mudstone	78 (23.8)	117.5 (35.8)
2	**Limestone**: as Unit 25 of the Mount Whyte Formation (below)	38 (11.6)	39.5 (12)
1	**Limestone**: dark grey, massive. At the base, skeletal (trilobite) wackestone; at the top, a 10 cm thick bed of oncoid packstone/wackestone.	1.5 (0.5)	1.5 (0.5)
	Contact conformable, gradational, arbitrary.		

MOUNT WHYTE FORMATION
(581.5 ft/177.2 m)

The Mount Whyte Formation is recessive weathering overall, in contrast to the formations above and below. It mainly forms a ledged slope, with several minor cliffs supported by limestone units. The Weed Member at the base is resistant weathering, but less so than the Peyto Formation beneath, and its dark cliffs contrast markedly with the pale Peyto.

Chephren Member
(427.5 ft/130.3 m)
(Units 5 to 26)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
26	**Shale**: blue-grey, weathering brown and green; calcareous, fissile. Rare, 2 cm thick lenses of skeletal packstone. The unit becomes partly shaly limestone near the top	33.5 (10.2)	581.5 (177.2)
25	**Limestone**: parted lime mudstone; burrows perpendicular to bedding are especially prominent; rare beds contain trilobite fragments	17 (5.2)	548 (167)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
24	**Limestone**: lime mudstone; grey, weathers very pale brown; very argillaceous, laminated, crudely platy	15 (4.6)	531 (161.8)
23	**Limestone**: mainly parted lime mudstone, with minor lenses of skeletal (trilobite) packstone; in part, nodular bedded. Basal 8 ft (2.4 m) are massive, oncoid packstone/wackestone	53 (16.2)	516 (157.3)
22	**Limestone**: parted lime mudstone; oncoids (wackestone) at the base and, rarely, higher. Rare lenses of trilobite packstone	44.5 (13.6)	463 (141.1)
	Units 21 and below are strongly recessive weathering; Units 22 and above are more resistant, grading into the cliffs of the overlying Cathedral Formation.		
21	Covered Float of shale: blue-grey, chippy	12.5 (3.8)	418.5 (127.6)
20	**Shale**: green below, dark grey above, with prominent pencil structure. In the middle, a 45 cm thick bed of skeletal oncoid packstone/grainstone. At the top, a 75 cm thick bed consists of oncoid packstone below, with centimetre-scale algal stromatolites above	22 (6.7)	406 (123.7)
19	**Limestone**: grey, aphanitic, nodular, with argillaceous partings or matrix; thin bedded, with argillaceous/silty filigree. Minor shale: as below	3 (0.9)	384 (117)
18	**Shale**: green, weakly platy, calcareous, with a few nodules of limestone; spots of blue-green, neomorphic chlorite	19 (5.8)	381 (116.1)
17	**Limestone**: parted lime mudstone; nodular, very thin bedded; partings constitute 50 per cent or more of the rock	6 (1.8)	362 (110.3)
16	**Shale** and **siltstone** Shale: blue-green, weathers green and brown; calcareous, silty, crudely platy. Siltstone (subordinate): grey, calcareous, laminated, with abundant burrows and feeding traces. In the top 10 ft (3 m), several very thin beds of skeletal (trilobite) packstone	33 (10.1)	356 (108.5)
15	**Limestone** (80%) and **siltstone** (20%) Limestone: skeletal grainstone/packstone and ooid grainstone/packstone; thin bedded; with partings of brown weathering silty limestone: as below. Subunits of shaly siltstone: as below	13 (4)	323 (98.5)
14	**Siltstone**: shaly; as below; with scattered 1 to 2 cm thick beds of sandstone: as below. Ten per cent skeletal and oolitic beds, as above, in beds 2.5 to 10 cm thick	19 (5.8)	310 (94.5)
13	**Siltstone** and **sandstone** Siltstone: green; in part shaly. Sandstone: white, very fine grained, very calcareous; laminated and crosslaminated, ripple marked, very thin bedded. Clastic phases grade in part to limestone: skeletal, silty and slightly to very sandy. Unit is semi-recessive and weathers brown. Massive beds of ooid-skeletal grainstone/packstone, 2.5 cm and 30 cm thick, occur in the top 5 ft (1.5 m) GSC loc. 55354 (3.5 ft/1.1 m above the base) *Plagiura* sp.	31.5 (9.6)	291 (88.7)
12	**Limestone**: grey-green, skeletal (mainly trilobite) and ooid grainstone/packstone, in massive medium beds. At the base, the limestone fills inter-thrombolite spaces; at the top, it grades into overlying siltstone by interbedding GSC loc. 55347 (0.5 ft/15 cm, below the top) *Amecephalus*? sp. *Plagiura* sp.	7.5 (2.3)	259.5 (79.1)
11	**Limestone**: a thrombolite complex. The thrombolites, consisting of mottled/clotted lime mudstone, are revealed as such mainly by the termination against them of packets of thin bedded, parted lime mudstone. At the base, a layer of quasi-spherical bioherms occurs	26 (7.9)	252 (76.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Shale** and **limestone** (alternating subunits) Shale: grey, very calcareous, crudely platy. Limestone: lime mudstone; grey, very argillaceous, thin bedded, weathering pale yellow-brown	10 (3)	226 (68.9)
9	**Limestone**: ooid grainstone/packstone; medium bedded, massive; bedding planes strongly stylolitic; rare (?)thrombolites throughout; top of unit bears domes with 15 cm maximum relief	35 (10.7)	216 (65.8)
	GSC loc. 55355 (4 ft/1.2 m, below the top) *Amecephalus* sp. *Plagiura* sp.		
8	**Limestone**: burrow-mottled lime mudstone; thin bedded. Domal stromatolites (?thrombolites) 3 ft (1 m) above the base have 8 cm of surface relief	9 (2.7)	181 (55.2)
7	**Limestone**: lime mudstone; grey, weathers brownish grey; laminated, partly sandy, in very thin beds with paper-thin argillaceous partings	12 (3.7)	172 (52.4)
6	**Limestone**: ooid grainstone/packstone; in massive, medium beds	3 (0.9)	160 (48.8)
5	**Limestone**: parted lime mudstone; coarsely laminated	3 (0.9)	157 (47.9)
	Weed Member (154 ft/46.9 m) (Units 1 to 4)		
4	**Siltstone**: as below; coarsely laminated, individual laminae weather in differential relief according to their clay content; abundant burrows, trails, and feeding traces	7 (2.1)	154 (46.9)
3	**Limestone**: skeletal grainstone/packstone; partly oolitic, oncoidal; in thin beds with interlaminae of siltstone: as below	2 (0.6)	147 (44.8)
2	**Siltstone**: as below; with nodules and discontinuous thin beds of lime mudstone	6 (1.8)	145 (44.2)
1	**Siltstone**: green, weathering brown and green; argillaceous, laminated, lamination gradually dies out upward; a strong cliff former. Burrows and feeding trails are prominent in talus, inconspicuous in cliff face.	139 (42.4)	139 (42.4)
	Contact abrupt, locally planar, locally with wavy relief of 5 cm; rare penetration of underlying limestone by clastic dykelets. An erosion surface.		

GOG GROUP

PEYTO FORMATION
(197 ft/60 m)

The Peyto Formation is highly resistant, forming pale grey cliffs and a cuesta extending outward from the mountain.

Irregular bedding contacts are common throughout the formation; some of these are definitely erosional, but others may be large-scale stylolitic contacts.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	**Limestone**: skeletal ooid grainstone; massive; faint, discontinuous thin bedding. Top 1 ft (30 cm) is oncoid-trilobite wackestone	35 (10.7)	197 (60)
20	**Limestone**: argillaceous lime mudstone, partly oncoid and trilobite wackestone; oncoids commonly have trilobite fragments as nuclei. Large size of trilobite fragments (olenellids) is notable	2 (0.6)	162 (49.4)
19	**Limestone**: argillaceous, oncoid wackestone/packstone; scattered trilobite debris; oncoids are spheroidal, up to 2 x 4 cm in cross-section	7 (2.1)	160 (48.8)
18	**Limestone**: oolite; as below; a few beds carry oncoids. A 2 ft (60 cm) thick subunit of nodular bedded, argillaceous limestone, 15 ft (4.6 m) above the base, weathers slightly recessive	30 (9.1)	153 (46.6)
17	**Limestone**: lime mudstone, partly skeletal wackestone; nodular bedded with argillaceous partings; recessive weathering. A few oncoids at the top	3 (0.9)	123 (37.5)
	GSC loc. 55342 *Bonnia* sp. *Olenellus* sp. *Piaziella* sp.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
16	**Limestone**: ooid grainstone/packstone; with layers and blotches of dolomite: very fine crystalline, orange weathering. Bedding style and massive, cliff forming character are as Unit 15. The base of the unit is a bed of oncoid packstone that thickens southward from 0.6 to 1.1 m over 600 ft (183 m)	20.5 (6.2)	120 (36.6)
15	**Limestone**: skeletal packstone/grainstone; grey, very dolomitic, sandy; mainly thin and medium bedded, locally nodular; massive, resistant. A 20 cm thick bed of oncoid packstone forms the base locally	27.5 (8.4)	99.5 (30.3)
	Contact rough, irregular, with 2.5 cm relief.		
14	**Sandstone**: grey, medium grained, poorly sorted, calcareous; cement is distributed in coarsely nodular fashion	4 (1.2)	72 (21.9)
	Lateral to the line of section, Unit 14 is capped by a 25 cm thick bed of coarse and very coarse sandstone.		
13	**Sandstone** and **siltstone** Very fine grained sandstone and siltstone: pale brownish white, calcareous, soft, very thick bedded, massive. The top is grey, hard, locally weathering to fist sized spheroids	12 (3.7)	68 (20.7)
12	Covered	6 (1.8)	56 (17.1)
11	**Limestone**: skeletal grainstone/packstone; thin bedded	1 (0.3)	50 (15.2)
10	Covered	6 (1.8)	49 (14.9)
9	**Limestone**: coarse, skeletal (mainly trilobite) grainstone/packstone; very thick bedded, massive. Locally altered to medium crystalline dolomite	4.5 (1.4)	43 (13.1)
8	**Sandstone**: a single massive bed; as below, but medium grained, with carbonate pebbles	1.5 (0.5)	38.5 (11.7)
7	**Sandstone**: green-grey, fine grained, quartzitic, slightly glauconitic; in beds 15 cm and less thick, with minor interbeds of shale: as below	3.5 (1.1)	37 (11.3)
6	**Shale**: pale grey, silty, micaceous, very fissile	2.5 (0.8)	33.5 (10.2)
5	**Sandstone**: partly white, with secondary brown spots; partly grey, mostly with ferruginous carbonate cement; medium grained, mostly very well sorted; very thick bedded, massive (except for a subunit of 8 cm thick beds in the middle). Unit weathers brown, resistant	14 (4.3)	31 (9.4)
4	Covered	4 (1.2)	17 (5.2)
3	**Limestone**: as below, but lacking oncoids; in massive, 10 to 20 cm thick beds	4.5 (1.4)	13 (4)
2	**Limestone**: oncoid packstone/wackestone/floatstone; grey weathering, massive. Oncoids are up to 2 cm in diameter and weather in relief	6 (1.8)	8.5 (2.6)
1	**Dolomite**: grey, fine crystalline; in 10 cm thick, massive beds.	2.5 (0.8)	2.5 (0.8)
	Contact concealed; apparently interbedded, conformable.		

SUB-PEYTO STRATA

2	**Sandstone**: pink and quartzitic at the base; higher, the sandstone is grey, brown, pepper and salt (possibly not primary colours), cemented with ferruginous carbonate; medium grained, very well sorted, crossbedded	32 (9.8)	52 (15.8)
1	**Quartzite**: very pale grey, weathers white and yellow, resistant; medium grained, very well sorted, vitreous, very uniform; crossbedded in sets 30 to 60 cm thick; local carbonate cement weathers rusty brown, in patches along bedding planes.	20 (6.1)	20 (6.1)

Exposures continue downward for some distance, but the Gog Group is not completely exposed.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

SECTION AC-48

Reference section for the Cathedral Formation, and type section of its Trinity Lakes Member at Beauty Creek/Trinity Lakes

(lat. 52°18′30″N, long. 177°13′40″W)
(For access see Appendix C)

ARCTOMYS FORMATION

The Arctomys Formation is markedly recessive weathering; in this section, over 400 ft (125 m) of beds (nearly all of the lower half of the formation) are covered in the strike valley of upper Beauty Creek.

Unit No.	Lithology	Unit	Total from base
4	Covered: recessive weathering	471 (143.6)	501 (152.7)
3	**Shale** (50%) and **siltstone** (50%) (interlaminated) Shale: purple-red. Siltstone: yellow, calcareous	3 (0.9)	30 (9.1)
2	**Shale**: purple-red, minor green, fissile, with minor laminae of siltstone: as above. Siltstone at top of unit contains minute salt hoppers	10 (3)	27 (8.2)
1	Covered: recessive weathering A 5 cm thick bed of mudstone: grey, partly calcareous, partly dolomitic, flaggy, and orange weathering, occurs at the base.	17 (5.2)	17 (5.2)

Contact abrupt, concordant.

PIKA FORMATION
(914 ft/278.6 m)

The Pika Formation is resistant, particularly at and near the base, but less so than the underlying Eldon. The Pika was studied at low elevations, in glacially scoured, valley bottom and creek outcrops, at the junction of Trinity Lakes Valley and the strike valley of upper Beauty Creek.

Unit No.	Lithology	Unit	Total from base
31	Poorly exposed **Limestone:** parted lime mudstone; as below; partings relatively thick and prominent. Eleven feet (3.4 m) above the base, a 12 cm thick bed of ooid grainstone/packstone occurs. No rudstone was seen	25 (7.6)	914 (278.6)
30	**Limestone**: massive bed of mottled lime mudstone, in which the dolomite mottlings approach 50 per cent of the rock, and isolate nodule-like bodies of limestone	1 (0.3)	889 (271)
29	Poorly exposed **Limestone:** parted lime mudstone with much flat-pebble rudstone; as below	11 (3.4)	888 (270.7)
28	Covered: recessive weathering	42 (12.8)	877 (267.3)
27	**Limestone**: parted lime mudstone; as below	19.5 (5.9)	835 (254.5)
26	**Limestone**: as below; with much flat-pebble rudstone in beds up to 30 cm thick. Top of unit supports nearly spheroidal stromatolites 30 to 60 cm in diameter	20.5 (6.2)	815.5 (248.6)
25	Covered: recessive weathering	52 (15.8)	795 (242.3)
24	Poorly exposed **Limestone:** parted lime mudstone; as below. Twenty per cent flat-pebble rudstone; rudstone beds locally succeed one another	23 (7)	743 (226.5)
23	Covered: recessive weathering	50.5 (15.4)	720 (219.5)
22	**Limestone**: parted lime mudstone. Flat-pebble rudstone appears in this unit. Near the base, a rudstone bed, 2.5 to 5 cm thick, occurs every 10 ft (3 m). Forty feet (12.2 m) above the base, conglomerates occur about every 5 ft (1.5 m) and, above that, rudstone beds, ranging from 2.5 to 10 cm thick, occur every 2 to 3 ft (60 to 90 cm). Sixty-five feet (19.8 m) above the base, the first bed of dolomitized oolite occurs - 1 ft (30 cm) thick with very fine ooids in a sparry matrix. Another, similar bed occurs higher	89.5 (27.3)	669.5 (204.1)
21	Covered Except for two small exposures of parted lime mudstone	74 (22.6)	580 (176.8)
20	Poorly exposed **Limestone:** parted lime mudstone as below, but bedding tends to be lenticular/nodular, and partings are strongly developed (20–30 per cent of rock volume). Calcitic feeding burrows or gut casts (cylindrical, and 2 to 3 mm in diameter) occur in the dolomitic parting material. Unit tends toward pale yellow-brown weathering	78 (23.8)	506 (154.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
19	**Limestone**: parted lime mudstone; as Unit 17. Near the base, the limestone is partly replaced by late dolomite, in spongy fashion. Unit weathers grey	35 (10.7)	428 (130.5)
18	Covered	8 (2.4)	393 (119.8)
17	Incompletely exposed (exposure only fair)		
	Limestone: parted lime mudstone; in beds 0.5 to 2.5 cm thick, partings strongly developed, with microdykes of dolomitic parting material commonly transecting limestone beds (?syneresis cracks)	80 (24.4)	385 (117.3)
16	**Limestone**: as Unit 11; grading upward to massive lime mudstone. Top 20 ft (6.1 m) are irregularly replaced, in an interbedded manner, by buff to orange weathering dolomite. Three feet (1 m) below the top, a 20 cm thick bed of flat-pebble rudstone occurs	63 (19.2)	305 (93)
15	Covered		
	In the middle, 3.5 ft (1.1 m) of dolomite: dark grey, argillaceous, microcrystalline, massive, orange weathering	23 (7)	242 (73.8)
14	**Limestone**: as Unit 11, massive at base, flaggy above	25.5 (7.8)	219 (66.8)
13	**Limestone**: ooid grainstone/packstone; massive	1.5 (0.5)	193.5 (59)
12	Covered: recessive weathering	25.5 (7.8)	192 (58.5)
11	**Limestone**: parted lime mudstone; in 0.5 to 2.5 cm thick beds; platy and flaggy	12 (3.7)	166.5 (50.7)
10	Covered: recessive weathering	16.5 (5)	154.5 (47.1)
9	**Limestone**: parted lime mudstone; in beds 1 to 2.5 cm thick; black weathering	11 (3.4)	138 (42.1)
8	Covered: recessive weathering	10 (3)	127 (38.7)
7	**Shale**: as below; with scattered nodules of microcrystalline limestone, and lenses and laminae (<1 cm thick) of skeletal packstone; markedly recessive weathering	19 (5.8)	117 (35.7)
6	**Limestone**: parted lime mudstone; in markedly lenticular, 0.5 to 2 cm thick beds, with partings of shale: brown, calcareous, fissile; thin beds and lenses of skeletal packstone; minor flat-pebble rudstone; very recessive weathering	15 (4.6)	98 (29.9)
	GSC loc. 55287 *Elrathia*? sp. *Marjumia*? sp. *Talbotina* sp.		
5	Covered: recessive weathering	20.5 (6.2)	83 (25.3)
4	Poorly exposed **Limestone:** parted lime mudstone; flaggy. Middle part (and entire unit nearby) is replaced by dolomite: mottled, orange weathering	31.5 (9.6)	62.5 (19)
3	**Limestone**: dark grey with purplish cast, microcrystalline; largely stromatolite biostromes with intervals of regular 8 cm thick beds. In the middle, a biostrome of stromatolites shaped like the human brain, partly replaced by black chert, weathers in relief. Unit weathers dark grey	16.5 (5)	31 (9.4)
2	**Dolomite**: as Unit 1, but weathering bright orange. One layer of flat pebbles	6.5 (2)	14.5 (4.4)
1	**Dolomite**: dark purplish grey with steely lustre, weathers partly grey, partly smooth, pale yellow-brown; microcrystalline, hard, argillaceous; laminated, platy and flaggy. Many fissures, perpendicular to bedding and typically 15 cm deep, are filled with microbreccia, against which laminae are upturned; that is, tepee structures. The fissures and tepees suggest that lamination is cryptalgal.	8 (2.4)	8 (2.4)
	Contact gradational over 1 ft (30 cm).		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

ELDON FORMATION
(1252.5 ft/381.8 m)

The Eldon Formation is a major feature former. Measurement commenced in the Stephen Formation, on the mountainside north of Trinity Lakes, and continued into the Eldon Formation. The section was then offset, on the Eldon Unit 1/Unit 2 contact, to the valley leading out of the lakes into Beauty Creek. The line followed the boss of outcrop between two parallel creeks, and then the southernmost creek.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
13	**Dolomite** (mottled): mottlings of dark grey, very fine crystalline dolomite, in dolomite: pale grey, medium crystalline. Flaggy and very thin bedded at the base (ex-parted lime mudstone), becoming massive (ex-burrow-mottled lime mudstone) higher in the unit. Again becomes thin bedded and flaggy in the uppermost 20 ft (6.1 m), as the gradational contact is approached	69 (21)	1252.5 (381.8)
12	**Dolomite** (mottled): mainly pale grey to white, minor grey to dark grey, weathers grey, vuggy, cavernous (e.g., near the megacrystalline/stromatactoid lithofacies); medium and coarse inequicrystalline, massive; minor intervals of thick bedded, apparently ex-particulate dolomite. The basal part changes laterally to ex-particulate dolomite	82 (25)	1183.5 (360.7)
11	**Dolomite**: ex-particulate; pale grey, pepper-and-salt, grey weathering; fine crystalline; alternating paler and darker grey laminae (0.5–2.5 cm); prominently crosslaminated and crossbedded, massive; (?)ex-oolite	64 (19.5)	1101.5 (335.7)
10	**Dolomite**: ex-burrow-mottled or ex-parted lime mudstone; grey, fine and medium crystalline, sparsely mottled with dark grey, very fine crystalline dolomite; regularly thin bedded (about 5 cm); weathers grey, locally cream	85 (25.9)	1037.5 (316.2)
9	**Dolomite** (mottled): as below; orange weathering	24 (7.3)	952.5 (290.3)
8	**Dolomite** (mottled) On the line of section, this unit continues the lithology of Unit 7. Two hundred metres southeast, however, the same stratigraphic interval is **limestone**: burrow-mottled lime mudstone (mottlings aligned to suggest thin bedding); massive. Subordinate beds, 8 to 60 cm thick, are of massive dark-pellet grainstone and minor intraclast grain/rudstone	142 (43.3)	928.5 (283)
7	**Dolomite** (mottled): continuing the macrofabric of the Unit 6 limestone precisely. See Unit 10 for description. Solution-enlarged bedding joints are developed in the dolomite, but not in the limestone of equivalent lithofacies	212 (64.6)	786.5 (239.7)
	The upward change from limestone to dolomite is extensive at about this level. The dolomites are less resistant than the underlying limestones.		
6	**Limestone**: burrow-mottled lime mudstone; very massive; the dolomite mottlings make up a variable proportion (10–40 per cent) of the rock mass	84 (25.6)	574.5 (175.1)
5	**Limestone**: as Unit 4, but with burrowed partings. On the line of section, the limestone is dolomitized except for scattered relict masses that occur from 38 ft (11.6 m) above the base to the top of the unit. Near by, however, the limestone is continuous throughout the unit. The derived dolomite is partly pale brown, fine crystalline, mottled with dark grey, very fine crystalline; and partly dirty white, with patchy, medium inequicrystalline texture. It weathers dull orange-grey with dark grey mottling, and flaggy	93 (28.3)	490.5 (149.5)
4	**Limestone**: parted lime mudstone; nonburrowed; bedding is lenticular. Unit is massive, but flaggy where deeply weathered	40 (12.2)	397.5 (121.2)
3	**Limestone**: parted lime mudstone; irregularly bedded. At the top, one 5 cm thick bed of dark-pellet grainstone	255 (77.7)	357.5 (109)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	**Limestone**: parted lime mudstone; beds 1 to 8 cm thick; bedding surfaces are pitted; coarsely flaggy, except for uppermost 15 ft (4.6 m) which is platy	90 (27.4)	102.5 (31.2)
1	**Limestone**: argillaceous lime mudstone; shaly, with very thin parting laminae of yellow-brown weathering shale. Rare trilobite fragments.	12.5 (3.8)	12.5 (3.8)
	Gradational contact.		

STEPHEN FORMATION
(493.5 ft/150.4 m)

The Stephen Formation is recessive weathering, forming a ledged interval. The Waputik Member is less resistant than the Narao Member.

Waputik Member
(409 ft/124.6 m)
(Units 10 to 27)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
27	**Shale** to **limestone** (cycle) The transition from shale to limestone occurs 7 ft (2.1 m) above the base. Several beds of finely laminated quartz siltstone occur in the interval 4 to 6 ft (1.2 to 1.8 m) above the base; these are capped by millimetre-scale runzel marks. Scattered small chitinous brachiopods occur. Unit reverts to interbedded limestone and shale at the top	18 (5.5)	493.5 (150.4)
26	**Shale** to **limestone** (cycle) Shale: very pale brown to brown, calcareous, platy; grades to parted lime mudstone, 8 ft (2.4 m) above the base. Scattered small chitinous brachiopods	12.5 (3.8)	475.5 (144.9)
25	**Shale** to **limestone** (cycle) Shale (as below) at the base, grading to parted lime mudstone 6.5 ft (2 m) above the base. A minor reversion to shale (or the basal part of a new cycle) occurs from 19.5 to 22.5 ft (5.9 to 6.9 m) above the base. Ripple marks occur here and there. Some beds, especially at the top of the unit, have thin stromatolitic caps	28 (8.5)	463 (141.1)
24	**"Conglomerate"**: subangular, equant pebbles up to 5 cm in largest dimension, in a matrix of skeletal packstone. This bed is interpreted as a submarine hardground. The "conglomerate" is locally capped with patches of pillow shaped, algal stromatolites, up to 2 ft (60 cm) high and 4 ft (1.2 m) in diameter, with well preserved, crenulate LLH lamination	0.5 (0.2)	435 (132.6)
23	**Shale** to **limestone** (cycle) The cycle commences with shale: pale grey, weathering pinkish pale brown, very calcareous, platy above, massive (mudstone) in basal 1 ft (30 cm). Ten feet (3 m) above the base, 1 cm thick beds of lime mudstone appear gradationally, and the remainder is very thinly interbedded shale and limestone. Rare chitinous brachiopods	15 (4.6)	434.5 (132.4)
22	**Limestone**: parted lime mudstone, as below; ripple marks common; rare pebbly layers; rare, small, isolated stromatolites	27 (8.2)	419.5 (127.9)
21	**Limestone**: as below, but less monotonous; beds are largely 0.5 to 1 cm thick, interrupted by widely spaced 8 cm thick beds, and by 1 to 2 ft (30 to 60 cm) thick intervals in which the shaly partings are more than 50 per cent of the rock volume. Several beds of thrombolitic limestone. Shale: as below, occurs from 40.5 to 42.5 ft (12.3 to 13 m) above the base. A 10 cm thick bed of clotted, aphanitic, thrombolitic limestone, 44.5 ft (13.6 m) above the base, supports stromatolites with 8 cm relief. Small algal stromatolites are common above this last level, and the unit is capped by a 45 cm thick and overlying 25 cm thick bed of inverted pear-shaped stromatolites. The parted lime mudstone (?calcisiltite) that fills the interstromatolite spaces is oscillation ripple marked, the ripples are commonly concentric around a stromatolite	68.5 (20.9)	392.5 (119.6)
20	**Shale**: grey, weathering yellow-brown; very calcareous, platy	5.5 (1.7)	324 (98.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
19	**Limestone**: parted lime mudstone, as below. Perched on the top, and rising into the overlying shale, are pillow-like thrombolites, 2 ft (60 cm) high and 3 ft (90 cm) across, with pustulate outer surfaces	10 (3)	318.5 (97.1)
18	**Limestone**: as below, with thin interbeds of shale: grey, calcareous, fissile, weathering dull orange. In the middle, a 0.7 ft (20 cm) thick bed of shale. Unit is capped by a layer of small stromatolites, infilled with pellet grainstone	12 (3.7)	308.5 (94)
17	**Limestone**: parted lime mudstone; as below; monotonous beds 1 to 2.5 cm thick. Wedge shaped shrinkage (?syneresis) cracks occur. These narrow downward and mainly cut a single bed of limestone, although in rare cases they cut up to 3 beds	70.5 (21.5)	296.5 (90.4)
16	**Flat-pebble rudstone**: largely with "edge-wise" fabric. Pebbles are rarely more than 0.5 cm thick and are up to 10 cm in largest dimension. Rare pink pebbles occur	1.5 (0.5)	226 (68.9)
15	**Limestone**: mainly parted lime mudstone, with thin beds of fine grained grainstone/packstone increasing upward. Beds mainly 0.5 to 2 cm thick, with a few beds to 4 cm. A 15 cm thick bed of oncoid packstone occurs 22 ft (6.7 m) above the base. A bed supporting oblate-spheroidal stromatolites (possibly thrombolites) 1 ft (30 cm) high and 2 ft (60 cm) in diameter, with a brainlike surface, lies 36.5 ft (11.1 m) above the base. These bodies do not have a coarsely particulate bed as a foundation. From 36 ft (11 m) upward, ripple marks are common	87 (26.5)	224.5 (68.4)
14	**Limestone**: oncoid packstone with skeletal packstone/grainstone matrix. A single, massive bed, reverse graded; the largest oncoids (at the top of the bed) reaching 2.5 cm in diameter	1 (0.3)	137.5 (41.9)
13	**Limestone** and **shale** Limestone: parted lime mudstone; partly laminated at the base. Interbeds of shale (as below) at base, grade upward through partings of shale to normal (no shale) dolomitic partings with burrows	7.5 (2.3)	136.5 (41.6)
12	**Limestone** and **shale** Limestone: in 0.5 to 2.5 cm thick beds; may be reverse graded; bases of beds are lime mudstone, tops are fine grainstone/packstone, locally pebbly. Interbeds of shale (as below) are subordinate. Top of unit is a 5 cm thick layer of elongate ooids developed on trilobite spines, etc.; its upper surface is covered with fist-sized knobs of oolite, interpreted as evidence of a submarine hardground	10.5 (3.2)	129 (39.3)
11	**Shale**: grey, green-grey, green weathering; calcareous, sheared; minor 1 cm thick beds of brown weathering, calcareous, laminated siltstone, and minor 5 to 10 cm thick beds of dark-pellet grainstone/packstone and rudstone. Feeding and dwelling burrows occur in the shale	14 (4.3)	118.5 (36.1)
10	Covered: recessive weathering Float of shale (as above but greener) and rudstone	20 (6.1)	104.5 (31.9)

Note: None of the large, easily recognized fragments of *Glossopleura*, widespread in the Narao Member, were observed in place or in loose material above the base of the Waputik Member.

Narao Member
(84.5 ft/25.8 m)
(Units 1 to 9)

Unit No.	Lithology	Unit	Total from base
9	**Limestone**: dark grey lime mudstone; with widely scattered, dolomitized oncoids	2.5 (0.8)	84.5 (25.8)
	GSC loc. 55284 (loose material originating from Units 4–9) *Amecephalus* sp. *Kistocare*? sp. *Glossopleura templensis*? Rasetti, 1951 *Glossopleura* sp.		
8	**Limestone**: as Unit 4; rare bedding planes with abundant trilobite free cheeks, as below	23.5 (7.2)	82 (25)

Units 1 to 7 form a ledged interval, markedly recessive relative to the upper Cathedral.

7	Covered: recessive weathering	12 (3.7)	58.5 (17.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Limestone**: as below, but beds slightly thicker (1 to 2.5 cm); trilobite remains as below	4.5 (1.4)	46.5 (14.2)
	GSC loc. 55291 (1.5 ft/50 cm above base) *Alokistocarella* sp. *Kisitocare*? sp. *Glossopleura boccar* Walcott, 1916 *Glossopleura* aff. *G. skokiensis* Rasetti, 1951		
5	Covered	7.5 (2.3)	42 (12.8)
4	**Limestone**: parted lime mudstone; exceptionally thin beds (laminae), 0.5 to 2 cm thick; ripple marks, abundant feeding and dwelling traces and coprolite-like bodies; large trilobite free cheeks (?*Glossopleura*) are abundant on bedding planes, and occur locally in heaps and "windrows"	14 (4.3)	34.5 (10.5)
3	Covered	11 (3.4)	20.5 (6.2)
2	**Limestone**: parted lime mudstone; partly rippled	2.5 (0.8)	9.5 (2.9)
1	**Limestone**: parted lime mudstone; argillaceous, planar and wavy laminated; flaggy at base, platy at top; recessive weathering.	7 (2.1)	7 (2.1)
	Abrupt, planar contact.		

CATHEDRAL FORMATION
(1422.5 ft/433.6 m)
(Reference Section)

Units 49 to 53 are strongly cliff forming.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
53	**Limestone**: burrow-mottled lime mudstone; becomes medium and thin bedded in top 5 ft (1.5 m)	26.5 (8.1)	1422.5 (433.6)
52	**Limestone**: (?)pale-pellet grainstone; nonbedded, massive, very resistant; widely scattered crystals of yellow-white dolomite weather in relief	49 (14.9)	1396 (425.5)
51	**Limestone**: burrow-mottled lime mudstone; with numerous dolomitized burrows, approaching 50 per cent in some beds; massive; aligned mottling suggests thin bedding	41 (12.5)	1347 (410.6)
50	**Limestone**: burrow-mottled lime mudstone with minor parted intervals. Rare beds, up to 60 cm thick, of dark-pellet grainstone	95 (29)	1306 (398.1)
49	**Limestone**: parted lime mudstone with partings thinner and less argillaceous than below; strong cliff former	75 (22.9)	1211 (369.1)
48	**Limestone**: parted lime mudstone; very thin beds (laminae), 0.5 to 2.5 cm thick; weathers black with orange laminae; flaggy; weakly cliff forming	35 (10.7)	1136 (346.3)
	Contact gradational, marked by a distinct topographic knick.		

Trinity Lakes Member
(221 ft/67.4 m)
(Type section, Units 38 to 47)

The member is recessive weathering, relative to the underlying and overlying limestone intervals; the ledged profile reflects the cyclical alternation of recessive shale and more resistant limestone.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
47	**Limestone** and **shale** (cycle) A complete cycle, like those underlying; shale at the base overlies an abrupt contact and grades to parted lime mudstone at 15.5 ft (4.7 m) above the base; trilobites are widespread	55 (16.8)	1101 (335.6)
46	**Limestone** (upper part of cycle): as Unit 44; trilobite fragments both scattered and in thin coquinas	18 (5.5)	1046 (318.8)
45	**Shale** (lower part of cycle): as below; a few half-centimetre thick laminae of trilobite coquina	12 (3.7)	1028 (313.3)
44	**Limestone** (upper part of cycle): parted lime mudstone; argillaceous, flaggy; rare laminae of trilobite coquina	32 (9.8)	1016 (309.7)
43	**Shale** (lower part of cycle): grey, weathering pale buff to orange-brown; very calcareous, platy; abundant trilobites 22 to 42 ft (6.7 to 12.8 m) above the base; rare 2.5 cm thick beds of trilobite coquina in the upper 8 ft (2.4 m)	45 (13.7)	984 (299.9)
42	Covered	33.5 (10.2)	939 (286.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
41	**Limestone** (upper part of cycle): parted lime mudstone; in "beaded", 1 to 2.5 cm thick, crudely flaggy beds; trilobite fragments common on weathered bedding planes, but do not break free of matrix	7.5 (2.3)	905.5 (276)
40	**Shale** (lower part of cycle): pale brownish grey, weathering silver-grey; calcareous, fissile; trilobites abundant	10 (3)	898 (273.7)
	GSC loc. 55298 *Amecephalus* sp. *Glossopleura boccar* Walcott, 1916		
39	**Limestone**: lime mudstone; with sparse dolomite mottling and rare dolomitized oncoids; regularly medium bedded; weathers black with orange mottling	4 (1.2)	888 (270.7)
38	Covered	4 (1.2)	884 (269.4)
	GSC loc. 55294 (from talus of this unit) *Arellanella* sp. *Athabaskia* sp. *Glossopleura* sp.		
	Units 32 to 37 form a distinct cliff and rib.		
37	**Limestone**: largely dark-pellet grainstone; thin and very thin bedded	9 (2.7)	880 (268.2)
36	**Limestone**: (?)pale-pellet grainstone; irregularly medium and thin bedded, weathering "prickly" and pale grey	27.5 (8.4)	871 (265.5)
35	**Limestone**: burrow-mottled lime mudstone; distinctly medium bedded; less resistant than the underlying unit	28 (8.5)	843.5 (257.1)
34	**Limestone**: burrow-mottled lime mudstone (mottling unusually faint); nonbedded, massive	79 (24.1)	815.5 (248.6)
33	**Limestone**: as Unit 32; numerous beds of dark-pellet grainstone	17 (5.2)	736.5 (224.5)
32	**Limestone**: burrow-mottled lime mudstone; very massive, strongly cliff forming	26 (7.9)	719.5 (219.3)
	Gradational contact.		
31	**Limestone**: as below; scattered oncoids	30 (9.1)	693.5 (211.4)
30	**Limestone**: parted lime mudstone; flaggy only where maturely weathered; moderately resistant	36 (11)	663.5 (202.2)
	GSC loc. 55297 (14 ft/4.3 m above the base) *Diraphora* sp. *Kochina*? sp. *Olenoides*? sp.		
29	Covered	31.5 (9.6)	627.5 (191.3)
28	**Limestone**: parted lime mudstone; many cylindrical objects, about 2 mm in diameter (?coprolites), on bedding surfaces	17.5 (5.3)	596 (181.7)
	GSC loc. 55286 (basal 5 ft/1.5 m) *Acrothele* sp. *Paralbertella bosworthi* Walcott, 1908 *Paralbertella declevis* Rasetti, 1951 *Kochina*? sp. *Mexicella* sp. *Plagiura* sp. aff. *Proveedoria* sp. *Ptarmigania* sp. *Vanuxemella* sp. dolichometopid cranidium		
27	**Limestone**: parted lime mudstone and dark-pellet grainstone; in regular 5 cm thick beds; poorly preserved oncoids near the top; trilobite fragments are abundant in the uppermost beds	10 (3)	578.5 (176.3)
	Units 22 to 26 form an upward-steepening cliff.		
26	This unit consists of two completely different lithofacies in abrupt lateral contact.		
	A. **Limestone**: parted lime mudstone, with a 7.5 cm thick bed of oncoid packstone at the base		
	B. **Limestone**: a thrombolite complex. Cabbage-sized and -shaped thrombolites, in compound mounds 20 to 100 ft (6 to 30 m) across – some of which extend the full height of the unit. Regularly thin bedded to laminated dark-pellet grainstone between the mounds. The oncoid bed is missing beneath the thrombolite complex. The mounded relief atop the thrombolite complex is inherited upward through Unit 27		
	Thickness of Unit 26	89 (27.1)	568.5 (173.3)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
25	**Limestone**: parted lime mudstone; argillaceous, laminated, with shaly fracture	56 (17.1)	479.5 (146.2)
	GSC loc. 55283 (upper contact) *Albertella* aff. *A. levis* Walcott, 1917 *Paralbertella* sp. *Paralbertella*? sp. *Ptarmiganoides*? sp. *Mexicella* sp. ptychoparioid		
24	**Limestone**: parted lime mudstone with thick partings; rare thin beds of grainstone, especially near the base; bedding planes carry trilobite fragments and coprolite-like cylindrical objects	55 (16.8)	423.5 (129.1)
	GSC loc. 55296 (35 ft/10.7 m above the base) *Paralbertella* cf. *P. robsonensis* Resser, 1936 *Paralbertella* spp. *Mexicella* sp. cf. *Plagiura* sp.		
23	**Limestone**: skeletal grainstone; non-bedded, massive; small, spheroidal, algal stromatolites, 10 to 15 cm in diameter, rest on top of the unit	5 (1.5)	368.5 (112.3)
	GSC loc. 55281 (basal 2 ft/61 cm) *Paralbertella* sp.		
22	**Limestone**: parted lime mudstone; very thin bedded and laminated	4 (1.2)	363.5 (110.8)

Ross Lake Member
(164.5 ft/50.2 m)
(Units 9 to 21)

The member is relatively recessive weathering and presents a ledgy topographic profile.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	Covered Entirely **shale**(?), except for a 12 cm thick bed of skeletal grainstone 5 ft (1.5 m) above the base	8 (2.4)	359.5 (109.6)
	GSC loc. 55288 (5 ft/1.5 m above the base) cf. *Paralbertella*? sp. cf. *Albertella levis* Walcott, 1917 dolichometopid cranidium		
	GSC loc. 55289 (talus from Units 19 to 21) *Albertella* cf. *A. helena* Walcott, 1908		
20	**Shale** to **limestone** (cycle) As Unit 15	14 (4.3)	351.5 (107.1)
19	**Limestone**: cryptalgal laminite; pale grey. Uppermost 10 cm are ooid grainstone with extremely elongate ooids, largely accreted around trilobite spines	2 (0.6)	337.5 (102.9)
18	Poorly exposed **Shale** and **limestone**. At the base, argillaceous, blue-grey, thin bedded lime mudstone; grading upward into calcareous shale	20 (6.1)	335.5 (102.3)
17	**Limestone**: parted lime mudstone with a strong skeletal component	3 (0.9)	315.5 (96.2)
16	Covered: recessive weathering	13.5 (4.1)	312.5 (95.2)
15	**Shale** to **limestone** (cycle) At the base, shale: blue-grey, weathering brown and green; calcareous, and platy. Shale grades upward to (top half) limestone: lime mudstone; blue-grey, weathering orange-brown; argillaceous, and thin bedded	14.5 (4.4)	299 (91.1)
14	**Limestone**: parted lime mudstone; rare beds are silty, pyritic, and micaceous	3.5 (1.1)	284.5 (86.7)
13	**Limestone**: lime mudstone; blue-grey, weathers orange-brown; very argillaceous, regularly thin bedded, laminated, platy to flaggy; fairly resistant. At the base, a 15 cm thick bed of oncoid packstone with skeletal packstone matrix	42.5 (13)	281 (85.6)
12	Covered Float of **shale**: green-grey, fissile	8 (2.4)	238.5 (72.7)
11	Poorly exposed **Shale**: blue-green, soft, very calcareous, platy; scattered trilobite fragments	10 (3)	230.5 (70.3)
10	Covered: recessive weathering	8 (2.4)	220.5 (67.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	**Shale** (90%) and **siltstone** (10%) Shale: green-grey, calcareous, very fissile, with greenish black specks of neomorphic chlorite. Siltstone: in thin beds; grey, rusty weathering, calcareous, laminated. Feeding traces. Unit weathers silvery grey-green, recessive	17.5 (5.3)	212.5 (64.8)
8	**Limestone**: mainly parted lime mudstone; argillaceous, micaceous, with prominent partings of argillaceous, bright yellow-brown to orange weathering dolomite. Burrow-mottling occurs in a few beds. Many thin beds of ooid packstone in the basal 10 ft (3 m). A single layer of pebbles occurs 46 ft (14 m) above the base. Unit weathers orange-brown, recessive	61.5 (18.7)	195 (59.4)
	Units 2 to 7 form a distinct topographic rib.		
7	**Limestone**: thrombolitic. In the lower part, the individual heads are hemispheres, fist-sized to 1 ft (30 cm) in diameter. The top 10 ft (3 m) consist of large hemicylinders 10 to 15 ft (3 to 4.6 m) wide and at least 50 ft (15.2 m) long, oriented in the dip direction (southwest); some of these have small hemispheres perched on them. Coarse ooid grainstone/packstone forms a discontinuous infill between the thrombolites	23 (7)	133.5 (40.7)
6	**Limestone**: burrow-mottled lime mudstone at the base, grading up into parted lime mudstone. A few thin beds of ooid grainstone/packstone	18 (5.5)	110.5 (33.7)
5	**Limestone**: oolite; as Unit 4; a few beds of skeletal grainstone/packstone; trilobites and brachiopods are abundant, but poorly preserved. Unit again ends with pancake shaped stromatolites (?thrombolites), up to 2 ft (60 cm) in diameter	14 (4.3)	92.5 (28.2)
4	**Limestone**: ooid grainstone/packstone, partly dolomitic (ooids preferentially dolomitized); weathers dark grey, massive. Unit is capped by hemispherical stromatolites (?thrombolites), mostly 20 cm and less in diameter	22 (6.7)	78.5 (23.9)
3	**Limestone**: lime mudstone, interlaminated with argillaceous lime mudstone; flaggy; feeding traces abundant	7 (2.1)	56.5 (17.2)
	Gradational contact with overlying unit.		
2	**Limestone**: dark grey. At the base, dark-pellet grainstone, grading upward to ooid grainstone/packstone, in irregular beds, 5 to 10 cm thick, weathering dark grey. Beds of oncoid packstone, 10 cm thick, occur 12.5 and 23 ft (3.8 and 7 m) above the base. Above 13 ft (4 m), some interbeds of parted lime mudstone occur. Brachiopod and trilobite fragments are fairly abundant in the oolite beds, but poorly preserved. Ooids are preferentially dolomitized in many beds	24 (7.3)	49.5 (15.1)
1	**Limestone**: lime mudstone and fine grained skeletal wackestone/packstone; in irregular laminae and thin beds, rarely reaching 2.5 cm thick; significant silt content; bedding planes are micaceous; feeding traces are common. Rare oolitic and oncoidal beds. Unit is recessive weathering.	25.5 (7.8)	25.5 (7.8)
	Contact rapidly gradational.		

MOUNT WHYTE FORMATION
(106.5 ft/32.5 m)

Weed Member
(106.5 ft/32.5 m)
(Units 1 to 3)

The formation forms a dark, notched cliff.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
3	**Siltstone**: grey, mainly in massive (?bioturbated) 30 cm thick beds, as in Unit 1; becomes more argillaceous toward the top	27.5 (8.4)	106.5 (32.5)
2	**Siltstone**: as Unit 1, but green, very argillaceous, micaceous, intensely burrowed. A few beds, up to 10 cm thick, of crosslaminated, fine grained skeletal grainstone/packstone. Unit is more recessive weathering than Units 1 and 3	9 (2.7)	79 (24.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Siltstone**: pale grey to white, locally greenish grey, brown weathering; quartzitic, slightly calcareous, in very regular, massive beds, 15 to 45 cm thick, with less than 10 per cent interbeds of similar, but shaly siltstone. Bedding planes are green, micaceous, marked with abundant feeding traces; moderate cliff former.	70 (21.3)	70 (21.3)
	Contact abrupt, concordant.		

GOG GROUP

PEYTO FORMATION
(148 ft/45.1 m)

The Peyto Formation is resistant, forming a cliff, with ledges developed on the more argillaceous, less resistant units.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Limestone**: fine grained ooid grainstone/packstone; crudely flaggy, weathering dark grey	4.5 (1.4)	148 (45.1)
10	**Limestone**: oncoid floatstone with matrix of argillaceous lime mudstone. Oncoids mainly 1 to 2 cm in diameter, but the largest (at the top) are up to 5 cm. Unit is very thick bedded and massive	28.5 (8.7)	143.5 (43.7)
9	**Limestone**: lime mudstone/pellet wackestone; argillaceous, in flaggy to shaly, medium beds; recessive weathering. Two 20 to 25 cm thick beds with crinkled laminae, orange weathering (?cryptalgal laminite)	11.5 (3.5)	115 (35.1)
8	**Limestone**: fenestral lime mudstone; grey, white, pale brownish grey, locally pink mottled, weathers grey and yellow; partly argillaceous; alternating thick bedded and massive, and thin bedded and flaggy. Sandy (quartz sand) in the basal 2 ft (60 cm) only	23.5 (7.2)	103.5 (31.5)
7	**Limestone**: fenestral lime mudstone; laminated (?cryptalgal lamination); hard, with conchoidal fracture; pale grey below, becoming pink, green, and pale yellow-brown upward, and red in the uppermost 30 cm; thin and medium bedded	14 (4.3)	80 (24.4)
6	**Dolomite**: a single massive bed; pale grey, weathering pale orange-grey; microcrystalline; sandy to very sandy, minor dolomitic sandstone	3 (0.9)	66 (20.1)
5	**Limestone**: skeletal grainstone with layers of coquina; thin bedded, cross-bedded; weathers dark grey, flaggy; scattered (?)pebbles of microcrystalline dolomite. Partly ooid-skeletal grainstone toward the top	40 (12.2)	63 (19.2)
	GSC loc. 55285 (2 to 22 ft/0.6 to 6.7 m above the base) *Scenella* sp. *Olenellus* cf. *O. gilberti* Meek *Onchocephalus* sp.		
	Interbedded, gradational contact at base.		
4	**Limestone**: grey, nodular; microcrystalline (or lime mudstone) nodules in a matrix of skeletal packstone/wackestone; very thick bedded, massive; weathering mainly dark grey, with yellow-brown weathering, dolomitic patches. Scattered oncoids occur in patches	3 (0.9)	23 (7)
	The Unit 3/Unit 4 contact is a facies contact, crossing at least 7 ft (2.1 m) of beds locally. The argillaceous Unit 3 persists higher in the section in an updip (northeast) direction. A stromatolite (?thrombolite) usually demarcates the abrupt lateral transition between lithofacies at any given level.		
3	Dolomitic **mudstone** or argillaceous **dolomite** Pale brown, pink, grey, green-grey, weathers pale yellowish brown; mostly sandy (quartz sand) with minor dolomitic, muddy sandstone; crudely medium bedded, and massive	11.5 (3.5)	20 (6.1)
2	**Mudstone**: red, red weathering; dolomitic	1 (0.3)	8.5 (2.6)
1	**Dolomite**: lavender (orange weathering), grading to red (red weathering); microcrystalline, argillaceous; partly sandy, grading to dolomitic mudstone and sandy mudstone; medium bedded, massive, moderately resistant.	7.5 (2.3)	7.5 (2.3)
	Concordant contact.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

SUB-PEYTO STRATA

The sandstone-dominated sub-Peyto section is highly resistant, with a well bedded, ledged appearance in these steeply dipping exposures.

25	**Sandstone**: red-brown, red, purple, weathering deep red; ferruginous, partly glauconitic; thin bedded, flaggy; argillaceous near the base, where ramifying burrows are present	25 (7.6)	74.5 (22.7)
24	**Quartzite**: very pure; snow white, pale grey, weathers greenish white; medium grained; planar crossbedding; in part, carries chips of green shale; massive	8 (2.4)	49.5 (15.1)
23	Covered: recessive (?)Shale	11.5 (3.5)	41.5 (12.6)
22	**Quartzite**: as below, mainly white; mostly medium grained, but one 15 cm thick snow white bed is fine grained; crossbedded throughout; megaripples on top of unit; scattered shale pebbles	30 (9.1)	30 (9.1)

Section continues downward.

COMPOSITE SECTION AC-53/AC-55

Vermilion Pass

(Section AC-53: lat. 51°13′30″N, long. 116°05′00″W)
(Section AC-55: lat. 51°11′30″N, long. 116°03′00″W)
(For access see Appendix C)

SECTION AC-55

ARCTOMYS FORMATION

Overlying beds of the Arctomys Formation consist of reddish, argillaceous dolomite.

ELDON AND PIKA FORMATIONS
(undifferentiated)
(1936 ft/590.1 m)

Units 15 to 36 form steep, locally vertical cliffs.

36	**Dolomite**: partly brownish grey, dull grey weathering, very fine crystalline, thin bedded, laminated dolomite; and partly pale grey, very pale yellowish grey weathering, microcrystalline, laminated dolomite	20 (6.1)	1936 (590.1)
35	**Dolomite**: as unit 33, but with minor streaks of dark grey; locally very vuggy	104 (31.7)	1916 (584)
34	**Dolomite**: dark brownish grey, very fine crystalline; shot through with vuggy, anastomosing veinlets of pink, medium crystalline dolomite	5 (1.5)	1812 (552.3)
33	**Dolomite**: snow white and pinkish white, weathers very pale grey with prominent orange patches; fine equicrystalline, silty, siliceous, uniform; massive, with indistinct wispy lamination	29 (8.8)	1807 (550.8)
32	**Dolomite**: white, pinkish white, and grey, weathering very pale yellowish grey; partly mottled, fine equicrystalline, locally vuggy; a few beds carry streaks of medium crystalline white dolomite; zones of collapse brecciation are common. Unit mostly weathers very pale yellowish grey, with rusty orange patches; a strong cliff former. Thin intervals of laminated dolomite (as below) occur at wide intervals. Some of the zones of vuggy porosity follow bedding, while others cut across the bedding	196 (59.7)	1778 (541.9)
31	**Dolomite**: grey to dark brownish grey, fine equicrystalline, with streaks and clots of pale, fine crystalline dolomite, increasing upward to produce a mottled effect at the top; mainly regularly thin bedded, weathering dark grey	54 (16.5)	1582 (482.2)
30	**Dolomite**: grey and brownish grey, very fine and fine crystalline, indistinctly laminated, with 50 per cent fenestrae of white medium crystalline dolomite (ex-fenestral cryptalgal laminite); grey weathering; locally vuggy at the top	53 (16.2)	1528 (465.7)
29	**Dolomite**: mainly pale grey, weathering grey and very pale yellowish grey; microcrystalline, laminated	45 (13.7)	1475 (449.6)
28	**Dolomite**: grey, partly mottled, fine equicrystalline, derived from underlying limestone; grades upward to largely white, medium crystalline dolomite (megacrystalline facies)	11 (3.4)	1430 (435.9)

Replacement contact crosses bedding.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
27	**Limestone**: dark-pellet packstone; with dolomitized matrix; beds are 7 to 30 cm thick, locally crosslaminated, massive, grey weathering; minor mottled lime mudstone	14 (4.3)	1419 (432.5)
26	Mainly **dolomite**: mainly cryptalgal laminite; pale grey, weathering very pale yellow-grey; microcrystalline to fine crystalline; in minor part, thick bedded and massive with dolomite filled vugs, and grey weathering. Near the base, a 60 cm thick, massive bed of limestone occurs – consisting of well sorted pellets, partly coated, in a dolomitized matrix	38 (11.6)	1405 (428.2)
25	**Limestone**: grey, microcrystalline, with scattered grains; thick bedded below, laminated above	8 (2.4)	1367 (416.7)
24	**Dolomite**: cryptalgal laminite with calcite-filled fenestrae; pale grey, very fine equicrystalline; grades upward into interlaminated, microcrystalline, grey limestone and dolomite	42 (12.8)	1359 (414.2)
23	**Limestone**: burrow-mottled lime mudstone; massive	37 (11.3)	1317 (401.4)
22	**Limestone**: parted lime mudstone; flaggy	10 (3)	1280 (390.1)
21	**Limestone**: ex-intraclast packstone(?); intraclasts of lime mudstone in matrix of dolomite: grey, very fine equicrystalline, calcareous; thin bedded and flaggy	13 (4)	1270 (387.1)
20	**Limestone**: parted lime mudstone and/or calcisiltite; beds 0.5 to 2 cm thick; platy to flaggy, recessive	16 (4.9)	1257 (383.1)
19	**Limestone**: as Unit 17, alternating with massive intervals of burrow-mottled lime mudstone. Limestone with dolomite laminae, partly crosslaminated and cryptalgalaminate, becomes dominant in the upper half of the unit. Also in the upper half, minor massive lime mudstone (as in Unit 18)	55 (16.8)	1241 (378.3)
18	**Limestone**: lime mudstone; with 10 per cent oblate-spheroidal sparry fenestrae about 5 mm in diameter; massive, grey weathering. Several massive, 30 cm thick beds of very dark lime mudstone with abundant macaroni-like bodies of white calcite, apparently organic	22 (6.7)	1186 (361.5)
17	**Limestone** and **dolomite** (mainly interlaminated) Cryptalgal laminite. Limestone includes calcisiltite, intraclast packstone and mat-chip breccia, also minor layers of fenestral lime mudstone; dolomite is grey, very fine crystalline, and calcareous	9 (2.7)	1164 (354.8)
16	**Limestone**: mainly (?)dark-pellet grainstone; laminated, commonly crosslaminated in beds 5 to 15 cm thick, rarely 30 cm; weathers grey, massive	30 (9.1)	1155 (352)
15	**Limestone**: parted lime mudstone; beds 2 to 6 cm thick; very uniform, strongly cliff forming	35 (10.7)	1125 (342.9)

Measurement was continued upward by offsetting about 0.8 km to the right (SE), along the ledge at the base of unit 12, a climbable chimney.

Field Member
(264 ft/80.5 m)
(Units 12 to 14)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
14	**Limestone**: as Unit 13; and limestone: brown, orange-tan weathering; microcrystalline, argillaceous, very dolomitic, and platy; occurring both interbedded and as alternating units 3 to 5 ft (0.9 to 1.5 m) thick (ribbon-bedded lime mudstone facies). Trilobites are present in the basal part of the unit, in skeletal packstone/wackestone. Relatively recessive weathering	53 (16.2)	1090 (332.2)
13	**Limestone**: as Unit 12, but beds are in general thicker (2.5 to 8 cm). Argillaceous limestone has diminished (from Unit 12) to tan weathering partings. 65 ft (19.8 m) above the base, the partings become discontinuous, and bedding planes become figured (parted lime mudstone); beds continue to thicken upward, and range from 2.5 to 10 cm thick at 90 ft (27.4 m). Rare trilobites are present	127 (38.7)	1037 (316.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
12	**Limestone**: lime mudstone; dark brown, very dolomitic, slightly argillaceous, in thick, planar, faintly laminated beds, separated by 1 cm thick partings of limestone (brown, tan weathering, microcrystalline, very dolomitic; argillaceous, grading to calcareous shale and very fine crystalline dolomite – ribbon-bedded lime mudstone facies). The unit is flaggy to shaly, recessive at the base, cliff forming above. Abundant very well preserved trilobites, and associated inarticulate brachiopods and sponge spicules	84 (25.6)	910 (277.4)
	GSC loc. 55341 (from the basal 54 ft/ 16.5 m. Talus from an isolated "castle", hence the source is definite) *Bathyuriscus* cf. *B. adaeus* Walcott, 1916 *Elrathina* cf. *E. cordillerae* Walcott, 1887 *Homotreta* sp. or *Pegmatreta* sp. *Peronopsis* sp. *Ptychagnostus intermedius*? (Tullberg), 1880 *Zacanthoides*?		

Units 2 to 11 form nearly vertical grey cliffs where present limestone, and broken, pale cliffs where present as dolomite.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Dolomite**: ex-burrow-mottled lime mudstone; white to pale grey, fine crystalline, mottled with dark grey, very fine crystalline; nonbedded, massive. Upward, the mottling becomes aligned, suggesting regular thin bedding, and the dolomite becomes flaggy (gradation to ex-parted lime mudstone). In the uppermost 80 ft (24.4 m), stromatactoid dolomite occurs at intervals. Uppermost 30 ft (9.1 m) of unit weather pinkish orange. One-half mile (0.8 km) to the southeast, beds equivalent to the upper part of this unit are mottled lime mudstone	228 (69.5)	826 (251.8)
10	**Dolomite**: grey, very fine crystalline, thin bedded, massive, with dark laminae between the beds; ex-particulate texture widespread. Low-angle tangential crossbedding and crosslamination are widespread. This unit is locally interrupted by large masses of dolomite: white and light grey, fine and medium crystalline, slightly vuggy, and massive	48 (14.6)	598 (182.3)
9	**Dolomite**: white, weathers pale grey with local pink stain; fine crystalline, becoming partly medium crystalline upward with local thin, discontinuous, dark grey streaks; massive, slightly vuggy; stromatactoid structure widespread	50 (15.2)	550 (167.6)
8	**Dolomite**: very pale grey streaked with dark grey, fine crystalline, stromatactoid structure throughout. Partly ex-intraclast grainstone at the top. Minor pink dolomite in middle of unit	102 (31.1)	500 (152.4)
7	**Dolomite**: white, megacrystalline, massive; gradational with underlying unit	18 (5.5)	398 (121.3)
6	**Dolomite**: as below, with streaks and discontinuous thin laminae of dark grey dolomite; stromatactoid structure widespread. In the uppermost 20 ft (6.1 m) partly ex-particulate dolomite	50 (15.2)	380 (115.8)
5	**Dolomite**: mainly white, pale grey weathering; medium crystalline, partly laminated, massive	43 (13.1)	330 (100.6)
4	**Dolomite**: mottled pale grey and white, fine crystalline, massive	19 (5.8)	287 (87.5)
3	**Dolomite**: ex-parted lime mudstone; flaggy, mottled	28 (8.5)	268 (81.7)
2	**Limestone**: parted lime mudstone. Beds of intraclast and ooid grainstone occur 67 to 69 ft (20.4 to 21 m) above the base	117 (35.7)	240 (73.2)
1	**Limestone**: parted lime mudstone, calcisiltite, and minor very fine grained pellet grainstone and skeletal packstone/wackestone; regularly thin bedded (2.5 cm) with prominent, tan weathering partings. At the base, a thin layer of trilobite coquina. Unit weathers very dark grey, weakly resistant, becoming resistant upward.	123 (37.5)	123 (37.5)
	Contact conformable, gradational, arbitrary.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

SECTION AC-53

STEPHEN FORMATION
(250 ft/76.2 m)

Waputik Member
(129 ft/39.3 m)
(Units 5 to 10)

The Waputik Member is mainly nonresistant, forming slopes interrupted by ledges.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Shale**: pale greenish grey, calcareous, platy. In the middle, a 30 cm thick bed of limestone: fine grained skeletal grainstone/packstone; silty and laminated at the base	31 (9.4)	250 (76.2)
9	**Mudstone**: pinkish buff (weathered?), calcareous, dolomitic, silty, and crystalline looking; minor nodules of limestone: pale green, microcrystalline, and very siliceous	9 (2.7)	219 (66.8)
8	**Shale**: pale green, pale buff, weathering partly green, partly pale yellow-brown; very calcareous, platy, and slaty. Several 10 to 30 cm thick beds of skeletal (pelmatozoan-brachiopod-trilobite) and ooid grainstone/packstone. Two beds of equant-pebble rudstone, with pebbles and fossils coated green on upper surfaces	12 (3.7)	210 (64)
7	**Limestone**: skeletal packstone; medium grained, very dolomitic, with calcisiltite matrix. Chloritized bedding plane	1 (0.3)	198 (60.4)
6	**Limestone**: grey, bluish grey, greenish grey, buff, and pink, very fine crystalline, argillaceous, grading to very calcareous mudstone; platy and shaly, locally slaty, very thin bedded, laminated, partly cryptalgalaminate. Unit weathers pale yellow-brown, and forms a minor cliff	28 (8.5)	197 (60)
5	**Shale**: grey, calcareous and noncalcareous, platy and slaty, with scattered trilobite fragments. Near the top, one 5 cm thick bed of rudstone	48 (14.6)	169 (51.5)

Narao Member
(121 ft/36.9 m)
(Units 1 to 4)

The Narao Member here is almost as resistant as the Cathedral Formation, and, viewed from a distance, appears to belong more to the latter than to the Stephen Formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Limestone** and **dolomite** (interlaminated) Cryptalgalaminate limestone: brownish grey, microcrystalline. Dolomite: grey, microcrystalline, locally laminoid fenestral. Local crosslamination; unit weathers grey and pale greyish brown, ledgy	45 (13.7)	121 (36.9)
3	**Oolite**: very dolomitic, with scattered clasts of microcrystalline dolomite of the underlying unit	1 (0.3)	76 (23.2)
2	**Dolomite**: grey, microcrystalline, very silty, siliceous, grading to dolomitic siltstone; thin bedded, with thin partings of greenish mudcracked shale; chips of shale are scattered on some bedding surfaces; weathers orange	3.5 (1.1)	75 (22.9)
1	**Limestone**: calcisiltite and very fine grained dark-pellet grainstone; largely laminated, locally cross-laminated; mainly in 2.5 cm thick flaggy beds with minor medium and thick bedded intervals. Tan weathering parting surfaces of grey, very fine crystalline dolomite carry various markings, including gut casts.	71.5 (21.8)	71.5 (21.8)
	Contact concordant, marked by a lithological change and subtle topographic "break".		

CATHEDRAL FORMATION
(1126 ft/343.2 m)

The units described below are moderately to strongly resistant.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
27	**Limestone**: burrow-mottled lime mudstone; mainly nonbedded, massive, but in flaggy beds, 5 cm thick, in the uppermost 15 ft (4.6 m)	96 (29.3)	1126 (343.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
26	**Limestone**: mottled lime mudstone; nonbedded, massive; basal 20 ft (6.1 m) of unit are ledge forming, the remainder strongly cliff forming	49 (14.9)	1030 (313.9)
25	**Limestone**: pale grey, microcrystalline, with abundant wavy laminae of dolomite: pale grey, very fine crystalline, grading locally to calcareous dolomite (cryptalgal laminite). Unit is massive and weathers grey	24 (7.3)	981 (299)
24	**Limestone**: dark lime mudstone; in part with clusters of dolomite crystals as below; weathers dark grey, mottled with white	17 (5.2)	957 (291.7)
23	**Limestone**: massive lime mudstone; with clusters of dolomite crystals as below	13 (4)	940 (286.5)
22	**Dolomite**: white, locally faintly pink, weathers very pale yellow-grey; fine equicrystalline; local stromatactoid structure; nonbedded and massive	99 (30.2)	927 (282.5)
21	**Limestone**: mottled medium and dark grey, microcrystalline, recrystallized, partly pale-pellet grainstone; abundant blebs and gash-fillings of coarse crystalline, white dolomite (after fenestrae?); nonbedded, massive, weathers grey, pitted	32 (9.8)	828 (252.4)
20	**Dolomite**: ex-burrow-mottled lime mudstone; mottled grey, buff weathering; fine and very fine crystalline, massive; grades upward into dolomite: mainly white, medium crystalline, locally coarse crystalline, massive	29 (8.8)	796 (242.6)
19	Covered	40 (12.2)	767 (233.8)
18	**Limestone**: lime mudstone; largely with scattered, dolomitized oncoids; in part, strongly dolomite mottled; medium to thick bedded, massive	75 (22.9)	727 (221.6)
17	Covered	28 (8.5)	652 (198.7)
16	**Limestone**: burrow-mottled lime mudstone; massive, very strongly mottled at the base; local clusters of dolomite crystals (as in higher units); weathers pale grey	25 (7.6)	624 (190.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	**Dolomite**: mottled pale and dark grey, fine crystalline, irregularly medium bedded	9 (2.7)	599 (182.6)
14	**Dolomite**: ex-parted lime mudstone; pale grey, fine crystalline, with relict partings and mottlings of dark grey, very fine crystalline dolomite; regularly thin bedded (2.5–5 cm)	7 (2.1)	590 (179.8)
13	Covered	53 (16.2)	583 (177.7)
	Note: line of section was of necessity offset along the base of the covered interval; up to 20 ft (6 m) of section may have been gained or lost in this offset.		
12	**Limestone**: burrow-mottled lime mudstone, minor intraclast grainstone; at the base, nonbedded, massive, dark brownish grey weathering; upward, becomes irregularly medium bedded and slabby; dolomite mottlings commonly make up more than 50 per cent of the rock	125 (38.1)	530 (161.5)
11	Covered Laterally, the interval consists of grey weathering carbonate rocks	34 (10.4)	405 (123.4)
10	**Limestone**: almost entirely pale-pellet grainstone; scattered dolomite crystals or clumps of coarse crystals; nonbedded, very massive, weathers pale grey. Minor, grey, (?)skeletal wackestone	46 (14)	371 (113.1)
9	**Limestone**: burrow-mottled lime mudstone; nonbedded, massive; weathers dark brownish grey	58 (17.7)	325 (99.1)
8	**Limestone**: laminated; as Unit 6	3 (0.9)	267 (81.4)
7	**Limestone**: fenestral lime mudstone; massive	24 (7.3)	264 (80.5)
	Erosion surface of cusps and bowls; subaerial solution surface.		
6	**Limestone**: medium to pale grey, microcrystalline, laminated, cross-laminated, and cryptalgalaminate; pale pellets are scattered throughout; minor layers of mat-chip breccia; unit weathers pale yellowish grey	11 (3.4)	240 (73.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
5	Mainly **dolomite**: pale grey, medium and fine crystalline, mottled with dark grey, fine crystalline dolomite; large relict masses of burrow-mottled lime mudstone; thin bedded at the base, becoming nonbedded, massive upward	29 (8.8)	229 (69.8)
4	**Dolomite**: cryptalgal laminite; interlaminated grey and buff, weathers very pale yellowish grey, smooth; microcrystalline, blocky to massive, small-scale scour-and-fill. In the uppermost 15 ft (4.6 m), several beds of sandstone: very pale brown, fine and very fine grained, calcareous, laminated. Unit is slightly recessive below, very resistant above	37 (11.3)	200 (61)
3	**Dolomite**: pale grey to white, weathers very pale yellow-brown ("buff"); locally faintly mottled; fine, locally medium crystalline, uniform; mainly medium bedded (10–20 cm) with minor thin bedded (2–5 cm) intervals; moderately resistant	63 (19.2)	163 (49.7)
2	**Dolomite**: dark grey to pale grey, weathers buff, pinkish and purplish buff; fine and very fine equicrystalline, flaggy, beds 2.5 to 10 cm thick; local patches of medium crystalline dolomite. Part of the unit is locally preserved as limestone: pale-pellet grainstone, locally fenestral. Unit is moderately recessive weathering	77.5 (23.6)	100 (30.5)
1	**Dolomite**: white, weathers orange-brown and pink, rubbly; fine and medium crystalline, locally vuggy; a very massive cliff former. Becomes sandy and very sandy in the uppermost 5 ft (1.5 m), with minor beds of sandstone: white, medium grained, poorly sorted, very dolomitic.	22.5 (6.9)	22.5 (6.9)
	Abrupt, concordant contact, not well exposed.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GOG GROUP		
3	**Sandstone**: pink to pale grey, fine, medium and minor coarse grained, commonly bimodal, dolomitic, crossbedded and crosslaminated. A 1 ft (0.3 m) thick, argillaceous and ferruginous bed, with rare traces of trilobite fragments, occurs 1 ft (0.3 m) above the base. Unit is massive, resistant, brown weathering	17.5 (5.3)	40 (12.2)
2	**Shale**: green, green weathering; silty, platy, with minor thin beds of calcareous and ferruginous sandstone	3.5 (1.1)	22.5 (6.9)
1	**Quartzite** and **sandstone** (interbedded) Quarzite: medium and coarse grained. Sandstone: dirty white, streaked with dark grey, poorly cemented with brown siderite(?), nearly friable, locally impregnated with hematite.		
	Minor intervals of shale: greenish grey, platy, silty, greenish grey weathering. Unit is irregularly, lenticularly, medium bedded and crossbedded.	19 (5.8)	19 (5.8)

COMPOSITE SECTION AC-86/AC-87

Miette Range

(lat. 53°07′14″N, long. 117°48′07″W)
(For access see Appendix C)

The upper, and greater, part of the section (AC-86) was measured at reasonably accessible exposures near the top of a long, largely unforested spur extending north-northwest from the northeast shoulder of Roche Miette toward Highway 16. The base of the Eldon Formation and lower strata are not exposed at this locality. The lower part (Section AC-87), extending from the top of the Gog Group to a horizon in the Eldon Formation correlatable to Section AC-86, was measured 6.3 miles (10.1 km) to the south-southeast, along strike, on the northeast slopes of a minor summit (elevation +7 300 ft/+2 225 m), lying midway between Capitol Mountain and Utopia Mountain and directly overlooking Miette Hot Springs to the northeast. The somewhat disturbed section of the Eldon at the latter locality does not precisely duplicate the sequence of rock units at Section AC-86, and appears to be 55 ft (16.8 m) thinner. Some erroneous gain or loss of section may result from combining the two sections.

This section has been adapted from Aitken (1968), and recast into the lithological terms of this report.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

SECTION AC-86

ARCTOMYS FORMATION

The Arctomys Formation is about as recessive weathering as the upper Pika. Placement of the Arctomys/Pika contact is based mainly on a difference in the fresh and weathered colours of the mudrocks in each formation, and, to a lesser extent, on the contrasting suites of primary structures.

Section continues upward.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
3	Poorly exposed: recessive weathering **Siltstone** (60%) and **shale** (40%) Siltstone: yellow, very dolomitic, calcareous, soft, vuggy, thin bedded to laminated, platy and flaggy; crosslamination and ripple marks widespread, salt-crystal casts rare. Shale: purple-red and green, as below. Unit weathers yellow	61 (18.6)	103 (31.4)
2	**Shale**: purple-red, minor green, with minor laminae and lenses of siltstone, as above. Rare mudcracks and salt-crystal casts (''salt hoppers'')	22 (6.7)	42 (12.8)
1	**Shale**: green to olive, dolomitic, flaky to platy. Very minor thin beds of dolomite: yellow-grey, very fine crystalline, very argillaceous. Interval weathers khaki, recessive.	20 (6.1)	20 (6.1)

Gradational contact.

PIKA FORMATION
(235.5 ft/71.8 m)

The Pika Formation here is atypically recessive weathering, because of its high content of mudrocks, especially in the upper third; furthermore, the Tershishner Member is not developed. The lower half of the formation, more or less, supports a distinctly ribbed slope.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	**Dolomite**: yellow-grey, weathering orange; very fine crystalline, very argillaceous; irregularly and very thin bedded; organic burrows and feeding trails are widespread. Minor very dolomitic mudstone, grading to shale. Unit is moderately recessive weathering	14 (4.3)	235.5 (71.8)
14	**Shale** (85%) and **dolomite** (15%) Shale: greenish khaki, very dolomitic, soft, and fissile. Dolomite: mainly ex-flat-pebble rudstone; very fine crystalline; mainly brown pebbles in a pale yellow-grey matrix. Unit is recessive weathering	22 (6.7)	221.5 (67.5)
13	**Shale** (50%) and **dolomite** (50%) Shale and platy mudstone: yellow, very dolomitic, mudcracked. Dolomite: partly flat-pebble rudstone, as above; yellowish khaki, very fine crystalline, siliceous, partly argillaceous	11.5 (3.5)	199.5 (60.8)
12	**Shale**: olive to khaki, dolomitic and calcareous, fissile	14.5 (4.4)	188 (57.3)
11	Poorly exposed: recessive weathering **Shale** (80%) and **dolomite** (20%) Shale: olive-green, minor khaki, fissile, partly micaceous. Dolomite: yellowish khaki, very fine equicrystalline, very siliceous, with calcite filled vugs; occurs in thin bedded, 1 ft (30 cm) thick intervals	21 (6.4)	173.5 (52.9)
10	**Mudstone**: olive-grey, weathers yellow and orange; very dolomitic, partly calcareous	7 (2.1)	152.5 (46.5)
9	**Dolomite**: as above, weathers yellow to orange	2.5 (0.8)	145.5 (44.3)
8	Poorly exposed: recessive weathering **Shale**: greenish grey, fissile, grading to calcareous and dolomitic mudstone, partly with nodules of limestone	12 (3.7)	143 (43.6)
7	**Limestone**: parted lime mudstone; very thin bedded. Many thin beds of flat-pebble rudstone. Several 0.5 to 4 cm thick beds of skeletal (trilobite) grainstone and packstone. The limestone is locally altered to dolomite: grey, very fine crystalline, very calcareous, and slightly argillaceous, mottled with dolomite: pale brown, very fine crystalline	21.5 (6.6)	131 (39.9)

GSC locs. 57617 and 57630
cf. *Rowia* sp. or *Ehmaniella* sp.
Parehmania? sp.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	Covered: recessive weathering A 3 ft (1 m) thick rib of limestone (as above) is exposed 8 ft (2.4 m) below the top. The unit yields float of grey and green shale; thin limestone beds also may be present	34 (10.4)	109.5 (33.4)
5	**Limestone** and **dolomite** (very thinly interbedded and interlaminated) (cryptalgal laminite?) Limestone: lime mudstone. Dolomite: pale yellow-grey, weathering orange; very fine crystalline, calcareous. A single, massive, resistant unit	4 (1.2)	75.5 (23)
	GSC loc. 57626 (from a thin bed of trilobite packstone, 3 ft/1 m above the base) *Elrathia*? sp.		
4	Covered: recessive weathering	60 (18.3)	71.5 (21.8)
3	**Limestone**: parted lime mudstone (in part calcisiltite); flaggy	2 (0.6)	11.5 (3.5)
2	**Limestone**: burrow-mottled lime mudstone; a single, massive, resistant unit	4 (1.2)	9.5 (2.9)
1	**Limestone**: parted lime mudstone (mainly calcisiltite). One 20 cm thick bed of very dolomitic intraclast grainstone, and one 10 to 15 cm thick bed of skeletal (trilobite) grainstone/packstone. One 2.5 to 5 cm thick bed of flat-pebble rudstone: partly pink, with a skeletal packstone matrix. One bed is topped by large-scale, oscillation ripple marks. Unit is moderately resistant.	5.5 (1.7)	5.5 (1.7)
	Contact is abrupt but gradational, and conformable.		

ELDON FORMATION
(336 ft/102.4 m)

With the exception of the basal unit, the Eldon Formation is highly resistant, forming grey weathering cliffs and glacially rounded ribs.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Limestone**: mottled lime mudstone, as below; becomes flaggy on prolonged weathering	6.5 (2)	336 (102.4)
9	**Limestone**: as below; subordinate beds of dark-pellet grainstone, up to 15 cm thick	20 (6.1)	329.5 (100.4)
8	**Limestone**: burrow-mottled lime mudstone; nonbedded, massive; locally, aligned mottling suggests thin bedding	124 (37.8)	309.5 (94.3)
7	**Limestone**: dark-pellet grainstone; dolomitic; medium to very thick bedded, massive, partly irregularly laminated; grey weathering	19 (5.8)	185.5 (56.5)
6	**Limestone** The unit is composed of two, laterally alternating lithofacies: A. Masses, 0.6 to 1 m wide (as measured in sections parallel to the limestone bedding) of pale grey lime mudstone, with prominent random mottling of very fine crystalline dolomite (lacking the geometry of organic burrows). These masses are interpreted as thrombolites B. Limestone: pellet grainstone, dolomitic, thin bedded, with partings of very fine crystalline dolomite. This material fills the spaces, characteristically 0.6 m wide, between thrombolites, and shows differential compaction against them	23 (7)	166.5 (50.7)
5	**Limestone**: almost entirely dark-pellet grainstone; variably dolomitic, indistinctly thin bedded, massive, grey weathering	24 (7.3)	143.5 (43.7)
4	**Limestone**: mainly burrow-mottled lime mudstone; nonbedded, massive; dolomite mottlings locally exceed 50 per cent of the rock. Subordinate beds of dark-pellet grainstone	19 (5.8)	119.5 (36.4)
3	**Limestone**: mainly intraclast grainstone; dolomitic, nonbedded, massive, grey weathering	21 (6.4)	100.5 (30.6)
2	**Limestone**: interbedded dark-pellet grainstone and parted lime mudstone. Unit is massive, grey weathering	15 (4.6)	79.5 (24.2)
	Offset to Section AC-87 on the contact between Units 1 and 2.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	SECTION AC-87		
1	**Limestone**: parted lime mudstone; pyritized burrows, as well as dolomitized ones, are common. Beds of intraclast grainstone, 5 cm thick, occur at wide intervals. Five to seven per cent of the uppermost 25 ft (7.6 m) of the unit comprises beds, 15 to 30 cm thick, of ooid grainstone and ooid packstone with calcisiltite matrix. Unit is moderately resistant, resistance increasing upward.	64.5 (19.7)	64.5 (19.7)
	SNAKE INDIAN FORMATION (843 ft/256.9 m)		

The Snake Indian Formation supports largely talus covered slopes, interrupted by two prominent outcropping ribs of limestone in the lower third. Accordingly, the thickness of the formation reported here is subject to question, due to structural uncertaintly.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
13	Covered: recessive weathering	74 (22.6)	843 (256.9)
12	**Shale**: green, splintery. Minor thin beds of limestone: calcisiltite and skeletal packstone, partly silty. Minor beds of siltstone: calcareous, crosslaminated. Shale increases upward to the exclusion of other rock types. At the base, a 30 cm thick bed of limestone – grey, coarse grained skeletal grainstone/packstone – overlies a thin bed of purple-red shale	30 (9.1)	769 (234.4)
11	Covered: recessive weathering Unit yields float of shale: olive-green, splintery, partly silty, and calcareous siltstone and silty limestone with abundant feeding traces and burrows. Rare slabs of silty limestone bear trilobite free cheeks and rare small cranidia. Thickness is questionable because of change of dip within the covered interval	329 (100.3)	739 (225.2)
	GSC loc. 57619 (float) *Ehmaniella* sp.		
10	**Siltstone** and **limestone** Calcareous siltstone, grading to silty limestone (skeletal packstone, calcisiltite matrix); very thin bedded, platy, brown weathering, with dimpled and burrowed bedding surfaces. At the base, these strata overlie green silty shale. At the top, a 25 cm thick bed of limestone: grey intraclast-ooid grainstone, glauconitic and dolomitic; the top of the bed is irregular, lumpy, and glauconite coated (submarine hardground?). Chitinous brachiopods are common in the siltstones. Unit is slightly resistant	6 (1.8)	410 (125)
9	Covered: recessive weathering	98 (29.9)	404 (123.1)
8	**Limestone**: burrow-mottled lime mudstone; nonbedded, massive, resistant. Minor intraclast packstone with pockets of grainstone	49 (14.9)	306 (93.3)
7	Poorly exposed: recessive weathering **Shale**: deep green, partly waxy, partly chloritic, platy. Rare thin beds of dolomitic siltstone, skeletal (pelmatozoan-trilobite) grainstone/packstone, and derived dolomite	71 (21.6)	257 (78.3)
6	**Limestone**: mainly oncoid packstone (calcisiltite matrix), very dolomitic, becoming dolomite upward. Very thick bedded and massive below, becoming flaggy in the top 8 ft (2.4 m). Unit weathers pale brown and resistant	21.5 (6.6)	186 (56.7)
5	**Limestone**: mainly parted lime mudstone (calcisiltite). Rare thin beds of skeletal grainstone/packstone. Near the top, minor thin beds of ooid grainstone/packstone and flat-pebble rudstone	20.5 (6.2)	164.5 (50.1)
4	**Limestone**: oncoid packstone with matrix of dolomitized calcisiltite; a single massive bed	3.5 (1.1)	144 (43.9)
3	**Limestone**: parted lime mudstone, mainly calcisiltite. At the base, a 60 cm thick bed of skeletal grainstone/packstone, with scattered oncoids. In the top 5 ft (1.5 m), several thin beds of fine ooid grainstone	30 (9.1)	140.5 (42.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	Covered In nearby exposures, the interval consists of sheared green shale with minor siltstone beds	101.5 (30.9)	110.5 (33.7)
1	**Shale**: deep green, chloritic, and sheared, with many thin beds of dolomitic, brown weathering siltstone, and dolomite: pale orange, very fine crystalline, argillaceous, and very silty. Tops of siltstone beds are coated with glauconite(?) and strongly burrowed. Traces of trilobites.	9 (2.7)	9 (2.7)

Contact abrupt, concordant.

GOG GROUP

1	**Quartzite**: fine grained, well sorted; 60 per cent purple to pink, and ferruginous; 40 per cent white, and locally calcareous; mainly thick bedded, massive, with minor thin bedded intervals. Most bed tops are burrowed.	31 (9.4)	31 (9.4)

Section ends downward at structurally disturbed quartzite beds.

SECTION AC-89

Type section of the Snake Indian Formation at Chetamon Mountain

(lat. 53°02′30″N, long. 118°09′40″W)
(For access see Appendix C)

ARCTOMYS FORMATION

The Arctomys Formation is recessive weathering, but not markedly more so than the upper Pika at this locality (because of the presence of units of shale in the latter). The basal contact is marked, at a distance, by the appearance of yellow, orange and minor red weathering in Arctomys outcrop and talus; furthermore, bedding is more clearly marked in the Pika Formation, when viewed from a distance.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	**Shale** (80%) and **siltstone** (20%) Shale: purple-red, subordinate green, fissile, with lenticular laminae of siltstone. Siltstone: yellow, very dolomitic, vuggy, in beds 0.5 to 5 cm thick. Structures include salt hoppers, mudcracks, oscillation ripple marks, and crosslamination. Very minor, thin beds of yellow dolomite and shale-chip breccia	166 (50.6)	224 (68.3)
1	Covered: recessive weathering Float of purple-red shale.	58 (17.7)	58 (17.7)

PIKA FORMATION
(741 ft/225.9 m)

The Pika Formation is moderately recessive weathering, forming a ledged slope banded with grey and khaki.

28	**Limestone** and **mudstone** (very thinly interbedded and laminated) Limestone: lime mudstone. Mudstone: very pale brown, weathering pale yellow-brown; very calcareous (extreme development of the parted lime mudstone lithofacies)	7 (2.1)	741 (225.9)
27	Covered: recessive weathering	161 (49.1)	734 (223.7)
26	Poorly exposed **Shale:** olive, very soft, calcareous, fissile. At the top, a 20 cm thick bed of flat-pebble rudstone, with a matrix of skeletal packstone	21 (6.4)	573 (174.7)
25	Very poor outcrop (recessive weathering) **Limestone:** as below, and flat-pebble rudstone. Trilobite fragments abundant in talus	29.5 (9)	552 (168.2)
24	**Limestone**: parted lime mudstone, with minor beds of flat-pebble rudstone. Pebbles in a bed at the top reach 10 cm in maximum dimension. Seven feet (2.1 m) covered in the middle, apparently shale	16.5 (5)	522.5 (159.3)
23	Covered: recessive weathering Float of green-grey weathering shale, and, apparently, limestone lenses or nodules	30 (9.1)	506 (154.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 57616 (talus originating 15–45 ft/4.6–13.7 m above the base) *Rowia*? sp. *Parehmania*? sp.		
22	**Limestone**: burrow-mottled lime mudstone; medium bedded. In the middle, a 25 cm thick bed of ooid grainstone/packstone	16 (4.9)	476 (145.1)
21	Covered: recessive weathering Float of mudstone: pale grey, calcareous	10 (3)	460 (140.2)
20	Poorly exposed **Limestone:** parted lime mudstone; thin and rare medium beds. At the base, a 15 cm thick bed of ooid grainstone/packstone, partly dolomitized	20 (6.1)	450 (137.2)
19	Mainly covered: recessive weathering Locally, at the top, 4 ft (1.2 m) of parted lime mudstone	33.5 (10.2)	430 (131.1)
18	**Limestone**: parted lime mudstone with especially prominent partings. Flat-pebble rudstone is prominent in the top 10 ft (3 m)	58.5 (17.8)	391.5 (120.9)
17	**Limestone**: burrow-mottled lime mudstone; very thick bedded, massive	21 (6.4)	338 (103)
16	**Limestone**: parted lime mudstone; thin bedding, partly lenticular to nodular; rare ripple marks. Flat-pebble rudstone beds are rare in the lower part, but increase in number and thicken upward (to as much as 30 cm) to prominence in the uppermost 15 ft (4.6 m)	49.5 (15.1)	317 (96.6)
15	Covered: recessive weathering	28.5 (8.7)	267.5 (81.5)
14	**Limestone**: parted lime mudstone	11 (3.4)	239 (72.8)
13	Covered: recessive weathering	15 (4.6)	228 (69.5)
12	**Limestone**: lime mudstone; grey, orange weathering; argillaceous, finely laminated	3.5 (1.1)	213 (64.9)
11	**Limestone**: poorly exposed in upper half, recessive weathering. At the base, parted lime mudstone, grading upward to a more argillaceous lime mudstone with fine argillaceous laminae	57.5 (17.5)	209.5 (63.9)
10	Covered Float of green weathering shale, and nodules of grey, microcrystalline limestone with abundant trilobite fragments	27 (8.2)	152 (46.3)
	GSC loc. 57628 (talus with source from 18 ft/5.5 m below to 6 ft/1.8 m above Unit 10) *Rowia*? sp. 2		
9	**Limestone**: dark grey, very dolomitic; a single massive bed of partly dolomitized ooid packstone/grainstone	2 (0.6)	125 (38.1)
8	**Limestone**: parted lime mudstone, with especially strong partings; traces of trilobites; minor flat-pebble rudstone	16 (4.9)	123 (37.5)
7	**Limestone**: dark grey, very dolomitic; partly dolomitized, fine ooid packstone/grainstone, with flakes of argillaceous limestone	4.5 (1.4)	107 (32.6)
6	**Limestone**: lime mudstone; grey, weathers partly grey-and-yellow, partly orange; very argillaceous, finely laminated (cryptalgal laminite?). Much matrix supported breccia of flake-like clasts – (?)mat-chip breccia	15.5 (4.7)	102.5 (31.2)
5	**Limestone**: parted and burrow-mottled lime mudstone. Several beds of unusual breccia, comprising flakes of argillaceous(?) dolomitic(?) limestone, 1 mm thick, supported by a lime mudstone matrix; "edgewise" arrangement is common	14 (4.3)	87 (26.5)
4	**Limestone**: as Unit 2	14 (4.3)	73 (22.3)
3	Covered: recessive weathering Except for 1 ft (30 cm) of parted lime mudstone in the middle	5 (1.5)	59 (18)
2	**Limestone**: grey, microcrystalline, with fine, continuous argillaceous (dolomitic?) laminae; platy. One subunit has polygonal stromatolites ("stacked saucers")	16 (4.9)	54 (16.5)
1	**Limestone**: parted lime mudstone; weathers flaggy, rubbly; partings are of argillaceous dolomite.	38 (11.6)	38 (11.6)
	Contact is subtle, gradational, and somewhat arbitrary.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

ELDON FORMATION
(809 ft/246.6 m)

The Eldon Formation, where preserved as limestone (as is mainly the case here), forms mainly unclimbable grey and dark grey cliffs. Where dolomitized, the cream coloured cliffs are more broken, and provide climbable routes for examination and measurement. The line of section was chosen to maximize the amount of limestone examined - consistent with safety.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
13	**Limestone**: mottled; as below, but thin and medium bedded, largely flaggy. Minor beds of lime mudstone, non-mottled	73 (22.3)	809 (246.6)
12	**Limestone**: burrow-mottled lime mudstone; alignment of mottling locally suggests thin bedding; overall, unit appears to be medium and thick bedded	91.5 (27.9)	736 (224.3)
11	**Limestone**: mainly burrow-mottled lime mudstone; nonbedded, very massive; minor subunits of non-mottled lime mudstone. In the upper half, minor beds of dark-pellet grainstone, with dolomitized pellets. The unit passes laterally into mottled dolomite, in which, characteristically, bedding joints are better developed	95.5 (29.1)	644.5 (196.4)
10	**Limestone**: largely fenestral lime mudstone (brown), with subordinate pale-pellet grainstone (grey); partly laminated (cryptalgal laminite). These pass laterally into dolomite, in which the fenestrae are preserved as white dolomite in a matrix of pale brown, fine and very fine crystalline dolomite. The limestone is nonbedded, massive; the equivalent dolomite is medium bedded and blocky	45 (13.7)	549 (167.3)
9	**Dolomite**: after limestone (as Unit 8), and in part passing laterally into such limestone. Fenestral fabric is preserved in dolomite - as described above	12 (3.7)	504 (153.6)
	Contact between units 8 and 9 is marked by large irregular masses of very coarsely crystalline calcite.		
8	**Limestone**: pale-pellet grainstone; fenestral, nonbedded, massive, weathering pale grey. Local clumps of pale crystals of dolomite. Unit is laterally dolomitized, to dolomite: dirty brownish white, weathering orange; fine equicrystalline	28 (8.5)	492 (150)
7	**Dolomite** A local, irregular body of dolomite that provides a climbable route; laterally, the unit is limestone (inaccessible). Dolomite: pale pinkish grey, fine crystalline, mottled with dark brown, very fine crystalline dolomite. Unit weathers cream to orange. Higher in the unit, subunits of cream to white, partly very coarse crystalline dolomite may be after limestone: as Unit 8	52 (15.8)	464 (141.4)
6	**Limestone**: burrow-mottled lime mudstone; very thick bedded, massive; aligned mottling locally suggests thin bedding. Minor, 10 to 20 cm thick beds of dark-pellet grainstone in the basal 57 ft (17.4 m)	82.5 (25.1)	412 (125.6)
	The base of Unit 6 is the limit of safe climbing on the preceding line. Measurement upward was continued about one-third of a mile to the south, by descending from the top of the Eldon to Unit 6, protected by a rope belay.		
5	**Limestone**: as below. Many medium to thick beds of dark-pellet and intraclast grainstone: massive, weathering pale grey - these beds dominate the upper half of the unit	18.5 (5.6)	329.5 (100.4)
4	**Limestone**: as Unit 2; almost entirely thin bedded	34 (10.4)	311 (94.8)
3	**Limestone**: as below, with 20 per cent thin and medium beds of dark-pellet grainstone and rare beds with rounded intraclasts up to 1 cm in diameter	48 (14.6)	277 (84.4)
2	**Limestone**: mainly parted lime mudstone. Beginning 30 ft (9.1 m) above the base, burrow-mottled lime mudstone appears gradationally, at first in medium, then in thick beds, but the parted facies remains dominant. Unit is massive and cliff forming	137 (41.8)	229 (69.8)
1	**Limestone**: parted lime mudstone; flaggy. Gradational top of unit marked by increasing resistance.	92 (28)	92 (28)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Conformable contact.		
	SNAKE INDIAN FORMATION		
	Stephen Member		
	(Comprises the third recessive, upper limestone, and fourth recessive "members" of Mountjoy and Aitken, 1978.)		
	(Fourth recessive member)		
62	Poorly exposed **Shale:** greenish grey; rare thin beds of skeletal grainstone/packstone	107 (32.6)	1416 (431.6)
61	Poorly exposed **Shale:** abundant thin beds of calcareous siltstone; feeding traces	40 (12.2)	1309 (399)
60	**Limestone**: parted lime mudstone	3 (0.9)	1269 (386.8)
59	Covered: recessive weathering Along strike, **shale**: grey-green to olive, with 40 per cent limestone, parted lime mudstone; minor rudstone	124 (37.8)	1266 (385.9)
	GSC loc. 57618 (talus) *Ehmaniella*? sp. *Spencella* sp.		
58	Poorly exposed: recessive weathering **Limestone**: parted lime mudstone	2.5 (0.8)	1142 (348.1)
	(Upper limestone member)		
57	**Limestone**: parted lime mudstone; argillaceous, flaggy, weakly cliff forming; grades upward to non-argillaceous, parted lime mudstone	15.5 (4.7)	1139.5 (347.3)
56	Covered	9.5 (2.9)	1124 (342.6)
55	**Limestone**: oncoid packstone (rudstone) and minor coarse ooid packstone	3.5 (1.1)	1114.5 (339.7)
54	**Limestone**: parted lime mudstone; flaggy, cliff forming	81.5 (24.8)	1111 (338.6)
53	**Limestone**: parted lime mudstone; lenticular to nodular bedded, recessive weathering; rare massive medium beds of oncoid floatstone (intraclast-skeletal packstone matrix). Near the base, minor brown calcareous shale, and 25 cm and 45 cm thick beds of oncoid floatstone	36.5 (11.1)	1029.5 (313.8)
	(Third recessive member)		
52	Partly covered **Shale:** green, brown weathering; lenses of lime mudstone increasingly common upward	31 (9.5)	993 (302.7)
51	**Limestone**: lime mudstone with scattered oncoids; weathers pale grey, resistant	6 (1.8)	962 (293.2)
50	**Shale**: green, waxy, with some thin limestone beds, partly oncoidal in upper part	56.5 (17.2)	956 (291.4)
	GSC locs. 42593, 90924 (30 ft/9.1 m above the base) *Glossopleura boccar* (Walcott), 1916 *Glossopleura* sp. *Micromitra* sp. *Zacanthoides* sp.		
49	**Limestone**: rudstone	0.5 (0.2)	899.5 (274.2)
48	Covered	4 (1.2)	899 (274)
	(Middle limestone member)		
47	**Limestone**: parted lime mudstone; flaggy; uppermost bed (10 cm thick) is ooid grainstone	25 (7.6)	895 (272.8)
46	**Limestone**: burrow-mottled lime mudstone, grading in part to parted lime mudstone; beds of oncoid floatstone/packstone 37 to 40 ft (11.3 to 13.4 m) and 68 ft (20.7 m) above base. Massive, strongly cliff forming	83 (25.3)	870 (265.2)
	Trinity Lakes Member **(Second recessive member)**		
45	**Shale**: partly purple in upper half; several zones contain very thin beds of siltstone: grey, brown weathering, calcareous, and laminated; minor limestone: as below; partly laminated, partly burrowed. Minor flat-pebble rudstone and trilobite packstone/wackestone, about 25 ft (7.6 m) below the top	84 (25.7)	787 (239.9)
44	**Limestone**: mainly parted lime mudstone; upper 10 cm and basal metre are ooid packstone with trilobite fragments	10 (3)	703 (214.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
43	**Shale**: green; interbedded with thin, lenticular beds of limestone (skeletal grainstone/packstone); burrowed	10 (3)	693 (211.2)
42	**Limestone**: parted lime mudstone; coarsely laminated to thin bedded, scattered trilobite fragments	5 (1.5)	683 (208.2)
	GSC loc. 57632 *Dictyonina* sp. *Glossopleura* cf. *G. templensis* Rasetti, 1951 *Kootenia* sp. *Wimanella*? sp.		
41	**Shale**: green, with irregular nodules and lenses of microcrystalline limestone	10 (3)	678 (206.7)
40	Covered	11 (3.4)	668 (203.7)
39	**Limestone**: parted lime mudstone; coarsely laminated and very thin bedded; upper 5 ft (1.5 m) consist of glauconitic oncoid and ooid packstone, with a spectacular bed of oncoids (2.5 cm in diameter and commonly with hyolithid nucleii) on top	30 (9.2)	657 (200.3)
38	**Shale**: pale green to brown, finely laminated, with nodular layers of silty, microcrystalline, dolomitic limestone; intensely burrowed at base	28 (8.5)	627 (191.1)
37	**Limestone**: skeletal ooid grainstone/ packstone; thin bedded	1 (0.3)	599 (182.6)
36	**Shale**: green, silty, recessive weathering	10 (3)	598 (182.3)
35	**Limestone**: parted lime mudstone; abundant trilobite fragments	1 (0.3)	588 (179.3)
34	**Shale**: green to olive green, slightly silty, recessive weathering, basal part covered	15 (4.7)	587 (179)
	(Lower limestone member)		
33	**Limestone**: trilobite wackestone and coquina; nodular, thin bedded, top mammillate	1 (0.3)	572 (174.3)
32	**Limestone**: lime mudstone; finely laminated, fenestral (cryptalgal laminite), slightly mottled, massive, cliff forming. Upper 15 cm comprise a bed of algal stromatolites, with polygonal cracks on the upper surface	38 (11.6)	571 (174)
31	**Limestone**: pale to dark grey lime mudstone (and ?pale-pellet grainstone); fenestral; cliff forming	30 (9.1)	533 (162.4)
30	**Limestone**: alternating burrow-mottled and parted lime mudstone; scattered oncoids and minor ooid packstone 30 to 35 ft (9.1 to 10.7 m) above base; cliff forming	94 (28.6)	503 (153.3)
	(First recessive member)		
29	Partly covered **Mudstone:** greenish grey, with a few nodules and thin beds of grey, microcrystalline limestone	23 (7)	409 (124.7)
28	**Limestone** and **shale** Limestone: burrow-mottled lime mudstone; interrupted by three units consisting of green shale with minor beds of pebbly skeletal grainstone, glauconitic	32 (9.8)	386 (117.7)
27	**Mudstone**: olive green, calcareous, chippy; with widely spaced lenses of limestone: skeletal grainstone/ packstone	29 (8.8)	354 (107.9)
26	**Limestone**: oncoid packstone; argillaceous	1 (0.3)	325 (99.1)
25	**Mudstone**: dark red; varve-like bedding; recessive weathering	28 (8.6)	324 (98.8)
24	**Shale**: dark green	6 (1.8)	296 (90.2)
	GSC loc. 90922 (middle of unit) *Albertella helena* Walcott, 1908 *Albertella levis*? Walcott, 1917		
23	**Mudstone**: khaki to pale green, calcareous, chippy, abundant burrows, varve-like bedding. Rare thin beds of muddy, skeletal packstone	36 (11)	290 (88.4)
	GSC loc. 90923 (talus) *Albertella levis*? Walcott, 1917		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
22	**Limestone**: fine skeletal grainstone; partly oolitic, resistant. Top 15 cm contain abundant oncoids up to 3.8 cm in diameter	2 (0.6)	254 (77.4)
21	**Limestone**: parted lime mudstone; grading to nodules of microcrystalline limestone in olive to khaki calcareous mudstone. A few 15 to 30 cm thick beds of skeletal ooid packstone	24 (7.3)	252 (76.8)
	GSC loc. 90921 *Paralbertella bosworthi* Walcott, 1917		
	GSC locs. 57670, 67673 (lower half of unit) *Albertella levis* Walcott, 1917 *Paralbertella* sp. *Mexicella* sp.		
20	**Limestone**: slightly skeletal ooid grainstone/packstone, partly oncoid and intraclast rudstone, glauconitic	1 (0.3)	228 (69.5)
	Weed Member **(Green quartz siltstone member)** (Units 6 to 19)		
19	**Mudstone**: silty, green, red in basal 3 ft (1 m); in part, argillaceous siltstone, partly finely laminated, partly burrowed, calcareous at top	22 (6.7)	227 (69.2)
	GSC loc. 90934 (top 1 ft/0.3 m) *Paralbertella* sp.		
18	**Siltstone**: dolomitic, pale greenish grey; abundant, well preserved burrows and feeding traces	1 (0.3)	205 (62.5)
17	**Mudstone**: red and green; silt lenses (flaser), some mudcracks	4 (1.2)	204 (62.2)
16	**Siltstone**: dolomitic, pale green, finely laminated and crosslaminated; forms a prominent, pale yellow weathering rib	2 (0.6)	200 (61)
15	**Mudstone**: dark red; interbedded with siltstone; ripple marks	11 (3.4)	198 (60.4)
14	**Shale** and **siltstone** (thinly interbedded) Shale: silty; siltstone: pale green; recessive weathering	4 (1.2)	187 (57)
13	**Limestone**: skeletal ooid grainstone/packstone; dolomitic, weathers yellow-grey, moderately resistant	0.5 (0.2)	183 (55.8)
	GSC loc. 90920 *Paralbertella* sp.		
12	**Siltstone**: calcareous, finely laminated, pale green; interbedded with silty green shale; abundant mudcracks, some ripple marks	2.5 (0.7)	182.5 (55.6)
11	**Siltstone** and **sandstone** Pale green, calcareous, partly finely laminated, partly highly burrowed	2 (0.6)	180 (54.9)
10	Covered	7 (2.1)	178 (54.3)
9	**Sandstone**: fine grained, quartzose, calcareous, finely laminated, weathers pale yellow	1 (0.3)	171 (52.1)
8	**Shale**: silty, dark red	3 (0.9)	170 (51.8)
7	**Shale**: green, silty	3 (0.9)	167 (50.9)
6	**Siltstone**: pale green, calcareous, partly finely laminated, partly burrowed, with feeding traces; minor very thin interbeds of microcrystalline limestone: dolomitic, and dolomite: pale yellow; ripple marks	4 (1.2)	164 (50)
	(Basal red member) (?Peyto Formation)		
5	**Limestone**: dark grey skeletal wackestone; silty, dolomitic, nodular thin bedded, mainly altered to dolomite: grey, very fine crystalline	4.5 (1.4)	160 (48.8)
4	**Mudstone** and **shale** Mudstone: very dolomitic. Shale: purple to red, some green. Minor dolomite: greenish grey, microcrystalline, silty, thin and medium bedded; thin beds of siltstone at the top; mudcracks and oscillation ripple marks at several levels; thin breccias, rare sandy beds	97.5 (29.7)	155.5 (47.4)
3	**Limestone**: red, microcrystalline, argillaceous, thin and very thin bedded, ripple marks, tepee structures; prominent thin layers of flakestone	20.5 (6.3)	58 (17.7)
2	**Mudstone**: red, calcareous	13 (3.9)	37.5 (11.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Dolomite**: grey, pale red, microcrystalline, silty, laminated, and nodular, partly burrowed; partings of green and purple shale; minor flakestone; mudcracks prominent.	24.5 (7.5)	24.5 (7.5)
	Abrupt contact.		

GOG GROUP

	Sandstone: quartzose, red to pale grey, fine to medium grained, pale grey carbonate cement, weathers pale brown in 1 to 3 ft thick (0.3 to 1 m) beds; moderately resistant.		

SECTION AC–94

Mount McDonald

(lat. 52°16′21″N, long. 116°40′13″W)

ARCTOMYS FORMATION

	Section continues upward.		
4	**Shale** (60%) and **dolomite** (40%) Shale: green, purple-red, fissile, partly silty. Dolomite: pale yellow-brown, grey, microcrystalline, argillaceous, partly silty, earthy; very thin bedded, laminated, platy/flaggy	14 (4.3)	150.5 (45.9)
3	Covered: recessive weathering	64 (19.5)	136.5 (41.6)
2	Poorly exposed: recessive weathering **Shale:** purple, pale green, platy and fissile below, fissile above. Near the base, many 0.5 to 1 cm thick laminae of dolomite: purple and green, microcrystalline, and argillaceous. In the upper half, many thin beds, lenses and laminae of siltstone: yellow and dolomitic. Mudcracks, ripple marks, and salt-crystal casts	58 (17.7)	72.5 (22.1)
1	**Dolomite**: interlaminated grey and pale yellow-brown; microcrystalline, argillaceous, calcareous, soft, earthy; mudcracks; unit weathers pale yellow-brown, flaggy.	14.5 (4.4)	14.5 (4.4)

PIKA FORMATION
(728.5 ft/222 m)

The Pika Formation displays markedly recessive weathering relative to the cliff forming Eldon beneath, and is scarcely more resistant than the overlying Arctomys. The Pika forms ledgy slopes, with numerous covered intervals. The Tershishner Member is not distinguishable from the rest of the Pika Formation here, on overall weathering colour or resistance.

Tershishner Member
(341 ft/103.9 m)
(Units 17 to 34)

34	**Mudstone** (60 to 75%) and **limestone** (25 to 40%) Mudstone: pale grey-brown, calcareous. Limestone: lime mudstone, in very thin beds, lenses and laminae, rarely more than 1 cm thick. A few very thin beds and lenses of flat-pebble rudstone. Covered at the base	15.5 (4.7)	728.5 (222)
33	**Limestone**: as below, with three beds of dolomitic oolite, 35 to 60 cm thick. Oolite beds occur at the base, middle, and top	24.5 (7.5)	713 (217.3)
32	**Limestone**: parted lime mudstone; very thin, lenticularly bedded; minor thin beds of rudstone (as below); three superposed rudstone beds at the top total 30 cm in thickness	16.5 (5)	688.5 (209.5)
31	Very poorly exposed **Limestone:** as Unit 27. The rudstone beds are in part of "edgewise" type	40 (12.2)	672 (204.8)
30	**Limestone**: ooid grainstone/packstone; variably dolomitized; a single, massive, brown weathering bed with scattered flat pebbles	1.5 (0.5)	632 (192.6)
29	Covered (70%): recessive weathering **Limestone:** as Unit 27; with 25 per cent rudstone	40 (12.2)	630.5 (192.2)
28	**Limestone**: as below; with three, 15 to 20 cm thick beds of ooid grainstone/packstone; very dolomitic	5.5 (1.7)	590.5 (180)
27	**Limestone**: parted lime mudstone (60%), and 40% flat-pebble and equant-pebble rudstone; in beds up to 15 cm thick. Fourteen feet above the base, small, domal algal stromatolites interrupt and project from a rudstone bed	19 (5.8)	585 (178.3)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
26	Covered (80%): recessive weathering The exposed ribs of outcrop are of parted lime mudstone and rudstone, as below. Trilobite fragments are abundant in the talus	61 (18.6)	566 (172.5)
	GSC loc. 57635 (collected in situ, from 43 to 45 ft/13.1 to 13.7 m above the base) *Americare* sp.		
25	**Limestone**: parted lime mudstone with especially prominent partings. Rudstone beds up to 8 cm thick are common	21 (6.4)	505 (153.9)
24	Covered: recessive weathering Float suggests thin beds of lime mudstone and rudstone, interbedded with shale or calcareous mudstone. Trilobites abundant in float	42 (12.8)	484 (147.5)
23	**Limestone**: parted lime mudstone; with two thin beds of grainstone (as below). The top bed is a massive bed of dolomitic oolite, 25 cm thick	8.5 (2.6)	442 (134.7)
22	**Limestone**: intraclast grainstone; brown, fine grained, dolomitic, thin and medium bedded, massive	2.5 (0.8)	433.5 (132.1)
21	**Limestone**: as Unit 17	12 (3.7)	431 (131.4)
20	Covered	2.5 (0.8)	419 (127.7)
19	**Limestone**: as Unit 17	3.5 (1.1)	416.5 (126.9)
18	Covered	3.5 (1.1)	413 (125.9)
17	**Limestone**: parted lime mudstone (as below); with 10 per cent flat-pebble rudstone beds up to 8 cm thick. At the base, a 35 cm thick bed of dolomitic oolite	22 (6.7)	409.5 (124.8)
16	**Limestone**: parted lime mudstone (as below). The only rudstone is a lens, 20 cm thick, extending for only 1.2 m (bedding-wise) in section. Ten feet (3 m) above the base, a bed of bun-shaped algal stromatolites 20 cm high. Many of the limestone beds are calcisiltite, and, possibly, very fine grained intraclast grainstone	38 (11.6)	387.5 (118.1)
15	Covered: recessive weathering One foot (30 cm) of shale: olive, fissile, is exposed at the base	4.5 (1.4)	349.5 (106.5)
14	**Limestone**: parted lime mudstone; burrows perpendicular to bedding are especially prominent; one ripple marked bedding surface. Flat-pebble rudstone with dolomitic matrix, in beds up to 10 cm thick, is prominent. Rudstone increases in proportion upward; a 25 cm thick rudstone bed occurs 53 ft (16.2 m) above the base	55 (16.8)	345 (105.2)
13	Covered: recessive weathering	18.5 (5.6)	290 (88.4)
12	**Limestone**: parted lime mudstone; with partings of argillaceous dolomite strongly developed, as are burrows and feeding traces; flaggy	22.5 (6.9)	271.5 (82.8)
11	Covered: recessive weathering	28 (8.5)	249 (75.9)
10	Poorly exposed (upper two thirds) **Limestone:** as Unit 12; minor flat-pebble rudstone. Vertical columns or walls of dolomitized limestone cut the unit	58.5 (17.8)	221 (67.4)
9	Covered: recessive weathering Abundant trilobite fragments in float	76.5 (23.3)	162.5 (49.5)
	GSC loc. 57664 (float from basal 18 ft/5.5 m) cf. *Marjumia* sp. *Modocia* sp. *Rowia* sp.		
8	**Dolomite**: ex-parted lime mudstone; platy/flaggy; hemispherical algal stromatolites, partly replaced by medium crystalline dolomite in the top one foot (30 cm)	12 (3.7)	86 (26.2)
7	**Dolomite**: brown, weathering orange; very fine crystalline, thin bedded, flaggy; one bedding surface with oscillation ripples	20 (6.1)	74 (22.6)
6	**Dolomite**: mainly brown, weathering pale orange-brown; fine equicrystalline, medium and thick bedded, massive, minor dolomite: ex-parted lime mudstone. Lenses and balls of dark grey chert. A 60 cm thick bed at the top contains hemispherical algal stromatolites, partly replaced by medium crystalline dolomite	12 (3.7)	54 (16.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
5	**Shale**: brown, dolomitic, hard, platy	4.5 (1.4)	42 (12.8)
4	**Dolomite**: grey, weathers yellow; microcrystalline, argillaceous, laminated; partly massive, partly flaggy	7.5 (2.3)	37.5 (11.4)
3	**Dolomite**: as Unit 1	12 (3.7)	30 (9.1)
2	**Dolomite**: mottled in shades of grey, weathers mottled pale brown; very fine crystalline, thick bedded, massive, vuggy; stained purple-red adjacent to minor faults	8 (2.4)	18 (5.5)
1	**Dolomite**: purplish brown, microcrystalline, argillaceous, irregularly thin and very thin bedded, flaggy; bedding planes prominently figured (?ex-parted lime mudstone). Three feet (1 m) above the base, a 2.5 cm thick bed of platy, black shale. Local lavender stain.	10 (3)	10 (3)

Contact abrupt, conformable.

ELDON FORMATION
(1128.5 ft/344 m)

Except for Units 1 and 2, at the base, the Eldon Formation is cliff forming throughout.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
19	**Dolomite**: pale brown, pale grey, and white; grey weathering; fine crystalline, with medium crystalline patches of white dolomite; largely vuggy, nonbedded, massive. Minor beds have poorly preserved fenestral fabric. Local stromatactoid structure and pink coloration	110 (33.5)	1128.5 (344)
18	**Dolomite**: with ex-fenestral fabric; brown, weathering cream-grey; fine crystalline; mottled and/or vermiculated with white, fine crystalline dolomite; medium and thick bedded, massive	39 (11.9)	1018.5 (310.4)
	A reverse fault with about 45 ft (13.7 m) of stratigraphic throw is compensated for at the Unit 17/Unit 18 contact.		
17	**Dolomite**: pale grey to white, weathering cream-grey with local pink tinge; mainly fine equicrystalline, with medium crystalline patches locally; nonbedded, massive, vuggy	43 (13.1)	979.5 (298.6)
16	**Dolomite**: laminated grey-brown and pale grey; weathers laminated grey and pale brown; very fine crystalline, partly mottled in the same colours; thin bedded, locally crosslaminated	15.5 (4.7)	936.5 (285.4)
15	**Dolomite**: as below, but non-vuggy; aligned dark mottling suggests thin bedding. Here, as commonly in the underlying dolomites, bedding planes are coated with pyrobitumen	87.5 (26.7)	921 (280.7)
14	**Dolomite**: mottled grey-brown and brown, weathers dull yellow-orange; very fine crystalline, with abundant blebs and patches of white, medium crystalline dolomite, commonly centered on vugs; unit is nonbedded and massive	17 (5.2)	833.5 (254.1)
13	**Dolomite**: as below, interrupted by beds (medium in the lower part, thick above) of white, fine and medium crystalline dolomite. The white beds weather reddish orange	41 (12.5)	816.5 (248.9)
12	**Dolomite**: as Unit 10	193 (58.5)	775.5 (236.4)
11	**Dolomite**: ex-burrow-mottled lime mudstone; mottled in grey-brown shades, weathering dull brownish orange; very fine crystalline, nonbedded, massive	38 (11.6)	582.5 (177.5)
10	**Dolomite**: ex-parted lime mudstone, as Unit 8	148 (45.1)	544.5 (166)
9	**Dolomite**: ex-burrow-mottled lime mudstone; brownish grey, weathering cream-grey; very fine crystalline, massive; wispy mottling appears only on weathered surfaces	20 (6.1)	396.5 (120.9)
8	**Dolomite**: pale to very pale brownish grey, mottled with brown and white; weathers pale orange-brown; mainly very fine crystalline, strongly cliff forming. Although massive, this dolomite is apparently ex-parted lime mudstone. From 62 ft (18.9 m) above the base upward, dolomite, as above, alternates with dolomite: brown, weathering pale brownish grey; very fine crystalline. (This is possibly an alternation of parted and burrow-mottled lime mudstones.)	126.5 (38.6)	376.5 (114.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Small thrust faults, uncompensated, were crossed 47.5 and 107.5 ft (14.5 and 32.8 m) above the base of Unit 8.		
7	**Limestone**: mainly lime mudstone; irregularly thin bedded, with thin dolomitic partings; some beds have indistinct, very fine particulate texture; scattered, indistinct oncoids. Basal bed, 10 cm thick, is intraclast grainstone, capped by a 2.5 cm thick bed of oncoid grainstone/packstone. Laterally, to the southeast, much of this unit is dolomite	45.5 (13.9)	250 (76.2)
6	**Limestone**: parted lime mudstone; irregularly thin bedded and lenticular; partings become progressively thinner upward. Unit is a strong cliff former	34 (10.4)	204.5 (62.3)
5	**Limestone**: mainly parted lime mudstone; a few medium and thick beds of lime mudstone, and minor thin and medium beds of intraclast grainstone, occur near the base; intraclasts are well rounded and sorted. Unit forms a sloping bench	34 (10.4)	170.5 (52)
4	**Limestone**: intraclast grainstone; weathers grey; fine and medium grained, poorly sorted; nonbedded, massive, with faint internal lamination and crosslamination; some preferential dolomitization of intraclasts; forms upper part of cliff	10.5 (3.2)	136.5 (41.6)
3	**Limestone**: as below; in beds 0.5 to 7.5 cm thick. About the middle of the unit, partings become thinner, and the unit gradually becomes less flaggy weathering	97 (29.6)	126 (38.4)
2	**Limestone**: parted lime mudstone; in thin and very thin, persistent flaggy beds, with partings of yellow weathering, khaki mudstone comprising 50 per cent of the bottom half, but diminishing to 30 per cent in the upper half	24.5 (7.5)	29 (8.8)
	Resistence to weathering and steepness of slope increase progressively upward through Units 2, 3, and 4.		
1	**Limestone**: parted lime mudstone; glauconitic at the base, irregularly thin and minor medium bedded, dolomite mottled.	4.5 (1.4)	4.5 (1.4)

STEPHEN FORMATION
(326.5 ft/99.5 m)

The Stephen Formation forms a distinct bench or ledged slope between the great cliffs of the Cathedral Formation below and the Eldon above.

Waputik Member
(?259 ft/78.9 m)
[Units 4(?) to 131]

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
13	**Shale** (80%) and **limestone** (20%) Shale: as below. Limestone: ooid grainstone/packstone; in massive, lenticular beds up to 30 cm thick	11.5 (3.5)	326.5 (99.5)
12	**Shale**: mainly olive green, with two purple beds near the base; calcareous, fissile. Minor very thin beds of siltstone: calcareous, dolomitic. In the middle, a few very thin beds of lime mudstone occur. A 1 cm thick lamina of calcareous greensand (glauconite rock) occurs 2.6 ft (80 cm) above the base	33.5 (10.2)	315 (96)
11	**Limestone**: parted lime mudstone; argillaceous; partings are green calcareous shale; minor silty beds. Thin beds of rather fine grained rudstone are prominent. Scattered trilobite fragments. Unit is moderately recessive weathering	10 (3)	281.5 (85.8)
10	**Shale**: brown shale at the base, weathering purple-brown, becoming green above; fissile; slightly calcareous. In the upper half, the shale is interlaminated with laminae of silty limestone (?calcisiltite) and calcareous siltstone; these laminae are lenticular, laminated and crosslaminated	4.5 (1.4)	271.5 (82.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	**Limestone**: parted lime mudstone; thin and very thin bedded, partly lenticular; partings are of green, calcareous shale. Locally, over intervals up to two ft (60 cm) thick, the shale partings are thicker than the limestone beds. Minor beds of fine grained rudstone occur. Ten per cent of the unit consists of subunits, 0.5 to 1.5 ft (15 to 45 cm) thick, of limestone: as Unit 8. Rudstone increases in proportion and coarsens upward; it is partly flat-pebble, partly equant-pebble rudstone, in part pink and green. The thickest rudstone bed, 15 cm thick, occurs 55 ft (16.8 m) above the base	80 (24.4)	267 (81.4)
8	**Limestone**: parted lime mudstone with thick dolomite partings; irregularly thin and very thin bedded; beds partly laminated internally (?calcisiltite); minor flat-pebble rudstone in thin beds. Beds of partly dolomitized oolite, 20 and 25 cm thick, occur 7 and 16 ft (2.1 and 4.9 m) above the base. Rare thin lenses of skeletal grainstone/packstone also occur	16 (4.9)	187 (57)
7	**Limestone**: as Unit 5, but with a single bed of rather coarse, flat-pebble rudstone, 15 cm thick, that terminates abruptly to the northeast	40 (12.2)	171 (52.1)
6	**Limestone**: parted lime mudstone; partly laminated; thin bedded, massive, burrows and feeding traces prominent	2.5 (0.8)	131 (39.9)
5	**Limestone**: parted lime mudstone; very thin bedded, with partings of olive green, calcareous shale; minor thin beds of flat-pebble rudstone	9 (2.7)	128.5 (39.2)
4	Poorly exposed: recessive weathering **Shale:** brownish grey at the base, olive above, fissile; partly with nodules of microcrystalline limestone below, partly with very thin, lenticular beds of the same above	52 (15.8)	119.5 (36.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Narao Member (?67.5 ft/20.6 m) (?Units 1 to 3)		
3	**Limestone**: intraclast packstone/wackestone; dark grey, dolomitic; scattered trilobite fragments; thin bedded, with thin dolomitic partings, flaggy	2.5 (0.8)	67.5 (20.6)
	GSC loc. 57637 *Amecephalus* sp. *Glossopleura boccar*? (Walcott), 1916 *Glossopleura* cf. *G. templensis* Rasetti, 1951 *Kootenia* cf. *K. pectenoides* Resser, 1939		
2	**Limestone**: parted lime mudstone; lenticular, thin and very thin beds; calcisiltite in part; scattered intraclasts	19 (5.8)	65 (19.8)
1	Covered: recessive weathering.	46 (14)	46 (14)
	Upward line of measurement through Stephen Formation is offset 400 m northwest from the line through the Cathedral Formation.		

CATHEDRAL FORMATION
(711 ft/216.7 m)

The Cathedral Formation supports two major cliffs, separated by the sloping ledge formed by the Trinity Lakes Member.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
17	**Dolomite**: dark grey, mottled with coarser pale grey and white; fine crystalline, with minor very fine and medium crystalline; thick bedded, massive, becoming thin bedded and flaggy in the top 5 ft (1.5 m). The unit passes laterally to limestone (off the line of section)	28 (8.5)	711 (216.7)
16	**Limestone** and **dolomite** Dolomite: pale grey and grey, fine and very fine crystalline, cryptalgalaminate, massive; passing to limestone, 8 ft (2.4 m) above the base. Limestone: cryptalgal laminite; grey, very fine crystalline to microcrystalline; some argillaceous laminae; blocky fracture. The limestone is penetrated along the bedding by several tongues of dolomite	38 (11.6)	683 (208.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	**Dolomite**: pale buff and white, cream weathering; fine crystalline, thick bedded, massive; good vuggy and intercrystalline porosity; gradational, replacement contacts at top and base	20 (6.1)	645 (196.6)
14	**Dolomite**: pale grey mottled with darker grey, weathers pinkish orange; fine and very fine crystalline; mainly nonbedded, massive, locally medium bedded (ex-burrow-mottled lime mudstone); a strong cliff former. Unit becomes mainly medium bedded toward the top	173 (52.7)	625 (190.5)
13	**Limestone**: mainly lime mudstone; nonbedded and massive; minor beds of oolite (as below); patchily and, laterally, completely dolomitized to dolomite: grey, fine crystalline	16 (4.9)	452 (137.8)
12	**Limestone**: ooid grainstone; grey, grey weathering; partly coarse; medium bedded, massive, resistant	10.5 (3.2)	436 (132.9)
11	**Dolomite**: ex-burrow-mottled lime mudstone; pale grey mottled with dark grey, very fine crystalline; some crude, dark grey laminae (ex-partings). Unit is mainly flaggy, grading to massive at the top	72 (21.9)	425.5 (129.7)
	Contact between dolomite and limestone crosses more than 10 ft (3 m) of beds.		
10	**Limestone**: parted lime mudstone; very thin bedded at the base, becoming thin bedded upward	11 (3.4)	353.5 (107.7)
	Trinity Lakes Member (110.5 ft/33.7 m) (Units 7 to 9)		
9	Covered: recessive weathering	68.5 (20.9)	342.5 (104.4)
8	**Limestone**: parted lime mudstone; argillaceous, thin bedded, flaggy; trilobite fragments	2 (0.6)	274 (83.5)
7	Weathered and very poorly exposed (generally covered laterally) **Shale:** olive grey, fissile; apparently with scattered thin beds, lenses or nodules of microcrystalline limestone containing trilobite fragments	40 (12.2)	272 (82.9)
6	**Limestone**: parted lime mudstone: thin bedded, flaggy; a weak cliff former, recessive weathering relative to the underlying dolomite	24 (7.3)	232 (70.7)
5	**Dolomite**: ex-burrow-mottled lime mudstone; mottled in shades of grey, orange weathering; very fine and fine crystalline, massive, strongly cliff forming	105.5 (32.2)	208 (63.4)
	Diffuse, replacement contact.		
4	**Limestone**: in the basal part, mainly intraclast grainstone with some oncoid grainstone; upward, becomes mainly parted and burrow-mottled lime mudstone	58.5 (17.8)	102.5 (31.2)
3	**Limestone**: oncoid packstone; medium bedded	5 (1.5)	44 (13.4)
2	**Limestone**: burrow-mottled lime mudstone; massive	5 (1.5)	39 (11.9)
1	**Limestone**: as Unit 20 of the Mount Whyte Formation, becoming more distinctly bedded upward as partings diminish in thickness.	34 (10.4)	34 (10.4)

MOUNT WHYTE FORMATION
(618.5 ft/188.5 m)

The Mount Whyte Formation is recessive weathering, the shaly units largely covered. Units of limestone form persistent ribs and small cliffs that interrupt the overall slope.

Chephren Member
(546.5 ft/166.6 m)
(Units 3 to 21)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	Covered	10 (3)	618.5 (188.5)
20	**Limestone**: parted lime mudstone	5 (1.5)	608.5 (185.5)
19	Covered Float of green weathering shale	55 (16.8)	603.5 (183.9)
18	**Limestone**: parted lime mudstone; very thin bedded and nodular thin bedded; partings of argillaceous, orange weathering dolomite form 40 per cent of the unit. A covered interval near the base may conceal shale	32 (9.8)	548.5 (167.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
17	**Shale**: platy, calcareous, as below, with laminae of microcrystalline limestone	10 (3)	516.5 (157.4)
16	**Limestone**: oncoid grain/rudstone; oncoids are up to 1 cm in maximum diameter and commonly have trilobite fragments as nuclei	1 (0.3)	506.5 (154.4)
15	Covered	28 (8.5)	505.5 (154.1)
14	**Shale**: brown, weathering yellow-grey; very calcareous, platy; minor beds of lime mudstone	29 (8.8)	477.5 (145.5)
13	Covered 39.9 to 41 ft (12.2 to 12.5 m) above the base, an exposure of shale: grey, very calcareous, platy, with abundant trilobites	60.5 (18.4)	448.5 (136.7)
	GSC loc. 57625 *Albertella helena*? Walcott, 1908 cf. "*Ptychoparia*"? *cilles* Walcott, 1917		
12	**Limestone**: (?)calcisiltite; pale brown, very dolomitic, very silty, very thin bedded; crosslamination and soft-sediment deformation are common; silt content decreases to zero at the top	11.5 (3.5)	388 (118.3)
11	**Limestone**: parted lime mudstone, minor flat-pebble rudstone	3.5 (1.1)	376.5 (114.8)
10	Covered Float of shale: as below	115.5 (35.2)	373 (113.7)
9	Poorly exposed: very recessive weathering. Very rarely exposed laterally. On line of section, 25 per cent exposed. **Shale**: olive, weathers green-grey; soft, calcareous, flaky; minor thin silty beds. Very minor, thin beds of bioturbated siltstone: grey and green-grey, weathering brown; calcareous, glauconitic	78 (23.8)	257.5 (78.5)
8	**Limestone**: argillaceous lime mudstone; weathering yellow-brown; in nodular beds interbedded with calcareous shale (as below); minor lenses of rudstone; ripple marks	20 (6.1)	179.5 (54.7)
7	**Limestone**: parted lime mudstone; very thin bedded	25 (7.6)	159.5 (48.6)
6	**Limestone**: argillaceous lime mudstone; brownish grey, soft, shaly, grading to calcareous shale. Two, 15 cm thick beds of pebbly, slightly argillaceous skeletal grainstone	16.5 (5)	134.5 (41)
	GSC loc. 57658 (4.5 ft/1.4 m above the base) *Amecephalus* sp. *Nisusia*? sp. *Parapoulsenia*? sp. *Plagiura* sp.		
5	**Limestone**: ooid grainstone; locally pebbly, very dolomitic, thick bedded, massive, resistant, with low-angle crossbedding. A median, 4 ft (1.2 m) thick subunit consists of flaggy, parted lime mudstone	22.5 (6.9)	118 (36)
4	**Limestone**: parted lime mudstone; irregularly very thin bedded. Minor shaly limestone at the base. One bed of fist-sized algal stromatolites	15 (4.6)	95.5 (29.1)
3	**Limestone**: mainly ooid grainstone/packstone; dolomitic; some intraclast grainstone/packstone; thick bedded. At the top, a thin bed of oncoid packstone. Scattered trilobite fragments	8.5 (2.6)	80.5 (24.5)
	Weed Member (72 ft/21.9 m) (Units 1 and 2)		
2	**Siltstone** Siltstone (60%): as below; argillaceous. Siltstone (40%): grey, brown weathering; slightly calcareous; regularly thin bedded, laminated, resistant. Rare thin beds of skeletal grainstone: glauconitic, pinkish grey, partly pebbly. Unit is a weak cliff former	52.5 (16)	72 (21.9)
1	**Siltstone** 30 per cent siltstone (and very fine grained sandstone): grey, greenish grey, weathers green; glauconitic, hard, resistant, thin bedded, minor medium and thick bedded. 70 per cent siltstone: grey, weathers green, rubbly; glauconitic, calcareous, argillaceous, crudely thin bedded, with abundant burrows and feeding traces.	19.5 (5.9)	19.5 (5.9)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GOG GROUP		
	PEYTO FORMATION (122.5 ft/37.3 m)		
	The Peyto Formation here forms a minor double rib above the Gog sandstones; it is even less conspicuous than elsewhere, because partial dolomitization causes it to weather in shades of orange, rather than grey.		
7	**Limestone**: as below, except that the basal 2 ft (60 cm) are argillaceous lime mudstone. In the middle, a 20 to 25 cm thick bed of oncoid packstone (oncoids up to 2 cm in diameter). At the top, a 7 to 20 cm thick bed of sandy, glauconitic, trilobite coquina	14.5 (4.4)	122.5 (37.3)
6	Covered: recessive weathering	11 (3.4)	108 (32.9)
5	**Limestone**: largely fine to coarse intraclast grainstone/packstone, with several beds of ooid packstone; grey, very dolomitic, with various particulate textures; scattered oncoids near the base. Unit is irregularly thin bedded, minor medium bedded, and forms a weak cliff	24 (7.3)	97 (29.6)
	GSC loc. 57620 (22 ft/6.7 m above the base) *Micromitra* sp. *Olenellus* sp. (very short eye lobes)		
4	**Limestone**: pellet or ooid packstone; very dark grey, very dolomitic, thick bedded, massive, resistant	3 (0.9)	73 (22.3)
3	Covered: recessive weathering Shale float	9 (2.7)	70 (21.3)
2	**Sandstone**: grey, weathers orange-grey to brown-grey; mainly coarse grained, very dolomitic, with laminae of sandy dolomite; thick bedded, massive, with tabular crosslamination	8.5 (2.6)	61 (18.6)
1	**Dolomite**: dark brownish grey, weathers dull orange; faintly mottled, very fine crystalline, slightly sandy, thick bedded, massive.	7.5 (2.3)	52.5 (16)
	Contact conformable, gradational.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	SUB-PEYTO STRATA		
	Poorly exposed **Sandstone:** partly as below, but with coarse grained beds, partly dolomitic. At the base, calcareous, soft, flaggy, brown-and-white mottled, burrowed. One bed of hard, massive silstone	28 (8.5)	45 (13.7)
	Sandstone: mainly white; minor green and pink patches and laminae; locally glauconitic; mainly fine grained, minor medium; quartzose, mainly quartz cemented; minor thin, calcareous subunits toward the top; very thick bedded, becoming medium bedded upward, local tangential crossbedding. At the top, rip-up clast (shale-flake) conglomerate	17 (5.2)	17 (5.2)

SECTION AC-102

Stephen, Eldon, and Pika formations at Eon Mountain

(lat. 50°50′00″N, long. 115°37′30″W)
(For access see Appendix C)

ARCTOMYS AND WATERFOWL FORMATIONS
(undifferentiated)

Section continues upward through a complete Arctomys-Waterfowl section into the Sullivan Formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Dolomite**: cryptalgal laminite; pale yellow, microcrystalline, silty. Minor similar siltstone: dolomitic, planar laminated, crosslaminated, and thin seams of pale green shale	9 (2.7)	31.5 (9.6)
3	**Siltstone**: very pale green, dolomitic, pyritic, shaly, recessive; cryptalgal laminae at the top	1.5 (0.5)	22.5 (6.9)
2	**Dolomite**: cryptalgal laminite, with rare large domal stromatolites; pale grey and pale brown, weathers orange-yellow; microcrystalline, silty, grading to dolomitic siltstone. Unit is semirecessive	11.5 (3.5)	21 (6.4)
1	Covered: recessive weathering.	9.5 (2.9)	9.5 (2.9)
	Contact covered, but appears abrupt – a marked topographic break at a yellow weathering ledge.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	PIKA FORMATION (379 ft/115.5 m)		
	The Pika Formation forms cliffs weathered grey and pale grey to cream, except for the three basal units which weather darker grey.		
13	**Dolomite**: white, yellow-white, grey-white, and pale grey, fine and very fine crystalline, partly stromatactoid; mainly medium to thick bedded and massive, minor thin bedded and flaggy. A prominent cream to grey weathering cliff former	91 (27.7)	379 (115.5)
12	**Dolomite**: as below, but very fine crystalline, thin bedded, crudely flaggy. At the top, a cavernous bed 2.5 ft (80 cm) thick	12 (3.7)	288 (87.7)
11	**Dolomite**: greyish white, yellowish white, minor pale grey and snow white, fine equicrystalline; largely with wavy lenticular laminae, 1 to 2 mm thick, of medium crystalline dolomite (lamination appears to be cryptalgal); very rare stromatolites, 10 cm high, occur; medium and thick bedded, massive – a prominent, grey weathering cliff former	8 (2.4)	276 (84.1)
10	**Dolomite**: as Unit 8	50 (15.2)	268 (81.7)
9	**Dolomite**: ex-ooid grainstone; grey, weathering pale brown; very fine crystalline, crossbedded, massive	3 (0.9)	218 (66.4)
8	**Dolomite**: partly ex-parted lime mudstone (flaggy), partly ex-burrow-mottled lime mudstone (massive); pale grey below, grey to dark grey above; very fine crystalline; stylolites. A grey weathering, resistant unit	83 (25.3)	215 (65.5)
7	**Limestone**: largely intraclast grainstone and intraclast grain/rudstone; dolomite mottled at base; medium and thick bedded, grey weathering, massive. Limestone/dolomite contact at the top crosses the bedding	10.5 (3.2)	132 (40.2)
6	**Dolomite**: cryptalgal laminite; as below	4.5 (1.4)	121.5 (37)
5	**Limestone**: parted lime mudstone and burrow-mottled lime mudstone; dwelling burrows up to 1 cm in diameter	4 (1.2)	117 (35.7)
4	**Dolomite**: entirely cryptalgal laminite; grey, microcrystalline, very thick bedded, massive; local relics of limestone: grey, microcrystalline. One massive bed of dolomitic pale-pellet grainstone, 1 ft (30 cm) thick	44 (13.4)	113 (34.4)
3	**Limestone**: mainly burrow-mottled lime mudstone; various particulate textures near the base, including intraclast grainstone; thin and medium bedded at the base, grading up to very thick bedded, massive, cliff forming. Unit weathers very dark grey. Limestone/dolomite contact at the top crosses the bedding	43 (13.1)	69 (21)
2	**Limestone**: fine to coarse ooid grainstone/packstone; dark grey, grey weathering; medium bedded, massive	12 (3.7)	26 (7.9)
1	**Limestone**: parted lime mudstone; bedding surfaces weather pale yellow-brown. Unit passes laterally into dolomite: pale grey, very fine equicrystalline, with irregular laminae of pale grey, microcrystalline dolomite; thin and very thin bedded, flaggy.	14 (4.3)	14 (4.3)
	Conformable contact.		
	ELDON FORMATION (1387 ft/422.8 m)		
	The Eldon Formation forms jagged, pale grey cliffs.		
23	**Dolomite**: pale grey, weathering pale cream-grey; fine equicrystalline, partly with aligned grey mottling (ex-burrow-mottled lime mudstone); massive. Minor patches, impersistent laterally, of dolomite: white, medium to coarse crystalline, mottled with grey, fine crystalline dolomite	167 (50.9)	1387 (422.8)
22	**Dolomite**: ex-parted lime mudstone; pale and dark grey, fine equicrystalline, massive	71 (21.6)	1220 (371.9)
21	**Dolomite**: pale grey mottled with dark grey, fine equicrystalline (ex-burrow-mottled lime mudstone); scattered small vugs. Two very thick beds of dolomite: white, medium crystalline, very vuggy, massive, grey weathering (probably ex-pale-pellet grainstone)	32 (9.8)	1149 (350.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
20	**Dolomite**: as Unit 18; interrupted by thick intervals of vuggy dolomite (as Unit 19). "*Yoholaminites*" occurs in several beds	82 (25)	1117 (340.5)
19	**Dolomite**: white, fine and medium crystalline, nonbedded, massive, mostly vuggy (probably ex-pale-pellet grainstone). A prominent, cream weathering cliff former	37 (11.3)	1035 (315.5)
18	**Dolomite**: white and very pale brownish white, fine crystalline; mostly heavily mottled with dolomite: dark grey, very fine crystalline (ex-burrow-mottled lime mudstone), interrupted by lenticular beds of dolomite (ex-intraclast grainstone). Unit weathers cream with grey mottling	73 (22.3)	998 (304.2)
17	**Dolomite**: coarse crystalline, as Unit 13	21-*39* (6.4)	925 (281.9)
16	**Dolomite**: as Unit 11	46-*64* (19.5)	904 (275.5)
	The uppermost 18 ft (5.5 m) of Unit 16, mainly ex-intraclast grainstone, pass southeastward by intertonguing over 5 ft (1.5 m) into a mass of stromatactoid dolomite that largely displays inclined crystal-lamination. The strong, preferred dip of the inclined laminae is toward 160° to 180°, in horizontal beds.		
15	**Dolomite**: as Unit 13	15 (4.6)	840 (256)
14	**Dolomite**: as Unit 11	22 (6.7)	825 (251.5)
13	**Dolomite**: white and nearly white, medium to very coarse crystalline, patchy, massive, with cavernous vugs; a reef-like mass; weathers white to cream, in pinnacles	12 (3.7)	803 (244.8)
12	**Dolomite**: ex-intraclast grainstone (90%), in beds up to 8 ft (2.4 m) thick. Dolomite (10%): white and nearly white, medium to coarse crystalline, vuggy, stromatactoid	38 (11.6)	791 (241.1)
11	**Dolomite**: unit consists of thin and medium beds of ex-intraclast grainstone, separating medium and thick beds of stromatactoid dolomite. Masses of dolomite: white, medium and coarse crystalline, are widely scattered. A few beds contain "*Yoholaminites*", partly in domal form	106 (32.3)	753 (229.5)
10	**Dolomite**: pale grey, white, and yellow-white, weathers cream; fine inequicrystalline, with rare vugs; massive, strongly cliff forming (probably ex-pale-pellet grainstone). A 2 ft (60 cm) thick subunit of ex-intraclast grainstone, 25.5 ft (7.8 m) above the base, extends only 25 ft (7.6 m) laterally; it is a lens (?channel fill). In the upper half of the unit, there are zones of lenses (up to 3 ft/1 m thick) of extremely vuggy dolomite. Some medium crystalline dolomite is present – in part laterally equivalent to ex-intraclast grainstone	144.5 (44)	647 (197.2)
9	**Dolomite**: as below, with minor ex-intraclast grainstone at the base and top	11.5 (3.5)	502.5 (153.2)
8	**Dolomite**: mainly as below, but tending to display stromatactoid fabric. Basal 10 ft (3 m) contain some dolomite: grey, microcrystalline, crudely laminated (?cryptalgal laminite)	11.5 (3.5)	491 (149.7)
7	**Dolomite**: pale to very pale grey, pale yellow-grey weathering; fine and very fine equicrystalline; partly with faint crystal-lamination parallel to bedding; massive, strongly cliff forming; minor patches and thin zones are very vuggy	51.5 (15.7)	479.5 (146.2)
6	**Dolomite**: 80 per cent is pale grey, cream weathering, fine and minor medium crystalline, crudely colour- and crystalline-laminated, vuggy in widely spaced 1 ft (30 cm) thick zones and in rare columns normal to bedding. Twenty per cent is ex-intraclast grainstone	60.5 (18.4)	428 (130.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
5	**Dolomite**: 70 per cent consists of thick beds of ex-intraclast grainstone. Thirty per cent is vuggy dolomite (as below). The unit forms a shelf. The thin beds of ex-grainstone appear to be depositional lenses, whereas the thick beds pass laterally, by gradation, into fine crystalline, pale dolomite	42 (12.8)	367.5 (112)
	[Description of "ex-intraclast grainstone": Dolomite: dark grey, weathering nearly black; very fine crystalline; crowded with irregular millimetre-scale patches of white, fine crystalline dolomite (after spar-filled pores). An alternative interpretation is ex-fenestral lime mudstone.]		
4	**Dolomite**: pale grey, faintly laminated with grey, fine crystalline, with abundant flattened vugs lined with pale, medium crystalline dolomite (probably ex-fenestral cryptalgal laminite). Random large patches of white, medium and coarse crystalline dolomite are especially prominent toward the top. Minor intercalations of ex-intraclast grainstone appear in the upper half, increasing in prominence toward the top. The unit forms a massive, grey weathering cliff	66 (20.1)	325.5 (99.2)
3	**Dolomite**: mainly ex-burrow-mottled lime mudstone and ex-parted lime mudstone; very pale grey and yellow-grey, very fine crystalline, minor fine crystalline; with dark grey dolomite as laminae and mottlings; alternating nonbedded and massive, with thin bedded, laminated, and flaggy. Relict crosslamination present locally, after a particulate precursor. Unit weathers cream and grey, laminated and mottled, and forms a broken cliff less steep than the "black band" below	65.5 (20)	259.5 (79.1)
2	**Limestone**: as below, but includes a few beds, up to 8 cm thick, of intraclast grainstone and grain/rudstone. A 25 cm thick bed of fine and medium grained ooid grainstone occurs just below the top	21.5 (6.6)	194 (59.1)
	The top of Unit 2 changes laterally to **dolomite**: partly pale grey, very fine crystalline, mottled with dark grey, and partly white, fine crystalline, thin bedded, and cream weathering. The oolite bed also is altered to dolomite recognizable as oolite. The limestone/dolomite contact crosses the bedding at a steep angle.		
1	**Limestone**: parted lime mudstone; unusually dark and weathering nearly black; chitinous brachiopods are common, trilobites rare. The unit forms a nearly black cliff – the "basal black band".	172.5 (52)	172.5 (52.6)
	GSC loc. 57666 (loose slabs originating 25 to 50 ft/76.6 to 15.2 m above the base) *Kootenia burgessensis* Resser, 1942 *Solenopleurella* sp.		
	Conformable contact.		

STEPHEN FORMATION
(52.5 ft/16 m)

The Stephen Formation forms a distinct, recessive weathering ledge that girdles the Mount Assiniboine massif.

Waputik Member
(52.5 ft/16 m)
(Units 1 to 4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Shale** (60%) and **limestone** (40%) Shale: pale brown to grey, green weathering; silty, very dolomitic, platy, and resistant. Limestone: skeletal wackestone; with scattered trilobite fragments; partly nodular and thinly interbedded with shale, partly in massive subunits up to 4 ft (1.2 m) thick, of nodular limestone with prominent, silty, argillaceous/dolomitic partings similar to the shale	14 (4.3)	52.5 (16)
3	**Limestone**: skeletal grainstone; very dolomitic, weathers orange-grey, medium to coarse grained, with a few pebbles; massive	0.5 (0.2)	38.5 (11.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	**Shale**: very slaty; green with pale brown laminae, brown weathering; dolomitic; abundant specks of blue-black, neomorphic chlorite. Minor, very thin beds and lenses of dolomite: pale brown, very fine crystalline	26 (7.9)	38 (11.6)
1	**Shale** and **siltstone** (90%), and **limestone** (10%) Shale: very silty, grading to siltstone: grey, argillaceous, dolomitic, laminated, platy, weathering green and brown. Limestone: widely spaced, medium beds of skeletal wackestone/packstone, nodular, with dolomitic mottling and partings separating the nodules.	12 (3.7)	12 (3.7)
	Contact concordant; abrupt lithological change and marked topographic break.		

CATHEDRAL FORMATION

Not described at this locality – see Section AC–103. Uppermost bed of the Cathedral Formation consists of coarse skeletal grainstone/packstone.

SECTION AC–103

Mount Wedgwood

(lat. 50°53.5′N, long. 115°39′W)
(For access see Appendix C)

STEPHEN FORMATION

Waputik Member

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Shale**: grey, weathers olive-brown; calcareous, platy, with abundant nodules of grey lime mudstone and interrupted by intervals of similar nodular limestone, with prominent argillaceous/dolomitic mottling.	Not measured	
	Concordant, abrupt contact.		

CATHEDRAL FORMATION
(1182 ft/360.3 m)

The units described below form cliffs broken by narrow ledges. Units 36 to 47 are interpreted as equivalent to the Narao Member.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
47	**Limestone**: ooid grainstone/packstone; grey, fine, thin bedded, with dolomitized partings and mottling	6 (1.8)	1182 (360.3)
46	**Limestone**: lime mudstone, partly with coarse fenestral fabric; pale grey, thin to thick bedded	5.5 (1.7)	1176 (358.4)
45	**Limestone**: cryptalgal laminite (as below); partly altered to grey microcrystalline dolomite (as below); pale grey, aphanitic; some beds carry scattered carbonate grains, others scattered, flat, carbonate chips	23.5 (7.2)	1170.5 (356.8)
44	**Limestone**: brown-grey, microcrystalline, fetid, laminated, becoming cryptalgal laminite upward; partly altered to dolomite: grey, microcrystalline, laminated, weathering very pale yellow. Very minor laminae of flakestone. Thin fenestral beds in top 10 ft (3 m)	35.5 (10.8)	1147 (349.6)
43	**Limestone**: fine ooid packstone; dark grey, slightly argillaceous, thin bedded, flaggy	3.5 (1.1)	1111.5 (338.8)
42	**Mudstone**: brownish grey, weathering bright orange; calcareous, massive. In upper half, several thin beds of fenestral limestone and flakestone	6.5 (2)	1108 (337.7)
41	**Limestone**: cryptalgal laminite; as below; partly dolomitized; a 15 cm thick bed of flakestone occurs 20 ft (6 m) above the base	32.5 (9.9)	1101.5 (335.7)
40	**Limestone**: parted lime mudstone; thin bedded, flaggy at base, becoming thick bedded, massive, brown-mottled at top	7 (2.1)	1069 (325.8)
39	**Limestone**: grey, aphanitic to microcrystalline; cryptalgal laminite at base, with some dolomite laminae; thin fenestral beds interspersed in the lower part, increasing to 100 per cent in the upper half of the unit	11.5 (3.5)	1062 (323.7)
38	**Limestone**: largely displaying fenestral fabric; grey, aphanitic, partly argillaceous at base	5 (2)	1050.5 (320.2)
37	**Limestone**: as below, but lacking coarse sparry beds; thin but strongly "invading" argillaceous/dolomitic partings and mottling	8.5 (2.6)	1044 (318.2)
36	**Limestone**: parted lime mudstone; grey, weathering dark grey; dense, dolomitic, thin bedded (2–8 cm), flaggy; interrupted by numerous 2 to 5 cm thick beds of oncoid grainstone, coarse intraclast grainstone and coarse trilobite grainstone	30 (9.1)	1035.5 (315.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 57662 (uppermost 3 ft/0.9 m) *Amecephalus* sp. *Glossopleura* cf. *G. merlinensis* Rasetti, 1951 *Glossopleura stenorhachis* Rasetti, 1951 *Polypleuraspis* sp. ptychoparioid cranidium		
35	**Limestone**: as below, but partings in this unit are very thin and mostly occupy markings and cracks in the bedding surfaces. The flaggy beds in this unit are mainly 1 to 8 cm thick, rarely 15 cm	33 (10.1)	1005.5 (306.5)
34	**Limestone**: grey, microcrystalline, irregularly thin bedded in beds 0.5 to 8 cm thick, flaggy; argillaceous/dolomitic partings prominent at the base but thinning upward (parted lime mudstone facies); scattered trilobites and chitinous brachiopods	35 (10.7)	972.5 (296.4)
33	**Mudstone**: as unit 32; with laminae and thin beds of grey, dense limestone	55 (16.8)	937.5 (285.8)
32	**Limestone** and **mudstone**: dark grey, microcrystalline, irregularly thin bedded (beds 0.5 to 3 cm thick); crudely flaggy, with thick, prominent, orange weathering, argillaceous/dolomitic partings, giving a striped appearance (e.g., ribbon-bedded lime mudstone facies). The limestone grades upward through interlaminated grey dense limestone and tan weathering calcareous mudstone to mudstone: grey calcareous, laminated, tan weathering, platy, and cliff forming	51 (15.5)	882.5 (269)
31	**Limestone**: lime mudstone; dark grey, argillaceous, thin bedded, non-flaggy, and slightly slaty; unit forms a dark grey weathering cliff	12.5 (3.8)	831.5 (253.4)
30	**Limestone**: dark grey, aphanitic, argillaceous, hard and brittle, in laminae up to 5 cm thick; very planar/flaggy beds, separated by tan weathering, argillaceous laminae. Upward, the unit changes to partly interlaminated argillaceous limestone (grey weathering) and very argillaceous limestone (tan weathering); platy (e.g., ribbon-bedded lime mudstone facies). Trilobites are rare in most of the unit, but complete specimens were collected from the interval 81 to 91 ft (24.6 to 27.7 m) above the base and are widely scattered in the uppermost 70 ft (21 m) of the unit. The unit forms two cliffs separated by a recessive bench (the most platy part)	165 (30.3)	819 (249.6)
	GSC loc. 57641 (81 to 91 ft/24.7 to 27.7 m above the base) ptychoparioid fragment		
29	**Limestone**: lime mudstone; dark grey, weathers same; lenticular medium bedded	7 (2.1)	654 (199.3)
28	**Limestone**: lime mudstone; dark grey, dolomitic, slightly argillaceous, pyritic, with scattered intraclasts and trilobite and brachiopod fragments; thin bedded, flaggy, partly with flaky argillaceous partings, partly with thick, dolomitized, tan weathering laminae along bedding planes (ribbon-bedded lime mudstone). This unit forms a double, dark grey rib, traceable around the Lake Magog cirque	30 (9.1)	647 (197.2)
	GSC loc. 57651 (4 ft/1.2 m above the base) *Acrothele* sp. *Nyella* sp. *Corynexochides* sp. *Eoptychoparia* sp. *Lingulella* sp. *Oryctocephalites* sp. *Oryctocephalus* sp. *Pegmatreta* sp. *Peronopsis* sp. *Prototreta* sp. *Spencia* sp. *Zacanthoides* sp. 1 *Zacanthoides* sp. indeterminate pygidium		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	The units described below are moderately recessive on the line of section; elsewhere, these units are moderately cliff forming.		
27	Poorly exposed: recessive weathering **Dolomite**: as Unit 25	21.5 (6.6)	617 (188.1)
26	**Dolomite**: fenestral; as below	7.5 (2.3)	595.5 (181.5)
25	**Dolomite**: grey, brownish grey, and pinkish grey, weathers buff and pale pinkish brown; fine equicrystalline, very thick bedded, massive	31 (9.4)	588 (179.2)
24	**Dolomite**: fenestral; very fine crystalline, medium and thick bedded, weathers grey with buff mottling	30 (9.1)	557 (169.8)
23	**Dolomite**: partly if not entirely very fine to medium grained ex-grainstone; grey, weathers grey with coarse brown mottling; fine crystalline, medium and thick bedded. Minor medium beds of dolomite: dark grey, very fine crystalline, dark grey weathering	39 (11.9)	527 (160.6)
22	Covered	12 (3.7)	488 (148.7)
21	**Dolomite**: as Unit 18	16 (4.9)	476 (145.1)
20	Poorly exposed: recessive weathering **Dolomite**: brownish grey to pale brownish grey, weathers orange brown; fine equicrystalline, massive, partly brecciated	20 (6.1)	460 (140.2)
19	Covered	18 (5.5)	440 (134.1)
18	**Dolomite**: dark grey mottled with white, weathers mottled brown and grey; fine equicrystalline, nonbedded, massive. This unit contains a large mass, some tens of feet across, of dolomite: pale grey, fine equicrystalline, buff weathering. Contacts are obscure	52.5 (16)	422 (128.6)
17	**Dolomite**: ex-burrow-mottled lime mudstone; very pale grey mottled with very pale brown, fine crystalline, thin and medium bedded, orange-buff weathering	26.5 (8.1)	369.5 (112.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	The units described below are strongly cliff forming.		
16	**Dolomite**: cryptalgal laminite; white with grey and buff laminae, weathers nearly white; microcrystalline. A 1 ft (30 cm) thick bed of dolomite, of the same type as Unit 15, occurs in the middle	6 (1.8)	343 (104.5)
15	**Dolomite**: ex-burrow-mottled lime mudstone; pale brownish grey and white intermottled, weathers mottled pink-buff and tan; fine inequicrystalline; bedding obscure	24 (7.3)	337 (102.7)
14	**Dolomite**: pale grey to white, pale buff, and pale pink, weathers buff and pink-buff; fine and very fine crystalline, thin and medium bedded	16 (4.9)	313 (95.4)
13	**Dolomite**: as Unit 14, with medium beds of ex-oncoidal dolomite (as below)	10 (3)	297 (90.5)
12	**Dolomite**: fenestral; appears to be at least partly ex-coarse intraclast grainstone; sparse blebs of white fine crystalline dolomite in grey, very fine crystalline dolomite; medium bedded with wavy bedding contacts; weathers orange-buff	27 (8.2)	287 (87.5)
11	**Dolomite**: ex-oncoid packstone; very fine crystalline; very dense with grey oncoids in buff matrix; very massive	2 (0.6)	260 (79.2)
10	**Dolomite**: massive, reefal unit consisting of "*Yoholaminites*" in two habits: a) laminar/domal; b) erect, branching. Dolomite is white and buff, fine and very fine crystalline. Unit weathers orange-buff with light tan mottling. This reef-like mass terminates indistinctly to the southwest, giving way to bedded dolomite (as below)	21 (6.4)	258 (78.6)
9	**Dolomite**: greyish white; fine inequicrystalline below, becoming very fine crystalline above; scattered blebs of white, medium crystalline dolomite. Unit appears nonbedded in cliffs but medium and thin bedded, somewhat flaggy, in ledgy outcrops. Forms a strong, orange-buff-weathering cliff. Upward, becomes partly brownish white, mottled with light brown	94 (28.6)	237 (72.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
8	**Limestone**: ooid and ooid-skeletal grainstone with scattered oncoids; grey, very dolomitic, medium grained; ooids and oncoids are preferentially dolomitized; very thick bedded, massive, with wispy dolomite laminae. Contact at top is poorly defined and crosses the bedding	9.5 (2.9)	143 (43.6)
7	**Limestone**: dark grey oncoid packstone, as below; in two thick beds and two very thin bedded subunits	8 (2.4)	133.5 (40.7)
6	**Limestone**: ooid grainstone; grey, dolomitic, fine and medium grained; medium bedded below, becoming medium to very thick bedded above, with minor thin beds; partly cross-bedded in sets up to 1.3 ft (0.4 m) thick; irregular, thin masses of dolomite	48.5 (14.8)	125.5 (38.3)
5	**Limestone**: oncoid packstone; dark grey, medium bedded, massive, with billowy bedding surfaces. Forms the base of a strong cliff	4 (1.2)	77 (23.5)
4	**Limestone**: oolite (as below); mainly fine and very fine grained; irregularly thin bedded in basal 15 ft (4.6 m); partly medium to coarse grained in the remainder of the unit, with a few medium and rare thick beds; dolomitic partings are prominent at the base but disappear upward. Rare medium beds of coarse skeletal grainstone, with abundant trilobites that resist collection. Unit steepens upward from recessive at the base to cliff forming at the top	58.5 (17.8)	73 (22.3)

The units described below are moderately recessive.

3	**Shale**: as below	1 (0.3)	14.5 (4.4)
2	**Limestone**: grey ooid grainstone; mainly very fine, partly fine grained at top, very dolomitic; beds 7 to 10 cm thick, partly crosslaminated; argillaceous/dolomitic partings at the top. Basal bed of coarse trilobite grainstone, 12 cm thick	11 (3.4)	13.5 (4.1)
1	**Limestone** and **shale** Unit consists of a bed of limestone: grey, dense, stromatolitic, 0.6 to 3 ft (0.2 to 0.9 m) thick, supporting well developed hemispherical to ellipsoidal stromatolites, buried in shale (as below). The limestone between stromatolites is skeletal grainstone.	2.5 (0.8)	2.5 (0.8)

NAISET FORMATION
(588 ft/179.2 m)

The units described below form steep cliffs interrupted by narrow ledges.

12	**Shale**: blue-green, weathering olive green, brown, and tan; calcareous, platy; specks and spheroids up to 5 mm in diameter of blue-green chlorite are closely crowded on widely spaced bedding planes. Several very thin beds of medium grained, slightly oolitic skeletal grainstone occur in the uppermost 15 ft (4.6 m)	67 (20.4)	588 (179.2)

GSC loc. 57654 (10 to 20 ft/3 to 6.1 m above the base)
Amecephalus sp.

11	**Shale** and **siltstone** (interlaminated) Shale: blue-green, calcareous, and silty. Siltstone: argillaceous, similar to the shale. At the base, which is especially silty, numerous burrows are present; chlorite spots continue as above. Unit weathers green and greenish tan	131.5 (40.1)	521 (158.8)

GSC loc. 57655 (41.5 to 56.5 ft/12.6 to 17.2 m above the base)
Amecephalus sp.

GSC loc. 57663 (28.5 to 31.5 ft/8.7 to 9.6 m above the base)
Amecephalus cf. *A. agnesensis* (Walcott), 1917

GSC loc. 57642 (talus originating below loc. 57663)
Chancia sp.
Amecephalus agnesensis (Walcott), 1917

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Mudstone**: pale green-grey and blue-grey, weathers bright tan; calcareous, soft, slightly silty with abundant very thin laminae of siltstone; very low-angle crosslamination, with some mildly contorted laminae; slightly recessive, flaggy. The interval from 41 to 44 ft (12.5 to 13.4 m) above the base has been involved in a major slump movement with the production of large, recumbent, penecontemporaneous folds and the rotation of large blocks through an angle of 20°. Specks and spheroids, up to 5 mm in diameter, of blue-green chlorite are closely crowded on widely spaced bedding planes. Upward, the unit develops alternating zones that are bright tan and green-and-brown weathering	56.5 (17.2)	389.5 (118.7)
9	**Shale** and **siltstone.** Seventy-five per cent calcareous shale: as below, very micaceous. Twenty-five per cent siltstone and very fine sandstone: pale green and blue-green, calcareous, very micaceous; very thinly interbedded with shale. Chlorite specks occur throughout the unit. A strong cliff former, weathering partly green, partly pale brown, partly tan	38.5 (11.7)	333 (101.5)
8	**Mudstone**: as below, with many thin lenticles of sandstone: white, calcareous, very fine grained, brown weathering	15 (4.6)	294.5 (89.8)
7	**Mudstone/shale**: as below, but lacking sandstone	52.5 (16)	279.5 (85.2)
6	**Mudstone/shale**: pale green and grey green, weathers pale brown and green with abundant, prominent, chlorite spots; laminated, platy; manganese dendrites prominent on weathering; widely spaced, thin beds and lenses of sandstone: as below, largely pebbly	29 (8.8)	227 (69.2)
5	**Sandstone**: grey, weathers brown; very coarse grained, pebbly, calcareous; lateral extent not determined	2 (0.6)	198 (60.4)
4	**Mudstone/shale**: as Unit 2, but laminated and weathering deeply to pale brown. Fifty-seven feet (17.4 m) below the top of this unit is the lowest occurrence noted of porphyroblasts of blue-green chlorite. These, where best developed, are oblate spheroids up to 5 mm in diameter and 2 mm thick. The porphyroblasts are almost continuously present above this (lowest) occurrence, being found in zones up to 2.5 cm thick spaced at 7 to 15 cm intervals, and as thin circular plates on bedding surfaces. The unit forms a modest, lichen-grown cliff	132 (40.2)	196 (59.7)
3	**Mudstone**: as below; very slightly dolomitic, massive, tan weathering; laminae of greenish blue chlorite. A lamina of medium grained, dolomitic sandstone, 6 mm thick, occurs at the top	34 (10.4)	64 (19.5)
2	**Mudstone**: blue grey, weathers olive and brown; platy, micaceous; rare lenses and laminae of sandstone: brown, coarse grained and pebbly, and calcareous	19 (5.8)	30 (9.1)
1	**Sandstone** and **quartzite**: grey, coarse grained, largely pebbly; large patches of brownish grey, brown weathering, calcareous sandstone; thick bedded, less resistant than underlying quartzites. Upper 2 ft (0.61 m) carry large chips of shale, bent between "billowy" bedding planes. Basal contact is planar, upper contact gently undulating. This unit is assigned to the Naiset Formation because, at Sunburst Peak, it crosscuts underlying beds.	11 (3.4)	11 (3.4)

Obscure unconformity.

GOG GROUP

Quartzite: white, greyish white, and pinkish grey; mainly fine and very fine grained, minor medium grained; thin to thick bedded, prominently crossbedded and crosslaminated, resistant.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

SECTIONS AC-112/114

Type section of the Takakkaw Tongue of the Cathedral Formation at Mount Stephen (North and Fossil gullies and northwest face)

(lat. 51°24′13″, long. 116°26′55″)
(For access see Appendix C)

ELDON AND PIKA FORMATIONS
(undifferentiated)

The Eldon–Pika forms an enormous, nearly vertical cliff, extending to the peak of Mount Stephen.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Limestone**: mainly calcisiltite and trilobite wackestone; regularly thin bedded, with thin, irregular dolomite partings. Forms a nearly black cliff – the "basal black band" of the Eldon.	+63 (19.2)	+63 (19.2)

STEPHEN FORMATION
(881.5 ft/268.7 m)

Wapta Member
(321 ft/97.8 m)
(Units 10 to 23)

The Wapta Member forms an upward-steepening slope, in contrast to the cliffs of the Cathedral below and the Eldon above, but much steeper and more difficult to traverse than the slopes on shale formations generally are in the region. Although the upward steepening coincides with an upward increase in limestone content, the resistance of the limestone beds generally differs little from that of the shales.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
23	**Shale** (85%) and **limestone** (15%) Shale: as below, mostly green, green weathering, with subunits of limestone 1 to 3 ft (0.3 to 1 m) thick. Limestone: fine skeletal packstone, nodular thin bedded with dolomite partings; massive	62 (18.9)	881.5 (268.7)
22	**Limestone**: as below	3 (0.9)	819.5 (249.8)
21	**Shale**: greyish green and medium grey, weathers green below, brown above; calcareous, laminated; minor slump structures	24 (7.3)	816.5 (248.9)
20	**Limestone**: ooid and skeletal-ooid grainstone/packstone, with oncoids both scattered and in discrete layers. Half of the unit is strongly mottled by dolomite	9 (2.7)	792.5 (241.6)
19	**Shale**: pale to medium greyish green, with 25 to 50 per cent lenticles and laminae of lime mudstone. Shale weathers green below, orange above	19 (5.8)	783.5 (238.8)
18	**Shale** (65%) and **limestone** (35%) Shale: as below, with very minor laminae of lime mudstone, and 1 to 3 ft (0.3 to 1 m) thick beds of skeletal packstone with scattered oncoids	23 (7)	764.5 (233)
17	**Shale** (75%) and **limestone** (25%) (interlaminated) Shale: grey, weathering pale brown; slightly calcareous, laminated. Limestone: lime mudstone; grey, argillaceous	18 (5.5)	741.5 (226)
16	**Limestone**: fine grained skeletal packstone/grainstone; in irregular thin beds with dolomite partings. Near the top, minor interbeds of shale. At the top, a layer of oncoid packstone	10 (3)	723.5 (220.5)
15	**Limestone**: parted lime mudstone; very thin beds and laminae; partings are orange weathering, brown, calcareous shale; slump structures. Near the top, the unit becomes interbedded limestone and shale	40 (12.2)	713.5 (217.5)
14	**Shale**: medium grey, calcareous and noncalcareous shale interlaminated; weakly fissile; slump structures. The uppermost 15 ft (4.6 m) consist of interlaminated shale and lime mudstone	57 (17.4)	673.5 (205.3)
13	**Limestone**: fine grained skeletal grainstone/packstone, commonly with a few oncoids; mainly irregularly thin bedded, with prominent, "invading", dolomite partings, but includes two massive, medium beds as well. Unit forms a recessive weathering shelf, less resistant than the shale above and below	16 (4.9)	616.5 (187.9)
12	**Shale**: "blue-grey", weathers partly green, partly brown; calcareous, laminated, platy, cliff forming	22 (6.7)	600.5 (183)
11	**Limestone**: fine grained, unsorted skeletal packstone/grainstone; crude, almost nodular, interlocking thin beds. Weathered profile is the same as that of the units above and below	11 (3.4)	578.5 (176.3)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	Very poorly exposed: recessive weathering Partly **limestone**: skeletal wackestone to grainstone; poorly sorted, thin bedded, with dolomite partings. Minor subunits of **shale**: as below	7 (2.1)	567.5 (173)
	Contact interbedded, arbitrary.		
	Amiskwi Member (560.5 ft/170.8 m) (Units 1 to 9)		
	The Amiskwi Member expresses itself topographically in two parts: the lower half, more or less, forms brown weathered outcrops less steeply inclined than those of the Cathedral Formation below, but still cliffy; while the slopes of the upper half are the least steep of any in the Stephen Formation here, and display more green weathering units.		
9	**Mudstone**: grey to brownish grey, brown weathering; calcareous, micaceous; bedding obscure, apparently thin and lenticular; cliff forming; certain laminae are enriched in silt-sized quartz or feldspar; laminae show scour-and-fill structure. Minute (?)apatite prisms are prominent. Laminae and lenses of limestone [skeletal (trilobite) grainstone] occur in the upper third. A uniform, monotonous unit	146 (44.5)	560.5 (170.8)
8	**Shale**: brown, brown weathering; calcareous, siliceous, slightly carbonaceous; laminated, very thin bedded, cliff forming; platy at the base, flaggy above	99 (30.2)	414.5 (126.3)
7	Covered	6 (1.8)	315.5 (96.2)
6	**Shale**: dark brown, weathers distinctive very pale tan below, pale greenish grey above; soft, very calcareous, carbonaceous, fossiliferous, laminated, crudely platy	74 (22.6)	309.5 (94.3)
	GSC loc. 65840 (20–35 ft/6.1–10.7 m above the base) *Anomalocaris* sp.		
	GSC loc. 65841 (20–40 ft/6.1–12.2 m above the base) *Elrathina* cf. *E. palliseri* (Walcott), 1908 *Elrathina* sp. *Kootenia* sp. *Olenoides*? sp.		
	GSC loc. 65842 (0–17.5 ft/0–5.3 m above the base, slumped blocks) *Acrothele* sp. *Bathyuriscus rotundatus*? (Rominger), 1887 *Choia* cf. *C. ridleyi* Walcott, 1920 *Elrathina*? sp. *Kootenia* sp. *Nisusia* sp. *Olenoides* sp. *Oryctocephalus* sp. *Peronopsis* cf. *P. montis* (Matthew), 1899 *Pirania muricata* Walcott, 1920 *Tuponia* sp.		
5	**Shale**: dark brown, weathers very pale tan below, orange above; calcareous; excellent platy cleavage; recessive	69.5 (21.2)	235.5 (71.8)
	"Boundary limestone" (Unit 4)		
4	**Limestone**: pellet wackestone; flaggy, regular, 2.5 to 7.5 cm thick beds; becomes finely laminated near the top. One hundred metres northeast, the upper half of this unit is a tongue of massive, resistant, pellet grainstone. Bedding passes uninterrupted from the flaggy into the massive phase	55.5 (16.9)	166 (50.6)
3	**Shale**: as unit 1, but lacking limestone beds and slumps; grades into overlying unit	17 (5.2)	110.5 (33.7)
2	**Mudstone**: pale greenish grey, weathers partly brown, partly green; slightly calcareous, siliceous, hard, nonfissile; abundant minute (?)apatite prisms; bedding obscure, appears thin and lenticular; almost entirely slumped, with well developed folds	32 (9.8)	93.5 (28.5)
1	**Shale and limestone** (very thinly interbedded and interlaminated) Shale (dominant): brownish grey, calcareous, siliceous, platy, and subordinate limestone: grey, argillaceous, siliceous lime mudstone. Penecontemporaneous slump structures near the base, not seen higher. Unit weathers brown.	61.5 (18.7)	61.5 (18.7)
	Abrupt lithological contact – probably a slide surface.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

CATHEDRAL FORMATION
(794.5 ft/242.2 m)

Takakkaw Tongue
(Type section)

The units described below form more or less continuous cliffs interrupted by thin, ledge-forming, recessive intervals. Viewed from the base of Mount Field, the recessive intervals pinch to the northeast, so that the Cathedral Formation forms an almost unbroken cliff at the Monarch Mine. To the southwest, the Cathedral Formation progressively loses its cliff forming character, and becomes indistinguishable, at a distance, from the underlying and overlying formations.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
16	**Limestone**: greyish brown, microcrystalline, siliceous, partly dolomitic; very thin, planar, uniform beds, 0.5 to 3.5 cm thick, with partings of orange weathering dense dolomite (ribbon-bedded lime mudstone). Penecontemporaneous slumps are present throughout the unit, although most prominent in the basal 50 ft (15.2 m). The uppermost 25 ft (7.6 m) of the unit are involved in an anticline and syncline, truncated by the base of overlying shales. Unit weathers dark grey with thin, orange weathering partings	304.5 (92.5)	794.5 (242.2)
15	**Limestone**: lime mudstone; slightly dolomitic, in 2.5 to 8 cm thick beds with thin, regularly wavy partings of grey, very fine crystalline dolomite (ribbon-bedded lime mudstone). Unit is massive and continues the bedding style of the underlying dolomite	26 (7.9)	490 (149.4)
	Replacement contact.		
14	**Dolomite**: pale brown to white, fine to medium crystalline, thin bedded; with 25 per cent partings of dolomite: dark brown, very fine crystalline, flaggy. Stromatactoid dolomite occurs at intervals throughout, and is especially well developed in the middle of the unit. Within the middle stromatactoid zone is a 20 cm thick bed of coarse dolomite breccia, containing slabs, up to 2.5 x 20 cm, of light coloured dolomite in a dark brown matrix (?debris-flow breccia). The beds of this unit pinch rapidly southwestward. Evidence of slumping includes contorted laminae and broken beds	34 (10.4)	464 (141.4)
13	**Limestone**: mainly dark-pellet grainstone; partly recrystallized, nonbedded, very massive, resistant. Large masses have been altered to pale grey and yellowish grey to white, medium inequicrystalline, vuggy, massive dolomite, with wisps of dark brown, very fine crystalline dolomite. Twenty feet (6.1 m) above the base is a mass (of unknown extent) of dolomitized breccia, probably debris-flow breccia; pale fragments of dolomite, up to 5 x 30 cm in section, lie in a dark brown matrix. Another mass of similar breccia occurs 15 ft (4.6 m) below the top of the unit. The upper part of this massive unit terminates abruptly southwestward and is overlain by thin bedded dolomite with pronounced draping	70 (21.3)	430 (131.1)
12	**Dolomite** and **limestone** At the base, thin and minor medium bedded limestone (as Unit 10) with thin partings of grey shale. Fifteen feet (4.6 m) above the base, the rock changes to dolomite: pale grey and pale brown to white, fine and minor medium to coarse crystalline, bedded precisely as the underlying limestone. Many beds display "grading" from fine crystalline at the base to medium or coarse crystalline at the top. Stromatactoid structure locally developed. Two feet (60 cm) below the top, an 8 cm thick zone displays apparent small-scale current ripple marks with a wavelength of 1 to 1.2 cm	59.5 (18.1)	360 (109.7)
11	**"Beaded" debris-flow** This massive depositional unit, generally 3.5 ft (1.1 m) thick, has local, abrupt swellings up to 6 ft (1.8 m) thick. On most weathered surfaces and fresh fragments, it appears to be lime mudstone; however, a specimen from one of the swellings is seen in thin section to be *Epiphyton* framestone. The unit was recognized as a debris flow only subsequent to I.A. McIlreath's documentation of the character of these flows as they occur in the tongue. On very careful re-examination, the fragmental nature of the unit was recognized. Some of the "beads" are probably small, displaced *Epiphyton* bioherms, but the "beads" are known elsewhere to consist of matrix-supported breccia as well	3.5 (1.1)	300.5 (91.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Limestone**: at the base, mainly laminated to thin bedded, flaggy, parted lime mudstone, with partings of argillaceous dolomite and dark grey shale, and minor thin and medium beds of dark-pellet grainstone, partly skeletal. Pelleted beds increase upward so that the upper part of the unit is dominated by thin and medium bedded, dark-pellet grainstone, intraclast-pellet grainstone, and trilobite-pellet grainstone. As well as trilobites, bioclasts include cryptalgal fragments and fragments of bryozoa	46.5 (14.2)	297 (90.5)
9	**Limestone**: intraclast-skeletal-pellet grainstone; as Unit 10; massive, resistant	6.5 (2)	250.5 (76.4)
8	**Limestone** (50%) and **shale** (50%) Limestone: trilobite wackestone; black, carbonaceous, with splendent lustre, medium bedded; interbedded with Shale: dark brown, weathering very pale yellow-brown; carbonaceous, slaty, slightly recessive	20 (6.1)	244 (74.5)
7	**Limestone**: (?)lime mudstone; fine crystalline, bituminous, with laminae of oolitic trilobite-echinoderm packstone/wackestone; overall appearance is medium bedded and massive with carbonaceous partings. Certain widely spaced medium beds develop swellings, or "beads" up to five times their normal thickness; on subsequent re-examination, these "beaded" beds are seen to be debris flows (cf. Unit 11), but their character of matrix supported breccia can be seen on only a few, especially favourable, "washed" surfaces. One debris flow, 27 ft (8.2 m) above the base, is the vehicle for a massive spheroid, 19 ft (5.8 m) in diameter, of *Epiphyton* framestone; this appears to be a transported, *Epiphyton* bioherm	40 (12.2)	224 (68.3)
	GSC loc. 65843 (19 ft/5.8 m above the base) *Nyella* sp. *Kochiella*? sp. *Ogygopsis* sp. *Pachyaspis* sp. *Pagetia* sp. *Stenothecoides* sp. cf. *Stephenaspis* sp.		
6	**Limestone**: grey, fine crystalline, argillaceous, in 7.5 to 20 cm thick regular beds, with subordinate interbeds of dark grey calcareous shale; rare trilobites	25 (7.6)	184 (56.1)
5	**Limestone**: dark-pellet wackestone; largely recrystallized; nonbedded, massive, with scattered discontinuous wisps of tan weathering dolomite. In the middle, a 2.5 ft (76 cm) thick subunit of shaly limestone (as below)	8 (2.4)	159 (48.5)
4	Covered One small outcrop of limestone (as below) occurs near the top	16 (4.9)	151 (46)
3	**Limestone**: at the base, mainly pelmatozoan wackestone, in thin lenticular beds with interbeds of argillaceous shaly limestone. Higher up the limestone is mainly calcisiltite, silty, argillaceous and shaly, with abundant brachiopods and poorly preserved trilobites; minor lenses of skeletal wackestone	40 (12.2)	135 (41.1)
2	**Limestone**: mainly skeletal, dark-pellet grainstone; pyritic, nodular, with sparse partings of dense dolomite. Three feet (1 m) below the top of the unit a pillow shaped mass, 2 ft x 10 ft (0.6 x 3 m) in cross-section, consists of skeletal pellet wackestone, and is presumably a slide block	19.5 (2.9)	95 (29)
1	**Limestone**: ooid grainstone; mainly medium grained, in lenticular thin and minor medium beds, with tan weathering partings of dense dolomite. Beds of pelmatozoan-trilobite grainstone/packstone with abundant cryptalgal bioclasts are minor constituents throughout most of the unit but dominate in the uppermost 15 ft (4.6 m).	75.5 (23)	75.5 (23)
	Abrupt contact and topographic break from relatively recessive below to cliff forming above.		

Upward continuation of section is offset two fifths of a mile (0.6 km) to the rib between Middle and Fossil gullies. The two legs of the section are tied on lithological sequence, verified by visual tracing of bedding; changes in the character of the strata above and below the contact are obvious between the initial and offset lines.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	NAISET FORMATION (337 ft/102.7 m)		
	The Naiset Formation is markedly less resistant than the Gog Group below and the Cathedral Formation above; it forms steep, dark, partly talus-covered slopes.		
11	**Limestone** and **sandstone** At the base, sandstone: pale pinkish brown, very fine grained, well sorted, angular, siderite cemented, finely laminated; grading upward to brachiopod–trilobite wackestone: silty, sandy, laminated. Top of unit has a pronounced mammilate surface with 2.5 cm relief	1.5 (0.5)	337 (102.7)
10	**Limestone**: calcisiltite; very siliceous, with abundant authigenic feldspar; finely laminated, massive, weathering dull orange. Moderately resistant	72 (21.9)	335.5 (102.3)
9	Covered	5.5 (1.7)	263.5 (80.3)
8	**Limestone**: siliceous calcisiltite; as Unit 10; abundant laminae and lenses of siliceous, locally sandy ooid grainstone, and minor laminae of very fine grained, dolomitic sandstone. Unit weathers "ribboned" dull orange and grey; massive, forms a minor cliff	53 (16.2)	258 (78.6)
7	**Limestone**: as Unit 6, but lacking oncoids; irregularly thin bedded with irregular dolomite partings	10 (3)	205 (62.5)
6	**Limestone**: ooid packstone with scattered oncoids at several levels; rare trilobites; irregularly medium bedded with irregular partings of tan weathering dense dolomite. Moderately resistant	10.5 (3.2)	195 (59.4)
5	**Shale**: dark brownish grey, brown weathering; calcareous, finely laminated, platy; abundant well preserved trilobites	51.5 (15.7)	184.5 (56.2)
	GSC loc. 65839 (basal 20 ft/6.1 m) *Stephenaspis* sp. *Wenkchemnia* sp.		
4	**Limestone**: calcisiltite and skeletal wackestone; silty, siliceous; in nodular thin beds with partings of dark brownish grey shale. Rare laminae contain concentrations of trilobite and brachiopod fragments	88 (26.8)	133 (40.5)
3	**Argillite** (50%) and **limestone** (50%) Argillite: as Unit 2 Limestone: skeletal grainstone and calcisiltite, as below, in thin lenticular beds and nodules Grades into overlying unit	20 (6.1)	45 (13.7)
2	**Argillite** and **siltstone** (thinly interlaminated) Argillite: dark grey Siltstone: grey, calcareous A platy, recessive unit	15 (4.6)	25 (7.6)
1	**Limestone** (60%), and **siltstone** and **argillite** (40%) Limestone: silty and sandy skeletal grainstone/packstone and calcisiltite; fine and very fine grained; thinly interbedded with 40 per cent dark greenish grey calcareous siltstone and dark grey argillite. Moderately recessive	10 (3)	10 (3)
	Abrupt contact.		
	GOG GROUP		
	The units described below are moderately resistant.		
3	**Quartzite** and minor sandstone: grey to nearly white, rusty specked, very fine and fine grained, glauconitic, partly calcareous, regularly thin and minor medium bedded; lenticles of trilobite coquina (olenellid fragments)	22 (6.7)	66 (20.1)
2	**Sandstone**: grey and greenish grey, speckled, fine and very fine grained, mostly very calcareous; abundant trilobite fragments; crosslaminated, mainly in lenticular beds 5 to 15 cm thick	14 (4.3)	44 (13.4)
1	**Siltstone** and **shale** (interlaminated) Siltstone: greenish grey, micaceous, calcareous Shale: dark greenish grey. Very regularly thin bedded.	+30 (9.1)	+30 (9.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

COMPOSITE SECTION AC–122/123

Kicking Horse Pass roadcuts

(This unusually accessible section is significant in that it exposes both the Cathedral and Stephen formations in undolomitized "near-rim" lithofacies)

(lat. 51°25′57″N, long. 116°23′22″W)
(For access see Appendix C)

ELDON FORMATION
(incomplete)

Section ends upward at the limit of continuous, roadcut outcrop, at Sherbrooke Creek.

The entire Eldon exposed here is affected by faults of near-bedding-plane orientation, which presumably thicken the section slightly.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	**Limestone**: as below; in many beds, amoeboid masses of fine and medium crystalline, dark grey calcite, up to 5 cm in diameter. The limestone is thin to thick bedded, with stylolitic bedding contacts, but is very massive and appears very thick bedded	20.5 (6.2)	181.5 (55.3)
8	**Limestone**: as Unit 6, but largely dolomite mottled; bedding thickens upward; beds up to 25 cm thick occur near the top	39 (11.9)	161 (49.1)
7	**Limestone**: a unit of pelleted beds, ranging from dark-pellet wackestone to pellet grainstone; irregularly thin bedded	1 (0.3)	122 (37.2)
6	**Limestone**: as below, but thicker bedded (2.5 to 12.5 cm). Numerous medium beds carry nearly spherical or nearly ellipsoidal bodies of fine crystalline, dark grey calcite	9 (2.7)	121 (36.9)
5	Parted **limestone**: as below, but obscurely thin and medium bedded (up to 18 cm); bedding planes are generally stylolitic	30 (9.1)	112 (34.1)
4	**Limestone**: lime mudstone/microspar; thinly interbedded with grey, microcrystalline dolomite (as below). Dolomite interbeds are in effect expanded partings	21 (6.4)	82 (25)
3	**Limestone**: lime mudstone/microspar; thin bedded (but thicker bedded than below), with very thin, upward thickening partings of grey, microcrystalline dolomite	9 (2.7)	61 (18.6)
2	**Limestone**: (?)microspar; regularly thin bedded, with grey, shaly, phyllitic partings; widely scattered, irregular blebs of dolomite. Unit weathers greenish grey	46.5 (14.2)	52 (15.8)
	(The interval 20 to 40 ft/6.1 to 12.2 m above the base is obscured by a slickensided fault surface.)		
1	**Limestone**: (?)microspar; grey, obscurely thin bedded, with grey, argillaceous wisps on bedding planes; pyritic. At the base, a 1 ft (30 cm) thick bed of pellet-intraclast packstone.	5.5 (1.7)	5.5 (1.7)
	Contact interbedded, conformable, arbitrary.		

STEPHEN FORMATION
(233 ft/71 m)

Waputik Member
(128 ft/39 m)
(Units 7 to 14)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
14	**Slate**: pale green; as below	10 (3)	233 (71)
13	**Limestone**: mainly pale grey, trilobite packstone, with scattered pebbles and small oncoids; thin bedded, with partings of slate (as below)	7 (2.1)	223 (68)
12	**Limestone**: skeletal grainstone/packstone; pale grey, fine, pyritic – a single, massive bed	1 (0.3)	216 (65.8)
11	**Slate** and **limestone** Slate: pale grey below, becoming pale green upward, green weathering, with a variable content of thin beds and lenses of grey microcrystalline limestone. The basal bed contains sparse, matrix-supported pebbles of limestone. Beds of oncoid packstone occur 8.5 ft (2.6 m) above the base (a 7.5 cm bed) and 79 ft (24.1 m) above the base (a 45 cm bed, with pebbly base). The limestone content of the slate varies, in different subunits, from 0 to 60 per cent; much of the limestone is pale green	8.5 (2.6)	215 (65.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Limestone**: parted lime mudstone (?calcisiltite); thin bedded, with 40 per cent partings of argillaceous dolomite: greenish grey, calcareous, orange weathering	13.5 (4.1)	206.5 (62.9)
9	**Slate**: as below; partly calcareous, with sparse, local limestone beds and nodules as below (slaty cleavage is weak in this unit). A 7.5 cm thick bed of oncoidal, equant-pebble rudstone, pyritic, with a matrix of trilobite packstone, lies 34.5 ft (10.5 m) above the base	56.5 (17.2)	193 (58.8)
8	**Limestone**: trilobite grainstone; grey, fine grained, massive	1 (0.3)	136.5 (41.6)
7	**Slate**: grey, noncalcareous, with abundant very thin beds and nodules of grey, microcrystalline limestone; weathers greenish grey to rusty orange	30.5 (9.3)	135.5 (41.3)
	Sharp, planar contact.		
	Narao Member (105 ft/32 m) (Units 1 to 6)		
6	**Limestone**: cryptalgal laminite and fenestral lime mudstone; dolomitic, massive; erosion surfaces common	33 (10.1)	105 (32)
5	**Limestone**: a 60 cm thick bed of massive, grey, ooid grainstone/packstone is overlain by a 30 cm thick bed of ooid packstone/wackestone	3 (0.9)	72 (21.9)
4	**Mudstone**: grey, orange weathering; massive, calcareous laminae	4 (1.2)	69 (21)
3	**Limestone**: cryptalgal laminite; pale grey, dolomitic; minute fenestrae are widespread. Thin beds of flat-pebble and equant-pebble rudstone are common. Many erosion surfaces. This unit was not recognized in the field as cryptalgal laminite, but microscopic examination reveals "spongiostromatid" texture at several levels	18 (5.5)	65 (19.8)
2	**Limestone**: cryptalgal laminite; dolomitic; overall appearance is regularly thin bedded below, medium bedded above, with hairline partings of grey shale	24 (7.3)	47 (14.3)
1	**Limestone**: parted lime mudstone; argillaceous, laminated and very thin bedded; partings are lime mudstone, more argillaceous and more dolomitic than the rest, and yellow-brown weathering; scattered intraclasts; burrows, gutcasts; rare trilobite fragments and, 14 ft (4.3 m) above the base, a 2 to 5 mm thick lamina of trilobite packstone (no identifiable specimens).	23 (7)	23 (7)
	Contact is atypically abrupt, and mainly planar. High on the blasted face, and inaccessible, is a channel-like feature with 20 to 30 cm of relief; confirmation of its nature, by close examination, is impracticable.		

CATHEDRAL FORMATION
(thickness undetermined)

The Cathedral Formation is broken by a fault of uncertain character (between Units 29 and 35). Comparison of the sum of unit thicknesses in this section (1304 ft/397.5 m) with the total thickness of the Cathedral at Ross Lake, nearby (1231.5 ft/375.4 m) suggests some repetition of section, but no match of units across the fault could be achieved with confidence.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
42	**Dolomite**: mottled, massive. Mainly dolomite: grey, fine crystalline (pyrobitumen in intercrystalline pores), with aligned mottling of dolomite: white, medium crystalline, commonly vuggy. Stromatactoid dolomite is subordinate, except in the uppermost 20 ft (6.1 m)	94 (28.7)	1200 (365.8)
	The basal contact of Unit 42 is a discordant, replacement contact; no structure in the underlying limestone corresponds to the pattern of mottling in the dolomite.		
41	**Limestone**: lime mudstone; pale, with mottlings of grey, fine crystalline calcite	23 (7)	1106 (337.1)
40	**Limestone**: burrow-mottled lime mudstone; mottling alternates from aligned along bedding to lacking any planar arrangement	38 (11.6)	1083 (330.1)
39	**Limestone**: cryptalgal laminite, in part fenestral; dolomitic. Overall aspect is laminated to nodular thin bedded, massive	27 (8.2)	1045 (318.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
38	**Dolomite**: stromatactoid (a classical exposure of the lithofacies). A relict bed of limestone, 25 to 27 ft (7.6 to 8.2 m) above the base, is pale-pellet grainstone. A higher bed of the same limestone pinches out short of the line of section, and also has bedding-parallel (but replacement) contacts. The limestone lacks any structure comparable to the oblique crystal-lamination of its dolomitized equivalent	72 (21.9)	1018 (310.3)
37	**Limestone**: pale-pellet grainstone, with a few pale intraclasts; an indistinct, overall mottling in shades of grey is apparent. A bed, 11 to 14 ft (3.4 to 4.3 m) above the base, is very pure, very pale grey limestone (cryptalgal laminite), distinctly pelleted. Minor subunits of dark grey, very dolomitic lime mudstone occur. Patches or mottlings of medium crystalline dolomite occur in some subunits. A subunit, 65 to 71 ft (19.8 to 21.6 m) above the base, consists of stromatactoid dolomite. A vein of pale grey, coarse crystalline dolomite lies in the plane of bedding, 114 to 115 ft (34.7 to 35 m) above the base, and disappears updip in "horsetail" fashion	185 (56.4)	946 (288.3)
	(Thickness of Unit 37 is probably exaggerated, owing to an upsection change in the bedding attitude to: strike 130°, dip 50° NE.)		
36	**Limestone** (?)lime mudstone; dark brown-grey, microcrystalline, very dolomitic, thoroughly sheared	7 (2.1)	761 (232)
35	**Limestone**: pale grey, entirely (?)pale-pellet grainstone, with abundant, irregular blebs of cream to white, coarse crystalline dolomite. Rock is thoroughly sheared and recrystallized. Abundant, sparry dolomite veinlets, subparallel to bedding	31 (9.4)	754 (229.8)
	Fault, and major gap in outcrop continuity. The numerical sequence of units is broken to avoid any suggestion of continuity or equivalence.		
29	**Limestone**: burrow-mottled lime mudstone; nonbedded, massive, with abundant, rounded objects of crystalline, dark grey calcite, 5 to 8 mm in diameter	13 (4)	723 (220.4)
	Gradational contact.		
28	**Limestone**: pale-pellet grainstone, as below, with mottled or clotted aspect shown by different shades of grey; thick bedded, massive. Near the base, minor cryptalgal laminite (cream coloured dolomite) in zones 2 to 3 cm thick	35 (10.7)	710 (216.4)
27	**Limestone**: burrow-mottled lime mudstone, with pellet ghosts; dolomite mottling is especially intense at the top	8 (2.4)	675 (205.7)
	Bedding attitude here changes abruptly upsection from a strike of 135°, and a dip of 74° NE, to a strike of 120°, and a dip of 40° NE – possibly a fault.		
	The upper contact of Unit 26 is gradational.		
26	**Limestone**: almost entirely fenestral, pale-pellet grainstone, with local cryptalgal lamination; pale grey, nonbedded, massive, very uniform	23 (7)	667 (203.3)
25	**Dolomite**: very pale brown, fine crystalline, with laminae and filled vugs of white, medium crystalline dolomite; entirely laminated; very uniform, well developed stylolites follow plane of bedding; local, good, vuggy porosity. Basal contact is slightly diffuse, planar; upper contact is a very diffuse, nearly planar, slightly crosscutting, replacement contact against fenestral, cryptalgalaminate limestone	17 (5.2)	644 (196.3)
24	**Limestone**: fifty per cent cryptalgal laminite with pale-pellet grainstone texture and fenestrae; and minor, local, mat-chip breccia or flakestone. Fifty per cent dark grey lime mudstone with scattered, round, spar-filled bodies – (?)burrows	43 (13.1)	627 (191.1)
23	**Limestone**: pale grey, apparently microcrystalline, uniform; fine lamination is probably cryptalgal, but might be secondary because the whole unit is penetratively sheared. Blebs of coarse crystalline calcite are common near the base	44 (13.4)	584 (178)
22	**Limestone**: burrow-mottled lime mudstone; nonbedded, massive	49 (14.9)	540 (164.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
21	**Limestone**: parted lime mudstone	28.5 (8.7)	491 (149.7)
20	**Limestone**: lime mudstone; dark brownish grey, carbonaceous, very thin bedded, slaty, with smeared carbonaceous films on slip surfaces	14.5 (4.4)	462.5 (141)
	Ross Lake Member (6 ft/1.8 m) (Units 18, 19)		
19	**Mudstone**: dark grey, calcareous, pyritic, with nodules of microcrystalline limestone aligned along bedding	4.5 (1.4)	448 (136.6)
18	**Limestone**: dark grey, argillaceous, shaly, pyritic, with sheared partings of dark grey shale; traces of trilobites. Unit is sheared and is recessive weathering	1.5 (0.5)	443.5 (135.2)
17	**Limestone**: lime mudstone; dark grey; abundant, slim, curved, parallel-sided, spar-filled laminae and other sparry blebs; laminated, massive	27 (8.2)	442 (134.7)
16	**Limestone**: cryptalgal laminite; grey, grey weathering, massive, resistant	39 (11.9)	415 (126.5)
15	**Limestone**: pale-pellet grainstone; massive; largely mottled with blebs of cream, very fine crystalline dolomite. Near the base, one subunit of dolomitic, cryptalgal laminite	78 (23.8)	376 (114.6)
14	**Limestone**: lime mudstone; dark grey, weathers dark grey; sooty, bituminous; abundant white fenestrae; nonbedded, massive	27 (8.2)	298 (90.8)
13	**Limestone**: at the base, pale (?)lime mudstone, grading upward to massive, dark grey, argillaceous, (?)bituminous lime mudstone. Higher, minor subunits of (?)pale-pellet grainstone	33 (10.1)	271 (82.6)
12	**Limestone**: mainly pale-pellet grainstone, with minor subunits of fenestral, cryptalgal laminite. Upper contact is gradational	24.5 (7.5)	238 (72.5)
11	**Dolomite**: cryptalgal laminite; grey, microcrystalline	5.5 (1.7)	213.5 (65.1)
10	**Limestone**: pale grey to white, very fine crystalline, laminated to nonbedded, massive, in part subtly nodular (possibly calcitized anhydrite). In the middle, white, very pure limestone contains millimetre sized, tabular crystals of gypsum/anhydrite. At the base and top, limestone is mottled with white, very fine crystalline, cream weathering dolomite. Stylolites are common	28 (8.5)	208 (63.4)
9	**Dolomite** and **limestone** Mainly microcrystalline dolomite, subordinate limestone; both are cryptalgal laminite, in part fenestral. Minor, thin, mat-chip breccias, or flakestones	19 (5.8)	180 (54.9)
8	**Limestone**: Seventy-five per cent pale-pellet grainstone, in part fenestral, with the usual pale dolomite mottling. Twenty-five per cent cryptalgal laminite, with flakestone laminae, in beds 15 to 100 cm thick	43 (13.1)	161 (49.1)
7	**Dolomite**: cryptalgal laminite; interlaminated pale grey and pinkish buff, weathering yellow; very fine equicrystalline; thin and medium bedded	5 (1.5)	118 (36)
6	**Dolomite**: as Unit 4	12.5 (3.8)	113 (34.4)
5	**Dolomite**: very pale grey, fine crystalline, with laminae of white, medium to coarse crystalline dolomite, outlined by black dolomite	3.5 (1.1)	100.5 (30.6)
4	**Dolomite**: white to pale grey, fine and very fine inequicrystalline, massive, with local, indistinct colour mottling; indistinctly bedded, stylolitic; fine, disseminated pyrite throughout	61 (18.6)	97 (29.6)
3	**Dolomite**: dark grey, very fine crystalline, with blebs of white, fine and medium crystalline dolomite (?ex-fenestral lime mudstone)	14 (4.3)	36 (11)
2	**Dolomite**: very pale grey to nearly white, lightly mottled with very pale brown; microcrystalline, uniform; indistinct, thin bedding visible locally; massive, resistant. In the lower half, several subunits are ex-parted lime mudstone. Minor subunits of dark grey, microcrystalline dolomite	7 (2.1)	22 (6.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Limestone**: the bedding style of Unit 8 of the Mount Whyte Formation continues upward in dolomitic limestone beds that are pale grey and fine crystalline in the interior, and dark grey, microcrystalline at the selvage (ex-parted lime mudstone); resistant, grey weathering. Unit becomes increasingly massive upward, without change in the bedding style.	15 (4.6)	15 (4.6)
	Contact gradational, arbitrary.		

MOUNT WHYTE FORMATION
(202 ft/61.6 m)

The Mount Whyte Formation is somewhat recessive weathering relative to the formations above and below. Outcrops in the canyon, north of the highway, are excellent, but very dangerous to work. Exposures south of the highway (roadcuts of the abandoned part of the highway) are intermittent and, since this section was described (1965), increasingly overgrown by alder and willow.

Chephren Member
(52 ft/15.8 m)
(Units 6 to 8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
8	**Limestone**: parted lime mudstone; very regular, thin beds; partings are argillaceous dolomite and brown shale	15 (4.6)	202 (61.6)
7	**Limestone**: grey, weathers greenish grey; very fine crystalline (?calcisiltite), argillaceous, silty; very thin bedded and laminated, with partings of dark grey shale and, at the top, dolomite; slaty cleavage	16 (4.9)	187 (57)
6	**Limestone**: fine trilobite packstone/grainstone; very irregular, thin beds, separated by partings and planes with orange weathering dolomite mottling. Subordinate subunits, beds, and lenses of skeletal ooid grainstone/packstone. Scattered oncoids in oolite in the top 1 ft (30 cm). The basal 1 ft (30 cm) contains several laminae of coarse trilobite grainstone (coquina)	21 (6.4)	171 (52.1)

Weed Member
(150 ft/45.7 m)
(Units 1 to 5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
5	**Siltstone** (75%) and **shale** (25%) As below; trace fossils are poorly seen because of slaty cleavage; bedding planes are micaceous	45 (13.7)	150 (45.7)
4	**Siltstone** and **shale** As below; intermittently exposed. Near the top, a few thin beds of dark greenish grey, argillaceous, microcrystalline limestone	70 (21.3)	105 (32)
3	**Siltstone** and **shale** Siltstone: grey, grey-green, pink, calcareous, dolomitic, very thinly interbedded and interlaminated with shale: dark grey, green; varved appearance, strong slaty cleavage. Unit weathers dark green and brown, moderately resistant	15 (4.6)	35 (10.7)
2	Covered: recessive weathering	15 (4.6)	20 (6.1)
1	**Siltstone**: grey to greenish grey, calcareous, quartzitic, thin bedded, massive.	5 (1.5)	5 (1.5)
	Abrupt contact.		

GOG GROUP

PEYTO FORMATION
(27 ft/8.2 m)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
3	**Sandstone**: grey, calcareous, fine and very fine grained, well sorted; scattered trilobite fragments; thin bedded, flaggy	13 (4)	27 (8.2)
2	**Limestone**: trilobite grainstone (coquina); very sandy, in part grading to very calcareous, fine grained sandstone; olenellid trilobite fragments; thin and medium bedded	3 (0.9)	14 (4.3)
1	**Limestone**: ooid grainstone/packstone; very dolomitic, slightly sandy; medium bedded; scattered trilobite fragments, especially toward the top.	11 (3.4)	11 (3.4)
	Contact conformable.		

SUB-PEYTO STRATA

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Quartzite and **sandstone**: pale to dark grey, pink, greyish purple, fine and very fine grained, well sorted, partly silica cemented, partly clay cemented; thick to thin bedded, massive. Near the top, beds become mainly calcareous, with scattered trilobite fragments.		+40 (+12.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

COMPOSITE SECTION AC-142/143

Stratigraphic section along the Alberta/British Columbia boundary, near Chaba River

(Top of Middle Cambrian section:
lat. 52°18′39″N, long. 111°47′10″W)
(Base of section: lat. 52°19′36″N, long. 117°44′40″W)
(For access, see Appendix C)

UPPER PART - SECTION AC-142

ARCTOMYS FORMATION
(42.5 ft/13 m)

The Arctomys Formation weathers notably recessive relative to the underlying Pika. Its outcrops are striped with bright and contrasting weathering colours, and thus differ markedly from those of the Pika Formation below.

Above the highest beds described here, the section continues with almost complete exposure, through the Upper Cambrian and into the Lower Ordovician.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Siltstone**: yellow, dolomitic, vuggy, platy	3 (0.9)	42.5 (13)
3	**Siltstone** and **shale** (alternating) Siltstone (dominant): pale greenish grey, dolomitic, laminated, platy to flaggy. Shale (subordinate): pale greenish grey to pale yellow-green, dolomitic, silty. Mudcracks, ripple marks, load casts. Unit is mildly recessive, weathers pale brown and greenish grey	30 (9.1)	39.5 (12)
2	**Dolomite**: very pale greenish grey, weathering pale orange-brown; microcrystalline, siliceous, finely laminated, flaggy	2 (0.6)	9.5 (2.9)
1	Covered (on line of section) **Dolomite:** as Unit 2. (By projection from exposures on the ridgeline to the northwest.)	7.5 (2.3)	7.5 (2.3)

PIKA FORMATION
(1186 ft/361.5 m)

The Pika Formation is fairly resistant, but along the cuesta it is weathered back from the top of the Eldon. It is more prominently bedded and ledged than the underlying Eldon Formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
50	**Limestone**: mainly pellet grainstone, minor ooid grainstone; very dolomitic (partly calcareous dolomite); medium bedded. At the top, strongly dolomite-mottled and yellow weathering	7 (2.1)	1186 (361.5)
49	**Dolomite**: pale grey, weathering yellow-orange; very fine crystalline; laminated, thin and medium bedded; two thin beds of limestone (as below)	2 (0.6)	1179 (359.4)
48	**Dolomite**: calcisiltite; partly crosslaminated; prominent partings of brown, calcareous, brown weathering shale	8.5 (2.6)	1177 (358.7)
47	**Limestone**: a variety of particulate rock types (detectable only on an etched surface) including pellet grainstone, pellet wackstone/packstone (calcisiltite matrix), and intraclast packstone. Trilobite packstone at the base. Unit is massive, medium bedded, minor thin bedded, and prominently mottled with orange weathering dolomite (as below)	41 (12.5)	1168.5 (356.2)

GSC locs. 72742 to 72744

Loc. 72744 (7 ft/2.1 m below the top)
Kootenia sp.

Loc. 72743 (8 ft/2.4 m below the top)
Americare? sp.
Kootenia sp.
Modocia sp.

Loc. 72742 (base of unit)
Kootenia sp.
Rowia? sp.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
46	**Limestone** and **mudstone** Limestone: as Unit 43; in nodules and very thin beds; in a copious matrix of grey-brown, calcareous, dolomitic mudstone (commonly more than half of the rock). Many thin and very thin lenticular beds of flat-pebble rudstone. A moderately resistant unit	8 (2.4)	1127.5 (343.7)
45	**Limestone**: in lower part, ooid packstone (calcisiltite matrix); in upper part, lime mudstone; very dark grey, medium bedded, massive; mottled with large irregular blotches of grey, microcrystalline, orange weathering dolomite	4 (1.2)	1119.5 (341.2)
44	**Limestone** and **mudstone** Limestone: as below; in nodules and very thin beds; in a copious matrix of grey-brown, calcareous, dolomitic mudstone (commonly more than half of the rock). Many thin and very thin lenticular beds of flat-pebble rudstone. A moderately resistant unit	21 (6.4)	1115.5 (340)
43	**Limestone**: lime mudstone; dark grey, dolomitic; mottled with dark grey, microcrystalline, pale orange weathering dolomite; medium bedded, massive. Lenses of intraclast-pellet wackestone/packstone	6 (1.8)	1094.5 (333.6)
42	**Limestone**: calcisiltite (as Unit 32); rare trilobite fragments; very thinly, lenticularly bedded, with partings as in Unit 35 (partings only locally exceed 20 per cent). Unit is massive, resistant. Rudstone (as below), comprises 15 per cent of the lower half, 10 per cent of the upper, mainly in thin beds. Rare, well preserved feeding traces	24 (7.3)	1088.5 (331.8)
41	**Limestone** and **shale** Limestone: as below; very thin, nodular beds with partings (commonly half of the rock) of shale: pale brown, dolomitic, weathering pale brown to pale yellow-brown	12 (3.7)	1064.5 (324.5)
40	**Limestone**: as Unit 42; rudstone and ichnofossils prominent	30 (9.1)	1052.5 (320.8)
39	**Limestone** Complex unit. This unit is mainly a bed, 15 to 25 cm thick, of coarse, dolomitic oolite. At intervals of 30 to 100 ft (10 to 30 m), the oolite is interrupted by bioherms, resembling thrombolites, up to 4.5 ft (1.4 m) high and 14 ft (4.3 m) across. Acid etching of the "grey microcrystalline limestone" of these bioherms reveals that they are largely composed of a calcareous, skeletal, "coralline", colonial organism with hexagonal chambers. Flat-pebble rudstone, spatially associated with the bioherms, is partly encrusted by the calcareous organism	1 (0.3)	1022.5 (311.7)
38	**Limestone**: calcisiltite (as below); rare trilobite fragments; very thinly, lenticularly bedded, with partings as in Unit 35 (partings only locally exceed 20 per cent). Unit is massive, resistant. Rudstone (as below) comprises 15 per cent of the lower half, 10 per cent of the upper, mainly in thin beds. Rare, well preserved feeding traces	216 (65.8)	1021.5 (311.4)
37	**Limestone**: as Unit 35; 15 per cent rudstone in lenses, thin and rare medium beds. Coarser pebbles (up to 8 cm in greatest dimension) are associated with the thicker beds. Mainly flaggy	43.5 (13.3)	805.5 (245.5)
36	**Limestone**: ooid grainstone/packstone; very dolomitic, with "floating", dolomitized intraclasts. A single, massive bed	2 (0.6)	762 (232.3)
35	**Limestone** and **mudstone** Limestone: calcisiltite; as below; very thin, nodular beds with strongly "invading" partings of grey-brown, orange weathering, calcareous, dolomitic mudstone that make up 30 to 60 per cent of different subunits. Lenses of flat-pebble rudstone continue prominent. Feeding traces continue. Rare silicified trilobite fragments	69.5 (21.2)	760 (231.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 72741 (44 ft/13.4 m above the base) *Americare* sp. GSC loc. 72740 (27 ft/8.2 m above base) *Americare* sp.		
34	**Limestone**: as Unit 32	19 (5.8)	690.5 (210.5)
33	**Mudstone**: brownish grey, very calcareous, weakly slaty, with thin beds of limestone (as below). Limestone beds contain laminae of silicified trilobite fragments. Unit weathers pale greyish brown, very recessive	2 (0.6)	671.5 (204.7)
	GSC loc. 72739 *Americare* sp.		
32	**Limestone**: calcisiltite; grey, very dolomitic, thin and very thin, lenticular and nodular bedded, with prominent, "invading" partings of brown, very fine crystalline, argillaceous, dull orange weathering dolomite. Abundant, thin, lenticular beds of flat-pebble rudstone. At the base, ooids in a disturbed dolomitic bed six inches (15 cm) thick. The interval 13 to 15 ft (4 to 4.6 m) above the base is covered and could be mudrock	139 (42.4)	669.5 (204.1)
	GSC locs. 72736 to 72738 Loc. 72738 (1 ft/30 cm above the base) *Americare* sp. Loc. 72737 (58 ft/17.7 m above base) *Americare* sp. Loc. 72736 (56 ft/17.1 m above the base) *Americare* sp. *Blainia*? sp. *Rowia*? sp.		
	The base of Unit 32 is the contact between two local "members" of the Pika Formation, not recognized elsewhere. Both members weather brownish grey, but the lower (although still brownish in contrast to the grey weathering Eldon Formation) is distinctly less brown than the upper.		
31	**Limestone**: parted lime mudstone; partly laminated. Lenses of flat-pebble rudstone and intraclast grain/rudstone are prominent, as are feeding traces and coprolites on bedding planes	31.5 (9.6)	530.5 (161.7)
30	**Limestone**: intraclast grainstone; with large blotches of pale brown, orange weathering, fine and very fine crystalline dolomite. A single, massive bed	3.5 (1.1)	499 (152.1)
29	**Limestone**: parted lime mudstone. Twenty per cent thin lenticular beds of flat-pebble rudstone (packstone)	15 (4.6)	495.5 (151)
28	**Limestone**: as below; with 30 per cent thin, lenticular beds of pellet, and minor intraclast, grainstone; dolomitic	4 (1.2)	480.5 (146.5)
27	**Limestone**: at the base, parted lime mudstone (nodular, and thin to very thin, lenticular bedded), grading upward to calcisiltite (thin and very thin bedded, with partings of dark grey, pale greyish brown weathering, very fine crystalline dolomite); massive to flaggy. Five feet (1.5 m) above the base, a bed of more or less spherical thrombolites of various diameters up to 1 m. Rare thin beds and lenses of dolomitic intraclast and pellet grainstone. Rare thin beds and stout lenses of flat-pebble rudstone. Feeding and dwelling traces; coprolites on bedding planes	104.5 (31.9)	476.5 (145.2)
26	**Limestone**: a bed of varied, largely digitate stromatolites, in part grouped into heads. Stromatolites pass laterally into simple, domal heads, 7 to 10 cm in diameter. Stromatolite relief is infilled by intraclast-pellet grainstone	1.5 (0.5)	372 (113.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
25	**Limestone**: pellet grainstone; at the base, thin bedded, with prominent, dolomitic partings; higher, the grainstone is nodular, dolomite-mottled, and massive	2 (0.6)	370.5 (112.9)
24	**Limestone** and **dolomite** (alternating) Limestone: dark grey, grey weathering; microcrystalline, laminated, thin bedded. Dolomite: dark grey, yellow weathering; microcrystalline, calcareous, cryptalgalaminate, massive	7.5 (2.3)	368.5 (112.3)
23	Covered: recessive weathering	8.5 (2.6)	361 (110)
22	**Limestone**: calcisiltite and pellet packstone (calcisiltite matrix), with a few thin layers of pellet grainstone; alternating thick, mottled, and thin beds, parted. In the basal 0.7 ft (20 cm), mottling is siliceous, with rare, small, chert lenses. At the base, a persistent bed of black chert lenses up to 5 cm thick	25 (7.6)	352.5 (107.4)
21	**Dolomite**: dark grey, weathering pale grey; microcrystalline, finely cryptalgalaminate	4.5 (1.4)	327.5 (99.8)
20	Covered: recessive weathering	6.5 (2)	323 (98.5)
19	**Dolomite**: as below, finely (cryptalgal) laminated, medium bedded, weathering very pale grey	3.5 (1.1)	316.5 (96.5)
18	**Dolomite**, grey, microcrystalline, calcareous, very finely laminated. At the base, polygonal stromatolites 30 cm in diameter	2 (0.6)	313 (95.4)
17	**Limestone**: parted lime mudstone. At the base, regularly thin bedded, becoming thin and medium bedded and partly laminated upward. Rare thin beds of intraclast-pellet grainstone. Calcite-filled fenestrae at the top	61.5 (18.7)	311 (94.8)
	(Note the cycle, a repetition of Unit 10).		
16	**Mudstone**: grey, brown weathering; dolomitic, massive	0.5 (0.2)	249.5 (76)
	GSC locs. 72733 and 72735 (basal 0.5 ft /15 cm) cf. *Kingstonioides* sp. *Rowia* sp. phyllocarid crustacean		
	GSC loc. 72732 (1 ft/30 cm above base) *Clappaspis*? sp. *Rowia*? sp.		
15	**Limestone**: pellet grainstone; thin bedded	1.5 (0.5)	249 (75.9)
	GSC loc. 72731 (0.5 ft/15 cm above base) cf. *Amecephalina curticei* (Resser), 1938 (pygidium only) *Rowia*? sp.		
14	**Mudstone**: grey, weathering greyish orange; slightly calcareous (?dolomitic), crudely slaty; lenses of pellet packstone and rare thin beds of rudstone at the base, diminishing upward to disappearance. A resistant unit	12.5 (3.8)	247.5 (75.4)
13	**Dolomite**: as below. A single bed of simple, domal stromatolites, mostly about 10 cm in diameter	1 (0.3)	235 (71.6)
12	**Limestone**: massive lime mudstone; streaky laminae of dolomitized fine grains	2 (0.6)	234 (71.3)
11	**Limestone** and **dolomite** (thinly interlaminated) Limestone: grey, microcrystalline limestone. Dolomite: as below; locally, entirely dolomitized. Near the top, a 1.5 ft (46 cm) thick bed of pale grey, microcrystalline dolomite. Lamination at the top is clearly cryptalgal	7 (2.1)	232 (70.7)
10	**Limestone**: parted lime mudstone; partly laminated; abundant very thin beds and lenses of intraclast grain/rudstone (embayed intraclasts), especially near the base. Fenestrae and cryptalgal lamination are well developed at the top	39 (11.9)	225 (68.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	**Mudstone**: pale brownish grey, weathering pale yellow-grey to orange-brown; very calcareous; disturbed lamination	3.5 (1.1)	186 (56.7)
8	**Limestone**: parted lime mudstone; nodular thin bedded	2 (0.6)	182.5 (55.6)
7	**Dolomite** and **limestone** (very finely interlaminated) Dolomite: grey, microcrystalline, and similar limestone (cryptalgal laminite). Dolomite is dominant and weathers yellow; the limestone weathers grey. This unit continues the resistant character of underlying units	8.5 (2.6)	180.5 (55)
6	**Limestone**: cryptalgal laminite; partly platy/shaly, weathering grey	18 (5.5)	172 (52.4)
5	**Limestone**: as below; numerous beds of rudstone	16.5 (5)	154 (46.9)
4	**Limestone**: parted lime mudstone; regularly thin and very thin bedded, minor medium beds; abundant dwelling burrows 1 to 2 mm in diameter; rare pebbly bedding surfaces. At the base, a bed of intraclast grainstone, six inches (15 cm) thick	32 (9.8)	137.5 (41.9)
3	**Limestone** and **mudstone** Limestone: parted lime mudstone; with partings of mudstone (as Unit 2) that invade the limestone beds along burrows and shrinkage cracks. Unit weathers grey with yellow-orange laminae, and tends to be flaggy	14.5 (4.4)	105.5 (32.2)
2	**Mudstone**: brownish grey, calcareous, partly slaty, with few to abundant nodules of pale grey, microcrystalline limestone (commonly with streaks of trilobite fragments), and rare, irregular, thin beds and laminae of limestone. Unit weathers yellow-grey, orange-grey, and spongy (through selective solution of limestone nodules)	41 (12.5)	91 (27.7)
	GSC locs. 72728 to 72730		
	Loc. 72730 (21 ft/6.4 m above base) *Clappaspis* sp. *Rowia*? sp.		
	Loc. 72729 (16 ft/4.9 m above base) *Clappaspis*? sp. *Ehmaniella*? sp. *Solenopleurella*? sp.		
	Loc. 72728 (5 ft/1.5 m above base) *Rowia*? sp. *Modocia* sp.		
1	**Limestone**: parted lime mudstone. At the base, nodular and massive, becoming thin bedded and flaggy, with "invading" dolomite partings, upward. Bedding surfaces littered with (?)coprolites. Unit appears pale brown from a distance.	50 (15.2)	50 (15.2)
	GSC loc. 72727 (10 ft/8.3 m above the base) *Rowia*? sp.		
	Conformable, gradational contact, based largely on weathering colour and general bedding thickness.		

ELDON FORMATION
(2299 ft/677 m/estimated)

Although the Eldon Formation and the overlying Pika have numerous rock types in common, the Eldon is distinguished by its generally thicker bedding, greater resistance to erosion, and grey (as opposed to brownish) weathering.

Unit No.	Lithology	Thickness feet (m)
41	**Limestone:** mottled lime mudstone; weathers dark grey with orange mottling; very thick bedded below, grading upward to thin bedded. Grades to mottled pellet packstone (calcisiltite matrix) at top	22 (6.7)
40	**Limestone:** locally, the unit consists of a bank of thrombolites 3 ft (1 m) high, capped by very fine grained grainstone/packstone as below. Thrombolites are extensive along the bedding, and are separated by ladder-like masses of bedded, grainy infill. Laterally, the unit consists of mottled limestone (as Unit 41)	4 (1.2)
39	**Limestone:** very fine ooid grainstone; weathers pale grey, perfectly sorted; medium to thick bedded, finely planar laminated, massive	16 (4.9)
38	**Limestone:** bed of stromatolites, varying from domal to digitate	1.5 (0.6)
37	**Limestone:** (?)skeletal grainstone/packstone; grey weathering, commonly pebbly, generally trough crosslaminated, massive	15.5 (4.7)
36	**Limestone:** sandy (as Unit 34)	7.5 (2.3)
35	**Dolomite:** very pale grey, weathers pale yellow; microcrystalline (cryptalgalaminate); abundant fenestrae	2 (0.6)
34	**Limestone:** (?)intraclast grainstone; very fine grained, dolomitic, largely slightly to very sandy (quartz); thin and medium bedded, trough crosslaminated. Quartz sand is very fine to very coarse grained, unsorted, subangular to subrounded (?attacked by solution), mainly disposed on crosslaminae and along stylolitic bedding planes. By inspection, crosslaminae indicate predominant transport toward the east-northeast. Unit is massive, grey weathering, and resistant	26.5 (8.1)
33	**Limestone:** as below; slightly silty, very slightly sandy (very fine to medium grained quartz sand); silicified skeletal grains	19.5 (5.9)
32	**Limestone:** grainstone/packstone, probably grading to calcisiltite; dark grey, very dolomitic; medium bedded and minor thin bedded below; thin bedded and minor medium bedded above; stylolitic contacts. A few dolomitic partings. In the middle, one thin bed of pellet grainstone. Ichnofossils on and perpendicular to bedding planes are prominent. Some pebbly bedding planes. Unit becomes slightly silty at the top	62.5 (19)
	GSC loc. 72726 (4 ft/1.2 m above the base) *Spencella*? sp.	
31	**Limestone:** mottled lime mudstone; medium and minor thin bedded below, thin and minor medium bedded above; weathers grey, with pale brownish yellow dolomite mottling. Calcite-filled fenestrae are widespread; local calcite-filled burrows	27 (8.2)
	GSC loc. 72725 (13 ft/4 m above the base) *Spencella*? sp. *Micromitra* sp.	
	GSC loc. 72724 (10 ft/3 m above the base) *Bathyuriscus*? sp. (part of cranidium only) *Spencella* sp.	
	Underlying beds (**limestone**): monotonous, burrow-mottled lime mudstone.	
	Unit 1 is not the lowest accessible part of the Eldon Formation, but, lower in the section, unscalable cliffs prevent measurement of a complete Eldon (see Lower Part, Section AC–143).	

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

LOWER PART - SECTION AC-143

ELDON FORMATION

The interval between the base of Unit 25 and the top of the Pika Formation (in section AC-142) has been determined graphically as 2550 ft (777 m). After subtracting the measured thickness of the Pika, and adding the total thickness of measured Units 1 to 24, the estimated thickness of the complete Eldon Formation is 2220 ft (677 m).

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
25	**Limestone**: parted lime mudstone, grading upward over 25 ft (7.6 m) into burrow-mottled lime mudstone; very massive and resistant. Unscalable cliff	not measured	
24	**Mudstone**: dark grey, weathering pale brown; very calcareous, massive; sparse, lenticular, very thin beds of dark grey microcrystalline limestone; pyritic	12 (3.7)	866 (264)
23	**Limestone**: at the base, ribbon-bedded lime mudstone, with several thin beds of pebbly skeletal packstone in the basal foot. Twenty-four feet (7.3 m) above the base, the ribbon-bedded lime mudstone grades upward into parted lime mudstone; partings are silicified in the zone 65 to 70 ft (19.8 to 21.3 m) above the base. Rare thin beds of rudstone and intraclast grain/rudstone	121.5 (37)	854 (260.3)
22	**Mudstone** (90%) and **limestone** (10%) Mudstone: dark brownish grey, weathering very pale orange-grey and green-grey; calcareous, slightly slaty. Limestone: very thin beds; grey, microcrystalline	6.5 (2)	732.5 (223.3)
21	**Limestone**: trilobite wackestone (calcisiltite matrix), with streaks of fine grained skeletal grainstone; nodular bedded, massive	1.5 (0.5)	726 (221.3)
20	**Slate**: ex-mudstone, very calcareous; interbedded pale green-grey, grey-green weathering, and dull orange, weathering orange-brown. Four feet (1.2 m) above the base, a 30 cm thick bed of ooid grainstone, the top bearing megaripples. Local, minor, nodular, thin beds of green tinged, microcrystalline limestone (as below)	57.5 (17.5)	724.5 (220.8)
19	**Limestone**: parted lime mudstone, as below, but largely nodular, very thin bedded; a pale green tinge is evident, especially on weathered surfaces. Several beds of coarse flat-pebble rudstone	42 (12.8)	667 (203.3)
18	**Slate**: green weathering; as below	7 (2.1)	625 (190.5)
17	**Limestone**: as Unit 14. One 45 cm thick bed of pale orange weathering mudstone 3 ft (1 m) below the top. Flat-pebble rudstone is prominent, especially near the top	21 (6.4)	618 (188.4)
16	**Slate**: ex-mudstone; very calcareous; interbedded pale green-grey, grey-green weathering, and dull orange, weathering orange-brown. In the middle, 3 ft (1 m) of limestone: thin bedded calcisiltite with slate partings; locally with large, pillow shaped thrombolites at the base	15 (4.6)	597 (182)
15	**Limestone**: as Unit 6; mainly very thin bedded	16 (4.9)	582 (177.4)
14	**Slate**: as Unit 10	5 (1.5)	566 (172.5)
13	**Limestone**: as Unit 6	27 (8.2)	561 (171)
12	**Mudstone** Unit of five medium beds of mudstone: brownish grey, weathering dull brownish orange to pale yellow-grey, calcareous, partly massive, partly slaty, alternating with intervals of limestone (lenticular thin bedded lime mudstone with mudstone partings). Several thin beds of equant-pebble rudstone	11.5 (3.5)	534 (162.8)
11	**Limestone**: as Unit 6; intraclast grain/rudstone is prominent. In the middle, a bed of thrombolites (as below)	39.5 (12)	522.5 (159.3)
10	**Limestone** and **mudstone** At the base, 1 ft (30 cm) of mudstone: pale brownish grey, weathering very pale greenish grey, calcareous, slightly slaty; gradationally overlain by limestone: very thin and lenticular bedded calcisiltite, with partings of the same mudstone	5 (1.5)	483 (147.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	**Limestone**: as Unit 6. In the basal 3 ft (1 m), the partings are almost as thick as the limestone beds. Crosslamination is prominent in some beds of calcisiltite. The interval 19 to 29 ft (5.8 to 8.8 m) above the base contains three beds of small stromatolites, egg-shaped in profile, maximum 1 ft (30 cm) in height. A fourth bed of the same, occurs in the middle. Thin, and rare medium, beds and lenses of intraclast grain/rudstone (intraclasts with cuspate margins) are prominent	94 (28.7)	478 (145.7)
8	**Mudstone**: brownish grey, weathering greyish yellow; calcareous, massive	3 (0.9)	384 (117)
7	**Limestone**: as Unit 6; except that flat-pebble rudstone and intraclast grain/rudstone, in thin and rare medium beds and lenses, are common. Erosion is evident at the base of some rudstone beds. Rare channels (gutter casts), less than 30 cm wide and up to 12 cm deep, filled with rudstone	50 (15.2)	381 (116.1)
6	**Limestone**: parted lime mudstone; uniform and monotonous; dwelling and feeding traces are prominent on some bedding planes. From a distance, the aspect of this unit is pale orange-brown; in some places, it forms the downward continuation of the great cliff of Unit 25. Rare beds contain scattered oncoids, 3 to 5 mm in diameter. Flat-pebble rudstone, and intraclast grain/rudstone with embayed clasts, continue as very minor constituents, tending to be grouped within intervals 0.5 to 2 ft (15 to 30 cm) thick	125 (38.1)	331 (100.9)
5	**Limestone** Cycles, as seen in Unit 3 below – typically, 3 ft (1 m) thick subunit of ribbon-bedded lime mudstone (interlaminated limestone and dolomite) at the base grades upward into monotonous parted lime mudstone (largely calcisiltite). This is repeated many times. A 1 ft (30 cm) thick bed of oncoid floatstone occurs 27.5 ft (8.4 m) above the base. Very rare thin beds of flat-pebble rudstone, with sparry cement. Beds of small thrombolites occur at 1.5 and 22.5 ft (4.7 and 6.9 m) above the base. Rudstone is prominent in the base. Rudstone is prominent in the top 10 ft (3 m). This unit forms a major cliff	172.5 (52.6)	206 (62.8)
4	**Limestone**: ooid grainstone/packstone	0.5 (0.2)	33.5 (10.2)
3	**Limestone** At the base, ribbon-bedded lime mudstone (interlaminated limestone and microcrystalline dolomite), grading rapidly upward into parted lime mudstone	20 (6.1)	33 (10.1)
	GSC loc. 72722 (top of unit) *Elrathina* sp.		
2	**Limestone**: as Unit 3	12.5 (3.8)	13 (4)
1	**Limestone**: ooid grainstone/packstone.	0.5 (0.2)	0.5 (0.2)

Conformable, gradational contact.

STEPHEN FORMATION
(358 ft/109.1 m)

The Stephen Formation at this locality is somewhat recessive weathering and supports a ribbed slope. Because of the presence of mudrock units in the underlying Cathedral and overlying Eldon formations, the boundaries of the Stephen are less clearly marked here than generally.

Waputik Member
(74 ft/22.6 m)
(Units 10 to 15)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	**Slate**: with very rare limestone bodies (as Unit 12). In the top 3 ft (1 m), the slate is interlaminated with limestone: argillaceous, dolomitic lime mudstone (a clearing-upward, shallowing-upward cycle that includes Unit 1 of the Eldon Formation)	26 (7.9)	358 (109.1)
14	**Slate**: pale greyish brown, weathering pale brownish grey; calcareous; a few lenses and nodules of calcisiltite and several 2.5 to 8 cm thick beds of flat-pebble rudstone with a calcisiltite matrix	12 (3.7)	332 (101.2)
13	**Limestone**: as Unit 7	6 (1.8)	320 (97.5)
12	**Slate**: dark grey, weathering greenish grey; calcareous, laminated. Rare lenses and nodules of grey microcrystalline limestone	16 (4.9)	314 (95.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	Covered	14 (4.3)	298 (90.8)
10	Poorly exposed: recessive weathering **Shale**: grey, with abundant nodules of grey, microcrystalline limestone, and minor thin beds of limestone: as below	5 (1.5)	284 (86.6)
	Narao Member (279 ft/85 m) (Units 1 to 9)		
9	**Limestone**: as Unit 4	14 (4.3)	279 (85)
8	**Limestone**: lime mudstone; very dark brown, irregularly thin bedded; becomes partly burrow-mottled lime mudstone toward the top. Slightly resistant weathering	14 (4.3)	265 (80.8)
7	**Limestone**: lime mudstone; very thin nodular beds with partings of shale: grey-brown, weathering very pale brown, calcareous; slightly recessive weathering	5 (1.5)	251 (76.5)
6	**Limestone** and **dolomite** In the lower part, very thinly interbedded and interlaminated limestone: grey, microcrystalline, dolomitic, and dolomite: pale brownish grey, microcrystalline, argillaceous, orange weathering (ribbon-bedded lime mudstone lithofacies); platy, moderately resistant. Upward, the rock grades into parted lime mudstone, with some bedding planes littered with apparent coprolites	95.5 (29.1)	246 (75)
	GSC loc. 72721 (58.5 ft/17.8 m above the base) *Glossopleura*? sp. cf. *Kochina* sp. *Zacanthoides* sp.		
	GSC loc. 72720 (53.5 ft/16.3 m above the base) *Glossopleura* sp.		
	GSC loc. 72719 (36.5 ft/11.1 m above base) *Amecephalus* sp. *Glossopleura* sp.		
5	**Slate**: grey, weathering very pale greenish grey; calcareous, recessive	9.5 (2.9)	150.5 (45.9)
4	**Limestone**: as Unit 3, but in very thin beds, with dolomite as planar partings; partings are locally siliceous; flaggy; minor cliff former	46 (14)	141 (43)
	GSC loc. 72717 (24 ft/7.3 m above base) *Glossopleura*? sp.		
3	**Limestone** and **dolomite** (interlaminated) Limestone: grey, microcrystalline. Dolomite: pale brown, microcrystalline, orange weathering.		
	Platy, moderately resistant (ribbon-bedded lime mudstone lithofacies)	21 (6.4)	95 (29)
2	**Limestone** and **shale** At the base, slate: very pale brownish grey, weathering very pale greyish brown; very calcareous, rapidly grading upward into interlaminated lime mudstone and pale brown, very calcareous, very pale greyish brown weathering, platy shale. Upward, the limestone becomes largely pale brown, very argillaceous, and the lithology approaches laminated, platy, calcareous shale. Gradational contact at the top	57 (17.4)	74 (22.6)
	GSC loc. 72716 (2 ft/60 cm above the base) *Glossopleura* sp.		
1	**Limestone**: skeletal wackestone/packstone; very thin bedded, with dolomitic, pale orange weathering partings; feeding traces and coprolites; moderately resistant weathering.	17 (5.2)	17 (5.2)
	GSC loc. 72715 (4 ft/1.2 m above the base) *Glossopleura* sp. cf. *Kochina* sp.		
	Concordant contact.		

CATHEDRAL FORMATION
(1153.5 ft/351.6 m)

The Cathedral Formation at this locality forms a generally resistant weathering interval broken by recessive weathering, shaly units. It lacks the monolithic aspect of the Cathedral as seen in the upper Bow Valley, and some might wish, therefore, to interpret the section as the Snake Indian Formation, instead of Mount Whyte/Cathedral/Stephen. Nevertheless, the presence of a mappable Stephen Formation above, and Mount Whyte Formation (Weed Member) below, justify recognition of the Cathedral Formation here.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
35	**Limestone** and **dolomite** Both rock types are microcrystalline, interlaminated, and cryptalgalaminate. Units 34 and 35 comprise a shallowing-upward cycle	4 (1.2)	1153.5 (351.6)
34	**Limestone**: as Unit 30; parted lime mudstone; feeding traces and coprolites	27 (8.2)	1149.5 (350.4)
33	**Limestone**: parted lime mudstone; subdued partings; massive; subordinate burrow-mottled lime mudstone. A prominent cliff forming unit	40 (12.2)	1122.5 (342.1)
32	**Limestone**: burrow-mottled lime mudstone; massive	50 (15.2)	1082.5 (329.9)
31	**Limestone**: parted lime mudstone; subdued partings; massive; subordinate burrow-mottled lime mudstone. A prominent cliff forming unit	85 (25.9)	1032.5 (314.7)
30	**Limestone**: parted lime mudstone. At the base, flaggy, with prominent orange weathering dolomite partings and mottlings; upward, partings become thin and weather pale greyish yellow. Gradational at the top	95 (29)	947.5 (288.8)
	Trinity Lakes Member (71 ft/21.6 m) (Units 28 and 29)		
29	**Slate** and **limestone** (clearing-upward cycle) As Unit 26; grading upward to limestone: grey, weathering pale brownish grey with brownish grey, argillaceous laminae; microcrystalline, argillaceous, laminated, flaggy, moderately resistant. Interbedded limestone and slate recur at intervals. Grades into overlying unit	62 (18.9)	852.5 (259.8)
	GSC loc. 72713 (noted as collected – 3 ft/1 m below the top of Unit 28 but is probably from the base of Unit 29) *Kootenia* sp. *Wimanella* sp.		
28	Poorly exposed: recessive weathering **Shale**: dark grey, carbonaceous, chippy	9 (2.7)	790.5 (240.9)
27	**Limestone**: parted lime mudstone; very prominent orange weathering dolomite partings; tends to be flaggy. Subordinate intervals of burrow-mottled lime mudstone, intergrading with the parted facies	142 (43.3)	781.5 (238.2)
	A steeply dipping fault occurs 24 ft (7.3 m) below the top of Unit 27. Drag structures suggest southwest-side-down displacement and, hence, that the uncompensated thickness, as measured, is less than the true thickness.		
	Ross Lake Member (341.5 ft/104.1 m) (Units 16 to 26)		
26	**Slate** and **limestone** (thinly interbedded) Slate: grey, weathering pale grey and greyish yellow; very calcareous. Limestone: dark grey, weathering dark grey; microcrystalline, very argillaceous, slaty	11 (3.4)	639.5 (194.9)
	GSC loc. 72712 (4 ft/1.2 m above the base) *Amecephalus* sp. *Kootenia* sp. *Wimanella* sp.		
25	**Limestone**: burrow-mottled lime mudstone; massive, resistant	74 (22.6)	628.5 (191.6)
24	Largely covered: recessive weathering **Shale**: dark grey	90 (27.4)	554.5 (109)
	GSC loc. 72711 (25 ft/7.6 m above the base) *Paralbertella* sp.		
	GSC loc. 72710 (18 ft/5.5 m above the base) *Paralbertella* sp.		
	GSC loc. 72709 (5 ft/1.5 m above the base) *Paralbertella*? sp. *Onchocephalus* sp.		
23	**Limestone**: calcisiltite; irregularly very thin bedded, wavy laminated, crosslaminated, with prominent, "invading", partings of argillaceous dolomite; at the top, grades to massive, burrow-mottled lime mudstone	11 (3.4)	464.5 (141.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 72708 (6 ft/1.8 m above the base) *Paralbertella* sp. *Bythicheilus*? sp.		
22	Covered: recessive weathering Apparently **shale**	13 (4)	453.5 (138.2)
21	**Limestone**: skeletal (trilobite) wackestone/packstone; very thin bedded, flaggy; prominent partings of dolomite	14 (4.3)	440.5 (134.3)
20	Poorly exposed: recessive weathering Alternating **mudstone** and **slate** (derived from similar mudstone). Mudstone (dominant): as below. Both rock types commonly contain thin lenses of grey, microcrystalline, very dolomitic limestone	75 (22.9)	426.5 (130)
19	**Mudstone**: as below, but very calcareous, dolomitic, massive, cross-laminated	4 (1.2)	351.5 (107.1)
18	Poorly exposed: recessive weathering **Slate**: as below, lacking ooids; abundant thin lenses of calcisiltite: cross-laminated, very dolomitic; in part, slate has seams of dark green chlorite along bedding planes, and specks of neoblastic chlorite	38 (11.6)	347.5 (105.9)
17	Covered: recessive weathering	10 (3)	309.5 (94.3)
16	**Slate**: ex-mudstone: very pale orange-grey, weathering the same; calcareous, dolomitic; stringers of silicified ooids	1.5 (0.5)	299.5 (91.3)
15	Poorly exposed **Limestone**: as Unit 13. Rare thin beds of skeletal (trilobite) wackestone/packstone, with silicified trilobite fragments. Very rare lenses of ooid packstone (partly siliceous), and scattered, isolated ooids. Four feet (1.2 m) below the top, a bed of thrombolites like those of Unit 11	22.5 (6.9)	289 (90.8)
	GSC loc. 72707 (base of unit) *Amecephalus* sp. *Nyella skapta* (Walcott), 1917 *Plagiura* sp.		
14	Covered: recessive weathering	20 (6.1)	275.5 (84)
13	Poorly exposed **Limestone**: calcisiltite; dolomitic, laminated, thin and very thin bedded, with partings of very pale brown, very fine crystalline, massive dolomite. Rare silicified trilobite fragments	20 (6.1)	255.5 (77.9)
	GSC locs. 72705 and 72706 (labelled as collected from Unit 12, but are probably from Unit 13)		
	Loc. 72706 *Kochaspis*? sp. *Plagiura* sp.		
	Loc. 72705 *Chancia*? sp. *Kochiella*? sp. *Plagiura* sp.		
12	Covered: recessive weathering	17.5 (5.3)	235.5 (71.8)
11	**Limestone**: parted calcisiltite (as upper part of Unit 1). At the top, a 5 cm thick bed of oncoid packstone (calcisiltite matrix), overlain by a 20 cm thick bed of compound thrombolites	2 (0.6)	218 (66.4)
10	Covered: recessive weathering	25.5 (7.8)	216 (65.8)
9	**Limestone**: as upper part of Unit 1. At the base, compound thrombolites up to 30 cm high	3 (0.9)	190.5 (58.1)
8	**Limestone**: ooid packstone; very dolomitic, with scattered, silicified pelmatozoan fragments	2 (0.6)	187.5 (57.1)
7	**Limestone** and **dolomite** (clearing-upward cycle, as Unit 1) Limestone becomes dominant 8 ft (2.4 m) above the base. Partly interlaminated limestone and dolomite. An 8 cm thick zone, 19 ft (5.8 m) above the base, displays penecontemporaneous slump-overfolds. Lenses of ooid grainstone, partly siliceous, occur 37 to 38 ft (11.3 to 11.6 m) above the base. Local ripple marks are present near the top. Partings and trilobite fragments are silicified locally	55 (16.8)	185.5 (56.5)
6	**Slate**: very pale brownish to greenish grey, weathering very pale grey; very calcareous, laminated	10.5 (3.2)	130.5 (39.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
5	**Limestone**: oncoid packstone; oncoids, 2.5 to 4 cm in diameter, are silicified at the top. A rubbly unit	1 (0.3)	120 (36.6)
4	**Limestone**: as below, but non silty; massive, locally platy; partings locally silicified at the top	22.5 (6.9)	119 (36.3)
3	**Limestone** and **dolomite** As below, with silty (quartz) partings. Crosslamination common	22.5 (6.9)	96.5 (29.4)
2	**Limestone** and **dolomite** (cycle, as Unit 1) The limestone-dominant phase commences 8 ft (2.4 m) above the base	56 (17.1)	74 (22.6)
1	**Limestone** and **dolomite** (a clearing-upward cycle) At the base, dolomite: grey, weathering dull orange; very fine equicrystalline, argillaceous, laminated, massive, with nodules and thin lenses of limestone (calcisiltite and skeletal wackestone); grading upward to very thin bedded calcisiltite with dolomite partings.	18 (5.5)	18 (5.5)

MOUNT WHYTE FORMATION
(172 ft/52.4 m)

Weed Member
(Units 1 to 4)

Strata of the Weed Member are more resistant than those of the overlying, basal Cathedral Formation. Unit 1 in particular is strongly cliff forming.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Siltstone** and **shale** (interlaminated) Calcareous siltstone and shale, as below	27 (8.2)	172 (52.4)
3	**Limestone**: dark grey, weathers yellowish grey; microcrystalline, very argillaceous, laminated, massive	2.5 (0.8)	145 (44.2)
2	**Siltstone** and **shale** (interlaminated) Siltstone and shale, as below, but patchily calcareous at the base, becoming generally calcareous above. Scattered nodules of grey, microcrystalline limestone. Upward, the weathering colour changes to very pale brownish yellow	60.5 (18.4)	142.5 (43.4)
	The absence of trace fossils and bioturbation is in striking contrast to this lithofacies in sections to the east.		
1	**Siltstone** and **shale** (very finely, planarly interlaminated) Siltstone: grey and greenish grey. Shale: dark grey and dark greenish grey. The unit is noncalcareous, except for minor, millimetre-scale lenses of calcisiltite, and weathers greenish grey and lichenous, nearly black. Hyolithids are abundant, and whole trilobites occur at several horizons. Weak slaty cleavage.	82 (25)	82 (25)

GSC loc. 72704 (75 ft/22.9 m above the base)
Amecephalus sp.

GSC loc. 72703 (68 ft/20.7 m above the base)
Amecephalus sp.

GSC loc. 72702 (44 ft/13.4 m above the base)
Amecephalus agnesensis (Walcott), 1917
Onchocephalus sp.

GSC loc. 72701 (41 ft/12.5 above the base)
Amecephalus sp.

GSC loc. 72700 (13 ft/4 m above the base)
Amecephalus sp.
Hyolithes sp.
Onchocephalus sp.

GSC loc. 72699 (10.5 ft/3.2 m above the base)
Amecephalus sp.
Hyolithes sp.
Onchocephalus sp.

GSC loc. 72698 (8 ft/2.4 m above the base)
Onchocephalus sp.

GSC loc. 72697 (1 ft/30 cm above the base)
Piaziella sp.
Wenkchemnia sp.

Abrupt, concordant contact.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GOG GROUP		
	PEYTO FORMATION (389 ft/118.6 m)		
	The Peyto Formation forms pale outcrops contrasting with the dark, commonly lichenous quartzites below and the dark siltstone and shale of the Mount Whyte Formation above. It is less resistant than both, and supports a ribbed topography of relatively resistant and recessive weathering units.		
24	**Limestone**: trilobite packstone (calcisiltite matrix); with irregular partings of shale	8 (2.4)	389 (118.6)
	GSC loc. 72696 (top bed) *Olenellus* sp. *Zacanthopsis* sp.		
	GSC loc. 72695 (2 ft/60 cm above the base) *Olenellus* sp.		
23	**Limestone**: ranging from skeletal (trilobite) wackestone/packstone to medium grained trilobite-pelmatozoan grainstone; thin and medium bedded, with dolomite partings; scattered pebbles	32 (9.8)	381 (116.1)
	GSC loc. 72694 (21 ft/6.4 m above the base) *Luxella* sp. *Olenellus* sp. *Zacanthopsis* sp.		
	GSC loc. 72693 (8 ft/2.4 m above the base) *Bonnia* sp. *Olenellus* sp. *Zacanthopsis* sp.		
22	**Limestone**: calcisiltite and fine to medium grained trilobite-pelmatozoan grainstone/packstone; irregularly thin and medium bedded, with dolomite partings; scattered oncoids, generally dolomitized, in the top 5 ft (1.5 m)	24 (7.3)	349 (108.4)
21	**Limestone**: skeletal packstone and wackestone; very fine grained, thin bedded, largely with dolomite partings (as below); rare thin streaks of fine oolite, scattered pebbles. Top 1 ft (30 cm) consists of equant-pebble rudstone. A few individual beds are persistently dolomitized and yellow weathering	18 (5.5)	325 (99.1)
	GSC loc. 72692 (2 ft/60 cm above the base) *Olenellus* sp.		
20	**Limestone**: as Unit 18	1 (0.3)	307 (93.6)
19	**Limestone**: calcisiltite; thin and very thin bedded, with prominent partings of grey, calcareous, laminated siltstone. Near the top is a slumped, amalgamated bed	16 (4.9)	306 (93.3)
18	**Limestone**: oncoid packstone; ovoid oncoids of the spongy type, up to 2 x 5 cm in diameter, in a matrix of brown, orange weathering dolomite (as below)	5 (1.5)	290 (88.4)
17	**Limestone**: calcisiltite; thin bedded; partings of dolomite (as below). Near the base, one 10 cm thick bed of rudstone with calcisiltite matrix. Crudely flaggy, moderately resistant	16 (4.9)	285 (86.9)
	GSC loc. 72690 (3 ft/1 m above the base) *Antagmus* sp.		
16	**Limestone** and **shale** (thinly, lenticularly interbedded) Limestone: calcisiltite, very dolomitic, laminated and crosslaminated. Shale: pale brown, weathering pale yellow-brown; calcareous	28 (8.5)	269 (82)
	GSC loc. 72689 (top of unit) *Antagmus* sp. *Olenellus* sp.		
	GSC loc. 72688 (20 ft/6.1 m above the base) *Olenellus* sp.		
	GSC loc. 72687 (5 ft/1.5 m above the base) *Antagmus* sp. *Olenellus* sp.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	**Argillite/shale** and **limestone** Alternating thick intervals of limestone and mudrocks (two limestone, three argillaceous intervals). Limestone: trilobite wackestone/packstone; in nodular thin beds, with partings of brown, orange weathering, very fine crystalline dolomite. Argillite: as below, grading upward to dark brownish grey, flaky shale, with abundant lenses and nodules of limestone (as described). A recessive weathering unit	67 (20.4)	241 (73.5)
	GSC loc. 72686 (9 ft/2.7 m above the base) *Antagmus* sp. *Olenellus* sp.		
	GSC loc. 72685 (5 ft/1.5 m above base) *Antagmus* sp. *Olenellus* cf. *O.* sp. 5 Fritz, 1972		
14	**Limestone**: pelmatozoan-trilobite grainstone/packstone; medium to coarse grained, thin to thick bedded, massive; strongly dolomite mottled at the base	3.5 (1.1)	174 (53)
13	**Argillite**: greenish grey, brownish grey weathering; calcareous, platy; thin beds and nodules of trilobite wackestone (calcisiltite matrix)	3.5 (1.1)	170.5 (52)
12	**Limestone**: pelmatozoan-trilobite grainstone/packstone; medium to coarse grained, thin to thick bedded, massive, very dolomitic, thin and medium bedded, with partings of argillite (as above)	5 (1.5)	167 (50.9)
11	**Limestone**: lime mudstone and trilobite wackstone; slightly argillaceous; thin bedded below, becoming nodular and indistinctly thin bedded above, with partings of dolomite: brown, microcrystalline, argillaceous, micaceous	24 (7.3)	162 (49.4)
	GSC loc. 72684 (7 ft/2.1 m below the top) *Antagmus* sp.		
	GSC loc. 72681 (3 ft/1 m above the base) *Bonnia* cf. *B. laevigata* Rasetti, 1948		
10	**Limestone**: oncoid packstone; massive. Oncoids are irregular, up to 2.5 cm in diameter; matrix is trilobite packstone	6.5 (2)	138 (42.1)
9	**Limestone**: pelmatozoan-trilobite grainstone/packstone; medium to coarse grained, thin to thick bedded, massive	10.5 (3.2)	131.5 (40.1)
	GSC loc. 72682 (6 ft/1.8 m above the base) *Olenellus* sp. *Onchocephalus* sp.		
	GSC loc. 72683 (1 ft/30 cm above the base) *Antagmus* sp. *Nisusia* sp. *Olenellus* cf. *O. puertoblancoensis* (Lochman), 1951		
8	**Limestone** In the lower part, mainly pale lime mudstone (fused, pale pellets?); in the upper part, mainly sandy (quartz) pale-pellet grainstone. Both rock types have fenestral fabrics, are pale grey, pale grey weathering, and massive. The basal 4 ft (1.2 m) contain streaks of quartz sand and minor sandstone beds (as Unit 7). The basal 2 ft (60 cm) have been altered to dolomite: pale grey, orange weathering, very fine crystalline	24 (7.3)	121 (36.9)
7	**Quartzite**: pale grey, rust specked, medium grained, very well sorted, well rounded; in thick, massive beds weathering nearly white, lichenous; sideritic patches, especially near the top	24 (7.3)	97 (29.6)
6	**Argillite**: greenish grey, weathering greenish grey and brown; very thin bedded, flaggy. Many clear impressions of large trilobites	9 (2.7)	73 (22.3)
	GSC loc. 72680 (5 ft/1.5 m above the base) *Olenellus* sp.		
5	**Limestone**: pelmatozoan-trilobite-hyolithid grainstone; fine and medium grained, very dolomitic; in massive crossbed sets 3 ft (1 m) and more thick. A bed of argillite (as above), 1 ft (30 cm) thick, occurs 3.5 ft (1.1 m) below the top. Upper contact is gradational	27 (8.2)	64 (19.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 72679 (2 ft/60 cm below the top) *Bonnia* sp. *Olenellus* sp. *Onchocephalus* sp.		
	GSC loc. 72678 (10 ft/3 m below the top) *Bonnia* sp. *Olenellus* sp.		
	GSC loc. 72677 (2 ft/60 cm above the base) *Bonnia* sp. *Micromitra* sp. *Syspacephalus* sp.		
	GSC loc. 72676 (base of unit) *Antagmus*? sp.		
4	**Argillite**: grey, platy, weathering deep brown; well preserved trilobite fragments widespread. Grades into the overlying unit via a thinly interbedded interval	7.5 (2.3)	37 (11)
	GSC loc. 72675 (2.5 ft/76 cm above the base) *Olenellus schofieldi*? Best, 1952		
3	**Limestone**: skeletal packstone (calcisiltite matrix); medium and coarse grained, very dolomitic; nodular thin bedded, with dolomite partings (as below)	5.5 (1.7)	29.5 (9)
	GSC loc. 72674 (4 ft/1.2 m above the base) *Antagmus* sp. *Bonnia* sp. *Olenellus* sp.		
	GSC loc. 72673 (1 ft/30 cm above the base) *Antagmus*? sp. *Nisusia* sp. *Olenellus* sp.		
2	**Limestone**: trilobite wackestone; dark grey, slightly argillaceous, nodular thin bedded, with partings and thin interbeds of argillite: dark brownish grey, weathering medium orange-brown; calcareous	17.5 (5.3)	24 (7.3)
	GSC loc. 72672 (1 ft/30 cm below the top) *Olenellus* sp.		
1	**Limestone**: trilobite wackestone with layers of trilobite packstone (calcisiltite matrix); nodular thin bedded, with partings and mottling of pale orange weathering dolomite. Oncoids, up to 2.5 cm in diameter, are scattered in the basal 4 ft (1.3 m). The basal 1.5 ft (46 cm) are altered to dolomite: grey, dull orange weathering; fine equicrystalline, massive. The top 0.3 ft (10 cm) consists of trilobite-hyolithid packstone (calcisiltite matrix).	6.5 (2)	6.5 (2)
	GSC loc. 72671 (top 0.3 ft/10 cm) *Antagmus* sp. *Bonnia* sp. *Olenellus* sp.		

The basal 30 ft (10 m) of the Peyto Formation are slightly recessive weathering; this facilitates the tracing of the contact on air photos and at a distance.

MAHTO FORMATION
(1250 ft/381 m)

The siliciclastic, sandstone dominated Mahto Formation supports resistant, lichenous, dark outcrops of well bedded appearance.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
31	**Quartzite**: pale grey and pale brownish grey, rust specked, very fine and fine grained, well sorted. At the base, medium to thick bedded subunits of quartzite alternate with subunits of quartzite thinly interbedded with subordinate argillite (as Unit 28). The upper part is entirely medium and thick bedded quartzite; carbonate cemented (?siderite) in the top 4 ft (1.2 m)	23 (7)	176 (53.6)
30	**Quartzite**: pale grey, minor pale green, rust specked; fine and very fine grained, well sorted; mainly thick bedded, with very minor beds of pale green, rust specked argillite	21 (6.4)	153 (46.6)
29	**Quartzite**: mainly pale green, minor pale grey, rust specked; very fine grained, very well sorted; regularly medium bedded	18.5 (5.6)	132 (40.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
28	**Quartzite** (55%) and **argillite** (45%) Quartzite: pale grey and pale brownish grey, fine and medium grained, generally well sorted, trough crosslaminated. Argillite: pale greenish grey, micaceous, crudely platy, in subunits up to 8 ft (2.4 m) thick. In the top 50 ft (15.2 m), the quartzite beds become mainly thick	113.5 (34.6)	113.5 (34.6)

The quartzite-dominated, siliciclastic succession continues downward. A unit of limestone and dolomite is present. This unit is 102 ft (31.1 m) thick, and its top is 1250 ft (381 m) below the base of the Peyto Formation. It contains a *Bonnia-Olenellus* Zone fauna (GSC locs. 72668 to 72670) and belongs to the Mural Formation.

SECTION AC-160

Tokumm Creek

(lat. 51°17′54″N, long. 116°18′54″W)
(For access see Appendix C)

This section exposes a "rim" facies of the Stephen Formation, in which the equivalent of the Narao Member has been incorporated, by all who have mapped the area, within the upper part of the Cathedral dolomites; thus, the Stephen here is entirely Waputik Member (cf. Mount Field). The "Eldon-Pika undifferentiated", on the other hand, is a ramp facies, and is overlain by Arctomys equivalents belonging to the outer detrital belt, "Chancellor", facies.

CHANCELLOR FORMATION
(ARCTOMYS-WATERFOWL EQUIVALENT)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
3	**Dolomite** and **slate** At the base, dolomite: grey, cream weathering; microcrystalline, in thin nodular beds with partings of dark grey slate, grading upward into 1 to 2.5 cm thick beds of dolomite, between beds of black slate, 2.5 to 8 cm thick	+46 (+14)	+178.5 (+54.4)
2	A succession of subunits of: 1. **Slate**: partly dark grey, partly laminated pale and dark grey; hard; 2. **Slate** as above, with nodules and thin lenticular beds of orange weathering, microcrystalline dolomite and grey weathering, microcrystalline limestone; 3. **Siltstone/argillite** as below, dark, laminated. One bed of dolomite: dark grey, orange weathering; microcrystalline, silty, well laminated	76 (23.2)	132.5 (40.4)
1	**Siltstone** and **argillite** (thinly, evenly interlaminated) Siltstone: dark grey. Argillite: pale green. Unit weathers dark greenish grey and rust. Contact abrupt, concordant.	56.5 (17.2)	56.5 (17.2)

ELDON AND PIKA FORMATIONS
(undifferentiated)
(1112.5 ft/339.1 m)

The Eldon-Pika forms a major cliff of sombre aspect.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
22	**Dolomite**: ex-burrow-mottled lime mudstone; indistinctly mottled in pale and very pale grey, fine and very fine crystalline; indistinctly thin and medium bedded, massive. The uppermost 15 ft (4.6 m) are locally parted lime mudstone, overlain by dolomite: laminated pale and dark grey, cream weathering; microcrystalline	148.5 (45.3)	1112.5 (339.1)
21	**Dolomite**: ex-ribbon-bedded lime mudstone; as below, but distinctly thin bedded; convergence of bedding (wedge bedding), and truncation of bedding by packets of overlying beds (coherent slide masses) are common	95 (29)	964 (293.8)
20	**Dolomite**: mottled pale and dark grey, weathers pale yellow-grey; very fine crystalline; indistinctly nodular thin bedded	30 (9.1)	869 (264.9)
19	**Limestone**: lime mudstone; nodular thin bedded (nodular at the base), with partings of pale brown weathering dolomite; much of the unit passes laterally to dolomite (as above). Near the base, a massive, 6 ft (2 m) thick subunit of debris-flow breccia occurs. This breccia comprises angular fragments of lime mudstone in a matrix of muddy dolomite, and has a discordant base	30 (9.1)	839 (255.7)

Each of the three underlying units, 16, 17 and 18, plus another lower unit that lies off the line of section (4 ft/1.2 m of massive intraclast rudstone), overlies Unit 15, at different places – because of the southward convergence of bedding at an angle of 9°. Thus, the succession recorded depends on the precise line of section selected.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
18	**Limestone** and **dolomite** (thinly, regularly, planarly interbedded and interlaminated) Limestone: grey, microcrystalline Dolomite: grey, microcrystalline Ribbon-bedded lime mudstone lithofacies; bedding is very uniform and regular, with local scour-and-fill and slide surfaces crosscutting the bedding	50 (15.2)	809 (246.6)
17	**Dolomite**: white, medium and coarse crystalline, with partings of dolomite: dark grey, very fine crystalline; regularly thin bedded, flaggy (parted lime mudstone, severely dolomitized). Direction of bedding convergence is due south	15.5 (4.7)	759 (231.3)
16	**Limestone**: ribbon-bedded lime mudstone; convergence of bedding is visible at several places within the unit	31.5 (9.6)	743.5 (226.6)

Field Member
(26.5 ft/8.1 m)
(Unit 15)

The Field Member is visible as a recessive, brown weathering unit, separating the cliffs above from those below.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	**Limestone**: lime mudstone; grey, planar thin bedded, with pale brown to orange weathering dolomite partings (a carbonaceous version of ribbon-bedded lime mudstone). Bedding surfaces carry carbonaceous debris, including trailing algae, partly in loops. The uppermost 4 ft (1.2 m) contains interbeds, up to 10 cm thick, of grey slate	26.5 (8.1)	712 (217)
14	**Dolomite**: as Unit 12	38.5 (11.7)	685.5 (208.9)
13	**Dolomite**: white, medium and coarse crystalline, with partings of dark grey, very fine crystalline dolomite; regularly thin bedded, flaggy (parted lime mudstone, severely dolomitized). On one bedding surface, 1 ft (30 cm) above the base, several trilobite fragments and one complete trilobite specimen are preserved (as dolomite) (specimen lost)	8 (2.4)	647 (197.2)
12	**Dolomite**: mottled, as below, but with several indistinctly bounded zones that contain many pockets of stromatactoid dolomite. Unit is essentially nonbedded	60 (18.3)	639 (194.8)
11	**Limestone**: mottled, as Unit 9	29.5 (9)	579 (176.5)
10	**Dolomite**: nearly white, fine crystalline, mottled in the same pattern as the underlying limestone; with dark grey, very fine crystalline dolomite. A very massive unit. Basal contact crosses the bedding	54.5 (16.6)	549.5 (167.5)
9	**Limestone**: burrow-mottled lime mudstone; dolomite mottlings are unusually large (+5 cm)	29 (8.8)	495 (150.9)
8	**Dolomite**: as Unit 6	63 (19.2)	466 (142)
7	**Limestone**: ribbon-bedded lime mudstone. The unit contains at least two slump masses with crosscutting bases; one of the slumped masses comprises an isoclinal overfold, at least 5 ft (1.6 m) from limb to limb. Small (0.5 cm), nearly spherical, bodies of black chert occur in some parts of the unit	22 (6.7)	403 (122.8)
6	**Dolomite**: as Unit 4, but 90 per cent stromatactoid. The laminae of coarse dolomite, oblique to bedding, dip unidirectionally over 10 to 15 ft (3 to 4.6 m) of section, and then reverse the sense of dip through the following interval (of similar thickness). Minor, relict masses of limestone (as Unit 5) also occur	198 (60.4)	381 (116.1)
5	**Limestone**: ribbon-bedded lime mudstone; regularly thin and medium bedded, weathering dark grey (unit is seen as part of the basal Eldon "black band"). The upper contact crosscuts the bedding strongly	34 (10.4)	183 (55.8)
4	**Dolomite**: pale grey, very fine and fine crystalline, with irregular partings of grey, very fine crystalline dolomite (?ex-parted lime mudstone); local stromatactoid structure. Unit weathers pale cream	51 (15.5)	149 (45.4)
3	**Dolomite**: mainly ex-burrow-mottled lime mudstone, with subordinate subunits of ex-ribbon-bedded lime mudstone	50 (15.2)	98 (29.9)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	**Limestone**: grading upward from parted, nodular-bedded lime mudstone (as Unit 1) into ribbon-bedded lime mudstone. Unit weathers very dark grey (basal "black band" of the Eldon)	19.5 (5.9)	48 (14.6)
1	**Limestone** and **shale** At the base, dolomitic lime mudstone in thin beds and nodules, with nearly 50 per cent partings of brownish olive, calcareous shale that weathers grey to pale grey-brown. These strata grade gradually upward into nodular thin bedded, dolomitic lime mudstone with irregular, orange weathering partings of grey, microcrystalline dolomite.	28.5 (8.7)	28.5 (8.7)
	(Unit 1 could as well be assigned to the Stephen Formation as to the Eldon, but the "highest shale" criterion would be applicable only with difficulty in mapping. The Unit 1/Unit 2 contact climbs across the bedding toward the southwest.)		
	Contact conformable, gradational, arbitrary.		

STEPHEN FORMATION
(89 ft/27.1 m)

Waputik Member

The Stephen Formation, here consisting of the Waputik Member only, forms a moderately recessive, brown weathering interval that separates the two cliff forming carbonate formations.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	**Shale** and **limestone** (very thinly interbedded) Shale: pale orange-brown, calcareous, grading to green at the top; partly silty, grading to siltstone. Limestone: partly grey, microcrystalline, partly altered to dolomite: pale grey, microcrystalline, orange weathering. Fifteen per cent mainly medium beds of limestone: largely skeletal wackestone; largely nodular, with argillaceous partings. Minor beds of skeletal packstone	72 (21.9)	89 (27.1)
1	**Shale**: dark grey, brown weathering; slightly calcareous, becoming partly pale greenish grey, and calcareous, upward. Minor thin lenses of particulate limestone. Five per cent lenticular, thin and medium beds of skeletal grainstone/packstone and rudstone.	17 (5.2)	17 (5.2)
	Contact abrupt, concordant.		

CATHEDRAL FORMATION
(incomplete, not measured)

Includes strata equivalent to the Narao Member of the Stephen Formation.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Dolomite: mainly pale grey to nearly white, very fine and microcrystalline, minor nearly white, fine equicrystalline; resistant, largely deep orange-brown weathering. Cryptalgal laminite is prominent (i.e., "rim" facies). Near the top, algal stromatolites are established atop wavelike mounds of fenestral limestone. Rare beds of dolomite with relict pebbles or oncoids. The top 4 ft (1.2 m) consist of parted, very fine crystalline, pale and dark grey dolomite; except for this, the normal parted and mottled carbonate rocks of the Cathedral Formation are not seen in the rocks exposed	(estimated exposed thickness 400 ft/ 121.9 m)	

COMPOSITE SECTION AC-161/162

Type sections of the Amiskwi and Wapta members of the Stephen Formation and the Field Member of the Eldon Formation, at Mount Field (west of the Cathedral Escarpment)

(lat. 51°25′28″N, long. 116°27′57″W)
(For access see Appendix C)

ELDON FORMATION
(incomplete)

The Eldon Formation forms the pale, upper faces and summit of Mount Field.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
14	**Dolomite**: grey to nearly white, grey weathering; fine and medium equicrystalline, mainly medium bedded. Four feet (1.2 m) above the base, a subunit, 2 ft (0.6 m) thick, of dolomite: ex-cryptalgal laminite; laminated grey and white, microcrystalline. This subunit is locally preserved as interlaminated limestone and dolomite, with small, laterally linked stromatolites, scour-and-fill structures, and rip-up clasts	26 (7.9)	1216.5 (370.8)
	Unit 14 forms the peak of Mount Field; higher beds are preserved on the east ridge of the mountain, but do not extend to the top of the Eldon-Pika interval.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
13	**Dolomite**: pale grey, fine crystalline, massive, with relict fenestrae (ex-fenestral lime mudstone or pale-pellet grainstone). Includes a 1 ft (30 cm) thick bed of rudstone/floatstone	5 (1.5)	1190.5 (362.9)
12	**Dolomite**: pale grey to white, fine and very fine crystalline; mainly thin bedded, with partings and laminae of dark grey, very fine crystalline dolomite. Minor massive dolomite with grey mottling, at the base. Unit weathers grey to yellow-grey. Lamination and crosslamination increase in prominence upward. A 4 ft (1.2 m) thick subunit containing domal to columnar thrombolites has its base 131 ft (39.9 m) above the base of the unit	168 (51.2)	1185.5 (361.3)
	Replacement contact.		
11	**Limestone**: burrow-mottled lime mudstone below, grading upward to parted lime mudstone; weathers dark grey; burrows and calcite-filled cracks throughout	45 (13.7)	1017.5 (310.1)
	Field Member (164 ft/49.9 m) (Type section, Units 8 to 10)		
10	**Argillite**: dark grey, calcareous, siliceous, silty; in part, subtly crosslaminated, with minor thin beds, lenses, and nodules of grey, microcrystalline limestone. Sparse trilobites and hyolithids, rare bivalves. Near the top, some beds weather pale grey and greenish grey	30 (9.1)	972.5 (296.4)
	GSC loc. 75190 (10 ft/3 m above the base) *Spencella montanensis*? Rasetti, 1963 *Bathyuriscus* sp. *Canadaspis* sp. (identified by M.J. Copeland)		
	Abrupt, planar contact		
9	**Limestone** At the base, limestone (as below), with some laminae of orange weathering dolomite. Upward, a gradation into ribbon bedded lime mudstone. Fossils, including numerous complete specimens, are abundant in the talus, and weather out differentially from the dolomitic partings, but do not break cleanly from the matrix	116 (35.4)	942.5 (287.3)
8	**Limestone**: lime mudstone; dark brownish grey, weathering dark grey; thin and very thin bedded, laminated; alternately flaggy and platy, moderately resistant. The basal 10 ft (3 m) yields abundant fossils	18 (5.5)	826.5 (251.9)
	GSC loc. 75189 (4 to 5 ft/1.2 to 1.5 m above the base) *Elrathina* sp. *Micromitra* sp. *Parkaspis* sp. *Peronopsis montis* (Matthew), 1899 *Ptychagnostus intermedius* (Tullberg), 1880 *Spencella* sp.		
	GSC loc. 65837 (an additional collection of loose material from Unit 8) *Bathyuriscus* cf. *B. adaeus*, Walcott, 1916 *Elrathina* cf. *E. cordillerae*, Walcott, 1887 *Pegmatreta* sp. *Peronopsis* cf. *P. scutalis* (Salter), 1872 *Ptychagnostus* cf. *P. atavus* (Tullberg), 1880 *Tomagnostus*? *Zacanthoides*?		
7	**Dolomite**: very pale grey to nearly white, fine crystalline; strongly mottled with irregular blobs, 0.5 to 1 cm in diameter, of dark grey, very fine crystalline dolomite (ex-burrow-mottled lime mudstone); mottling is in part aligned to suggest thin bedding; massive, except for minor subunits of thin bedded, parted dolomite near the base. Overall weathered aspect is pale yellowish grey. A 1 ft (30 cm) thick bed with scattered oncoids lies 30 ft (9.1 m) above the base	209 (63.7)	808.5 (246.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Dolomite**: mainly ex-oolite; as below, but less well preserved; mainly medium bedded. Subordinate intercalations of dolomite (as Unit 4)	51 (15.5)	599.5 (182.7)
5	**Dolomite**: very fine crystalline, with very well preserved ex-oolite texture, black ooids in a white matrix (ex-ooid grainstone); indistinctly thin bedded, massive, weathering medium grey; with minor, discontinuous partings of dark grey dolomite	61 (18.6)	548.5 (167.2)
4	**Dolomite**: as Unit 1, including stromatactoid subunits; beds are 2 to 10 cm thick	52 (15.8)	487.5 (148.6)
3	**Dolomite**: as below, but pale grey mottled with dark grey (ex-burrow-mottled lime mudstone). Stromatactoid dolomite is widespread in pockets and indistinctly bounded lenses. At about 53 ft (16.2 m) above the base, the unit grades upward to dolomite: as Unit 2. From 73 ft (22.3 m) above the base upward, relict pellets are visible	110 (33.5)	435.5 (132.7)
2	**Dolomite**: as below, but bedding is distinct, and is shown in part by aligned mottlings of dark grey, very fine crystalline dolomite (transition from ex-parted to ex-burrow-mottled lime mudstone). Subunits of stromatactoid dolomite occur at intervals	77 (23.5)	325.5 (99.2)
1	**Dolomite**: grey to very pale grey, fine and very fine crystalline, with partings and laminae of dark grey, very fine crystalline dolomite; seen close-to, weathering is dull greyish yellow, with dark grey stripes but, at a distance, the overall effect is greyish yellow. Subunits with stromatactoid structure occur intermittently in the interval 35 to 150 ft (10.7 to 45.7 m) above the base.	248.5 (75.7)	248.5 (75.7)
	Conformable contact.		

STEPHEN FORMATION
(911.5 ft/277.8 m)

The Stephen Formation, here of the basinal facies, supports brown weathered slopes, somewhat recessive weathering near the base, but steepening upward into ledgy cliffs.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Wapta Member (341.5 ft/104.1 m) (Type Section, Units 12-27)		
27	**Slate**: greenish grey, weathering dull green, noncalcareous	9.5 (2.9)	911.5 (277.9)
26	**Limestone**: skeletal wackestone; very fine grained, in very thin, nodular beds and nodules, with partings of grey, dolomitic, slightly silty shale.		
	This unit changes to dolomite near the Fossil Gully fault	17 (5.2)	902 (275)
25	**Shale**: pale greenish grey, weathers dull, deep green and brown; noncalcareous, very thin bedded, with siltstone interbeds	19 (5.8)	885 (269.8)
24	**Limestone** and **slate** Fifty per cent nodules of grey, microcrystalline limestone in a matrix of slate (as below). The limestone nodules change to orange weathering dolomite near the fault	3.5 (1.1)	866 (264)
23	**Shale**: pale greenish grey, weathers pale brown, calcareous, largely silty, well laminated, lichenous, burrows common. A one-foot (30 cm) thick bed of limestone (skeletal wackestone), strongly mottled with silty dolomite, has its base 10 ft (3 m) below the top of the unit. Bedding surfaces are micaceous. Weathers bluish green-grey	64.5 (19.7)	862.5 (263)
22	**Dolomite**: grey, weathering dull orange, fine equicrystalline, traces of ex-particulate texture	2 (.6)	798 (243.3)
21	**Slate**: pale greenish grey, calcareous, partly silty; slim lenses of grey, microcrystalline limestone are common (these change to dolomite near the Fossil Gully fault).		
	Unit grades upward to interlaminated limestone and dolomite, partly silty, as below	22 (6.7)	796 (242.7)
20	**Limestone** and **slate** Lower (40 cm thick) and upper (60 cm thick) beds of ooid and ooid-skeletal grainstone/packstone (the upper bed carrying a few oncoids) are separated by slate: grey, weathering olive-brown, calcareous, partly silty	7.5 (2.3)	774 (236)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
19	**Dolomite** and **limestone** (interlaminated) As Unit 16; largely silty; grains of quartz silt outline crosslamination in some beds	42.5 (13)	766.5 (233.7)
18	**Slate**: grey, weathering dull greyish green, calcareous	2 (0.6)	724 (220.8)
17	**Limestone** and **slate** Nodules of grey, microcrystalline limestone (locally dolomitized) in slate: as above	6 (1.8)	722 (220.1)
16	**Dolomite** (75%) and **limestone** (25%) (thinly interbedded and interlaminated) Dolomite: grey, orange weathering, microcrystalline, partly silty. Limestone: grey, grey weathering, microcrystalline; ribbon-bedded lime mudstone facies, unusually thinly bedded. Forty-three feet (13.1 m) above the base, a 25 cm thick packet of beds is involved in a slump structural	56 (17.1)	716 (218.3)
	At this point, a fault subsidiary to the main Fossil Gully fault is crossed. The section is "tied" on a distinctive, 15 to 30 cm thick bed of flat-pebble rudstone/floatstone, overlain by penecontemporaneously slumped beds, which lies 4 ft (1.2 m) below the top of Unit 16.		
15	**Slate**: grey, weathering pale brown, calcareous, platy, non-silty. Forty feet (12.2 m) above the base, a 20 cm thick bed of limestone: as Unit 12, with scattered pebbles	45 (13.7)	660 (201.2)
14	**Limestone**: as below; with scattered, small (3-4 mm) oncoids	2.5 (0.8)	615 (187.5)
13	**Slate**: grey, weathering banded grey and pale brown, calcareous, micaceous, silty, well laminated. Thin, lenticular beds of microcrystalline limestone are common in the uppermost 3 ft (1 m)	30.5 (9.3)	612.5 (187.1)
12	**Limestone**: trilobite packstone/grainstone; nodular thin bedded, flaggy, to nodular, massive, with partings and mottlings of orange weathering, microcrystalline dolomite. Very minor interbeds of slate as below. The basal, 1 ft (30 cm) thick bed is trilobite grainstone with dolomite blotches	12 (3.7)	582 (177.5)
	At this point, the upward line of measurement crosses a cluster of faults of the Fossil Gully system. The line is offset eastward, and the Unit 11/Unit 12 contact correlates across the faults.		
	Amiskwi Member (570 ft/173.7 m) (Type Section, Units 1 to 11)		
11	**Shale**: much as below, but dolomitic, "microcrystalline-looking", brown weathering	91 (27.7)	570 (173.7)
	Fossils in loose material decrease in number from Unit 10 upward into Unit 11. Laminae of trilobite coquina and rare thin lenses of skeletal grainstone/packstone reappear 70 ft (21.3 m) above the base, and continue upward.		
	Gradational contact		
10	**Shale**: brown, and brownish grey, weathering dark grey and pale brown, very calcareous, platy; widely spaced siltstone laminae; silty zones, several feet thick, occur at intervals. Trilobite fragments occur sparsely throughout the unit. The shale grades upward to dark grey and bluish grey, calcareous, fissile shale (strong lithic resemblance to the Burgess Shale). Well preserved *Pagetia* spp. are common. The lowest-noted gastropods and hyolithids occur 111 ft (33.8 m) above the base	143 (43.6)	479 (146)
9	**Limestone**: lime mudstone; dark brownish grey, weathers dark grey with yellow laminae (ribbon-bedded lime mudstone); thin bedded, laminated, dolomitic, massive	3.5 (1.1)	336 (102.4)
8	**Shale**: very calcareous, approaching argillaceous limestone; dark brown, weathering very dark grey, locally pale brown; sooty, platy, and richly fossiliferous at several levels (trilobites and brachiopods)	58.5 (17.8)	332.5 (101.4)
7	Covered: recessive weathering	30 (9.1)	274 (83.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Shale**: dark brownish grey, weathering very pale brown, very calcareous, sooty, conchoidal fracture. Unit is nearly barren of fossils in the lower half; the upper half is fossiliferous, with well preserved *Pagetia* spp.	20 (6.1)	244 (74.4)
5	Very poorly exposed **Shale**: as above	67-72 (22)	224 (68.3)

"Boundary limestone" (informal)
(Units 3, 4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Limestone**: a lenticular, massive unit, with dolomite mottling and a hummocky upper surface. Overall pale grey "wash" conceals the fragmental character; only local, water washed exposures allow inspection of the fabric, which is coarse, comprising angular fragments of limestone in a dolomitic lime mudstone matrix. The unit is a debris-flow deposit, or a complex of such beds	3.5-8.5 (1.1)	152 (46.3)
3	**Limestone**: lime mudstone and pellet grainstone; grey, orange to yellow weathering, thin bedded (1-8 cm), laminated and locally low-angle crosslaminated; prominent partings of dolomite: brown, microcrystalline	63.5 (19.4)	148.5 (45.3)
2	**Shale**: grey, weathering dull green, partly greenish grey; minor brown weathering zones; calcareous, partly silty	45 (13.7)	85 (25.9)
	The thickness assigned to Units 1 and 2 is imprecise, and probably exaggerated because of crumpling and minor faulting.		
1	**Shale**: grey and brownish grey, calcareous, platy, partly silty; weathers mainly pale brown, but the silty, dolomitic beds weather brownish orange; the proportion of silty beds increases upward.	40 (12.2)	40 (12.2)

Abrupt, concordant contact.

CATHEDRAL FORMATION

Takakkaw Tongue
(uppermost 105 ft/32 m only)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Limestone: ribbon-bedded lime mudstone; moderately resistant, but less so than some underlying units of this formation	105 (32)	105 (32)

SECTION AC–164

Mount Henry

(lat. 52°57′22″N, long. 118°15′16″W)
(For access see Appendix C)

ARCTOMYS FORMATION
(613.5 ft/187 m)

The Arctomys Formation comprises recessive, yellow and red weathering strata above the drab, more resistant and prominently bedded strata of the Pika Formation. The contact here has a less distinctive topographic expression than elsewhere, because the upper Pika is unusually argillaceous and recessive weathering.

Section continues upward.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
3	**Shale, mudstone,** and **siltstone** As below, but grey to green, dolomitic mudstone is subequal to purple-red shale, and siltstone comprises 40 per cent, in subunits up to 10 ft (3 m) thick, as well as in isolated beds and lenses	75 (22.9)	227.5 (69.3)
2	**Shale, mudstone,** and **siltstone** Shale (dominant): mainly deep purple-red, less commonly pale green, fissile; the similarly coloured, nonfissile mudstone is dolomitic. Siltstone (15%): pale grey, weathering dull yellow; partly calcareous and dolomitic, partly vuggy, partly crosslaminated; occurs as isolated lenses and laminae and also as subunits up to 2 ft (60 cm) thick, thin and very thin bedded	149 (45.4)	152.5 (46.5)
1	**Siltstone**: grey, weathers pale brown; calcareous, dolomitic, laminated, platy; with mudcracks of "stacked saucers" type.	3.5 (1.1)	3.5 (1.1)

Gradational contact.

PIKA FORMATION
(446 ft/135.9 m)

The Pika Formation is more obviously bedded than the underlying Eldon, somewhat less resistant generally and, at the top, actually recessive. Its weathering colour is more brownish than that of the Eldon.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
24	**Mudstone** and **limestone** The unit comprises 60 per cent parting material – pale brownish grey, calcareous, dolomitic mudstone – with 40 per cent thin, discontinuous beds of lime mudstone. This is an unusually argillaceous phase of the parted lime mudstone lithofacies. The topmost 2.5 ft (80 cm) are silty and platy	28.5 (8.7)	446 (135.9)
23	Poorly exposed: recessive weathering **Mudstone** and **shale**: pale brown, weathering very pale brown; calcareous; abundant thin beds and lenses of lime mudstone, flat-pebble rudstone, and trilobite coquina. In the lower half, one medium bed of ooid grainstone/packstone. In the upper half, one medium bed of equant-pebble rudstone (rounded, pink pebbles)	21.5 (6.6)	417.5 (127.3)
	GSC loc. 75354 (loose material from 46.5 to 56.5 ft/14.2 to 17.2 m above the base) *Glyphaspis* sp.		

Unit 22 and those below it display the normal resistance, more or less, of the Pika Formation; that is, a cyclic alternation of resistant, relatively clean carbonate units and recessive weathering, argillaceous and shaly units. Units 23 and 24 are recessive weathering and, from a distance, are not easily distinguished from the overlying Arctomys Formation. This characteristic is seen only in the northernmost sections of the Pika dealt with in this study: Mount Henry, Chetamon Mountain, and Roche Miette.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
22	**Limestone** Subunits of two types alternate. The dominant subunits consist of parted lime mudstone, tending to lenticular and nodular bedding, with partings of very argillaceous dolomite grading to calcareous, dolomitic shale. The subordinate subunits are more normal, parted limestone that forms more resistant ribs. Two subunits of dark grey shale occur near the base	53.5 (16.3)	396 (120.7)
21	**Limestone**: fine ooid grainstone/packstone; very dolomitic; coarse grained at the top	6.5 (2)	342.5 (104.4)
20	**Limestone**: parted lime mudstone	26 (7.9)	336 (102.4)
19	**Limestone**: burrow-mottled lime mudstone	7 (2.1)	310 (94.5)
18	**Limestone**: parted lime mudstone; nodular at the base. Two subunits are less resistant weathering because the partings are more argillaceous	20 (6.1)	303 (92.4)
17	**Shale**: limestone nodules in shale (as below)	5 (1.5)	283 (86.3)
16	**Limestone**: parted lime mudstone; tending to nodular bedding. At the top, a 25 cm thick bed of dolomitic ooid grainstone/packstone, capped by a 15 cm thick, domal layer of thrombolitic limestone	12 (3.7)	278 (84.7)

Units 15 and 16 jointly form a shallowing-upward cycle of a kind that can be recognized, with variations, throughout the Pika Formation; e.g., see Units 12 to 14.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
15	**Shale**: lenses of microcrystalline limestone in grey shale (as below)	8.5 (2.6)	266 (81.1)
14	**Limestone**: mainly parted lime mudstone. Subunits of burrow-mottled lime mudstone occur in the top 10 ft (3 m)	55 (16.8)	257.5 (78.5)
13	**Limestone**: parted lime mudstone with unusually thick dolomitic partings; nonresistant	26 (7.9)	202.5 (61.7)
12	**Shale**: grey; as below	4.5 (1.4)	176.5 (53.8)
11	**Limestone**: parted lime mudstone; resistant. At the base, a 25 cm thick bed of ooid grainstone/packstone	21.5 (6.6)	172 (52.4)
10	**Limestone**: recessive weathering; lower half of the standard cycle; as Unit 8	7.5 (2.3)	150.5 (45.9)
9	**Limestone**: parted lime mudstone, grading upward into laminated, pale brown, dolomitic lime mudstone; cryptalgal laminite, or lagoonal deposit?	15 (4.6)	143 (43.6)
8	**Limestone**: thin, lenticular nodular beds of lime mudstone (as below) with partings of shale (as below)	10.5 (3.2)	128 (39)
7	**Shale** (Basal unit of standard cycle.): grey, splintery; upward, increasing proportions of thin lenticular beds of intraclast packstone (with a variable skeletal component) and minor, thin beds of flat-pebble rudstone	14 (4.3)	117.5 (35.8)
	GSC loc. 75353 (top 1 ft/30 cm) *Elrathia*? sp. *Glyphaspis* sp.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
6	**Limestone**: ooid grainstone (poorly sorted); very dolomitic, massive. Dolomitized part weathers orange	3.5 (1.1)	103.5 (31.5)
5	**Limestone**: parted lime mudstone; massive; becomes largely nodular at the top	11.5 (3.5)	100 (30.5)
4	**Dolomite**: cryptalgal laminite; calcareous, laminated; as Unit 18 of the Eldon, below; minor laminae of flakestone	29 (8.8)	88.5 (27)
3	**Limestone**: mainly burrow-mottled lime mudstone below, becoming parted lime mudstone above. Some intraclast packstone near the base. Locally laminated	41 (12.5)	59.5 (18.1)
2	**Limestone**: a mass of nodules up to 25 x 35 cm; these nodules are intraclast packstone/wackestone	17 (5.2)	18.5 (5.6)
1	**Limestone**: ooid grainstone/packstone; very dolomitic; abundant flat pebbles of the underlying dolomite, and scattered, medium-sized grains of quartz sand.	1.5 (0.5)	1.5 (0.5)
	Contact (?)erosional, concordant.		

ELDON FORMATION
(766 ft/233.5 m)

The Eldon Formation forms the thickest and most resistant rib crossing the ridge; it weathers pale grey.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
18	**Dolomite**: cryptalgal laminite, with laminae of flakestone; grey, weathers pale grey and orange-yellow; microcrystalline, calcareous. From 16 ft (4.9 m) above the base upward, dolomite is argillaceous and recessive weathering, with mudcracks	24 (7.3)	766 (233.5)
17	**Dolomite**: brownish grey, fine equicrystalline, partly with relict particulate texture. Alternately thin bedded, with darker partings, and mottled, nonbedded (alternation of ex-parted with ex-burrow-mottled lime mudstone)	68 (20.7)	742 (226.2)
16	**Dolomite**: as below, but nonlaminated, thick bedded; weathers various shades of orange. Local stromatactoid structure	64 (19.5)	674 (205.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	At this point, the line of section crosses a north-side-down fault dipping 35° north. The fault is geometrically a normal fault, but mechanically a reverse fault. Three different unit contacts, appropriately spaced, were located across the fault to provide a positive "tie".		
15	**Dolomite**: very pale brownish grey, weathers orange; fine crystalline, largely laminated, massive	10 (3)	610 (185.9)
14	**Dolomite**: as below, but very thick to medium bedded, obviously ex-burrow-mottled lime mudstone; weathers pale orange-brown	51 (15.5)	600 (182.9)
	The lower boundary is a crosscutting, replacement contact. Here, the relationship of dolomitization to structure (fracturing) is obvious.		
13	**Limestone**: parted lime mudstone; bedding style is that of the underlying dolomite; weathers grey	18 (5.5)	549 (167.3)
12	**Dolomite**: brownish grey to very pale brownish grey, lightly mottled with very dark grey, weathers dull orange; very fine equicrystalline, some intercrystalline porosity; very regularly thin bedded. Upper contact is gradational	20 (6.1)	531 (161.8)
11	**Dolomite**: fine crystalline; relict particulate texture is preserved as pale brown objects in a white matrix or former cement; bedded as below, massive	80 (24.4)	511 (155.8)
10	**Limestone**: pellet and intraclast packstone; regularly thin bedded, massive; thin stylolitic partings of brown weathering dolomite. In the top 15 ft (4.6 m), numerous 5 to 12 cm thick beds of intraclast and pellet grainstone. Some "intraclasts" display a faint, crude concentric structure (?oncoids). Upper boundary is a crosscutting, replacement contact	37 (11.3)	431 (131.4)
9	**Limestone**: seventy per cent is largely intraclast and pellet packstone: massive, with aligned mottling, weathering grey-brown. Thirty per cent consists of 5 to 10 cm thick sparry beds, as below. A very massive, very resistant unit, weathering pale grey overall	100 (30.5)	394 (120.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
8	**Limestone**: eighty per cent is intraclast and pellet grainstone, as below. Twenty per cent consists of flaggy beds, as below	13 (4)	294 (89.6)
7	**Limestone**: as below, but slightly thinner bedded and somewhat flaggy. Ten per cent well sorted pellet grainstone and poorly sorted pellet-intraclast grainstone, in beds 2.5 to 8 cm thick at the base, and up to 25 cm thick at the top. As usual, these particulate beds are less dolomitic than the lime mudstone beds	52 (15.8)	281 (85.6)
6	**Limestone**: parted lime mudstone as Unit 3. Forty-seven feet (14.3 m) above the base, a 20 cm thick, massive bed of intraclast-pellet grainstone occurs	89 (27.1)	229 (69.8)
5	**Limestone**: parted; as below. Thirty per cent of the unit comprises subunits containing thrombolite-like bodies, apparently of intraclast grainstone, which interrupt the thin bedding	28 (8.5)	140 (42.7)
4	**Limestone**: burrow-mottled lime mudstone	5.5 (1.7)	112 (34.1)
3	**Limestone**: as below, with brown weathering partings. A few beds, up to 10 cm thick, have "billowy" tops	35.5 (10.8)	106.5 (32.5)
2	**Limestone**: as below, with two subunits containing pillow-like masses, up to 3 ft (1 m) thick, that arise out of medium beds. On the basis of field examination, these appear to be ordinary lime mudstone	6 (1.8)	71 (21.6)
1	**Limestone**: parted lime mudstone; beds are uniformly thin (1 to 5 cm, with a mode of 2.5 cm), with irregular surfaces; thin, dolomitic partings, yellow weathering at the base, becoming brown weathering upward; well developed burrows and feeding traces. Unit is flaggy at the base, becoming massive upward.	65 (19.8)	65 (19.8)

SNAKE INDIAN FORMATION
(1944.5 ft/592.7 m)

The Snake Indian Formation is a formation of markedly ribbed aspect; an alternation of resistant, relatively pure carbonate members, and recessive weathering, argillaceous and shaly members.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
63	**Mudstone** (60%) and **limestone** (40%) Limestone: very thin, partly nodular beds of lime mudstone with laminae of trilobite coquina (sparry cement). Mudstone: occurs as "partings"; brownish grey, yellow-orange weathering, calcareous, dolomitic. A recessive weathering unit	18 (5.5)	1944.5 (592.7)
62	Poorly exposed **Shale:** deep olive green to grey-green, largely silty, splintery. Limestone, about 5 per cent thin beds of medium to coarse grained, skeletal grainstone, partly silicified. Minor very thin beds of brown weathering, calcareous siltstone. Three medium beds of rudstone. Unit is recessive weathering, and gradational into the overlying unit	166 (50.6)	1926.5 (587.2)
	GSC loc. 75352 (130 ft/39.6 m above the base) *Alokistocare* sp. *Kootenia* sp.		
61	**Limestone**: as Unit 59 (similarly including shale partings at the base). The top 3 ft (1 m) are largely silty	16 (4.9)	1760.5 (536.6)
60	**Shale** (50%) and **limestone** (50%) Shale: olive green below, pale grey above. Limestone: equant-pebble rudstones with green-coated upper surfaces are prominent. Thin beds of pale grey lime mudstone and coarse skeletal grainstone/packstone. Minor thin beds of burrowed, calcareous siltstone. The topmost bed is a 30 cm thick bed of rudstone, capped by 12 cm of very coarse grained, well sorted ooid grainstone	24 (7.3)	1744.5 (531.7)
59	**Limestone**: as Unit 56, but very weakly resistant, except at the top. The basal 6 ft (2 m) have partings of green shale. Just below the top a 7 to 12 cm thick bed of flat-pebble rudstone occurs	45.5 (13.9)	1720.5 (524.4)
58	**Limestone**: pebbly, medium grained ooid grainstone/packstone, resting on a rudstone base. The upper surface forms ripples with a relief of 5 to 7.5 cm and a wavelength of 30 cm	1.5 (0.5)	1675 (510.5)
57	**Shale** and **limestone** As Unit 55, but lacking rudstone. Rare, thin beds of silty calcisiltite	29 (8.8)	1673.5 (510.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
56	**Limestone**: mainly calciciltite; very thin bedded, with prominent partings of yellow weathering dolomite. Unit forms a distinct rib. Near the top, a layer of low-domal, 5 cm high thrombolites	11 (3.4)	1644.5 (501.2)
55	**Shale** and **limestone** Shale: deeply weathered, grey-green in part, with abundant nodules and thin lenticular beds of microcrystalline limestone. Twenty per cent of the unit comprises subunits, 0.5 to 2 ft (15 to 60 cm) thick, of parted lime mudstone. Five per cent consists of thin and medium beds of equant-pebble rudstone. One bed near the base carries carbonaceous, flattened (noncalcified) oncoids. Minor beds of mudstone: calcareous, greenish grey, yellow weathering. A recessive weathering unit	67 (20.4)	1633.5 (497.9)
54	**Limestone**: parted lime mudstone; beds 2.5 cm and less thick; prominent burrows and feeding traces. Unit is capped by a "billowy" layer of thrombolitic limestone, with a maximum thickness and relief of 15 cm	22 (6.7)	1566.5 (477.5)
53	**Shale**: dark grey, with limestone nodules	6 (1.8)	1544.5 (470.8)
52	**Limestone**: burrow-mottled lime mudstone; thin bedded, scattered trilobite fragments. Five feet (1.5 m) below the top, a 1 ft (30 cm) thick subunit of pellet grainstone occurs	44.5 (13.6)	1538.5 (468.9)
51	**Limestone**: burrow-mottled lime mudstone; massive; aligned dolomite mottling suggests thin bedding	17 (5.2)	1494 (455.4)
50	**Limestone**: as Unit 41; numerous indistinct, oncoid-like bodies	32.5 (9.9)	1477 (450.2)
	Unit 50 forms the base of the highest, major, resistant rib of the Snake Indian Formation (Units 50–52).		
49	Covered: recessive weathering	10 (3)	1444.5 (440.3)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
48	**Shale** with **limestone** nodules: as below; subunits of parted lime mudstone (shale partings) near the top. In the basal 12 ft (3.7 m) of the unit, a lower bed, 30 cm thick, and an upper bed, 15 cm thick, of oncoid wackestone/packstone. In the upper bed, some of the oncoids extend upward as columnar stromatolites 7.5 cm high	53 (16.2)	1434.5 (437.2)
47	**Limestone**: oncoid packstone, in two thick beds	3 (0.9)	1381.5 (421.1)
46	**Limestone**: lime mudstone, burrow-mottled below, parted above	11 (3.4)	1378.5 (420.2)
45	**Shale**: grey, splintery, deeply weathered, with abundant thin beds and nodules of dolomite-mottled lime mudstone. A few, very thin beds and laminae of trilobite coquina (fossils largely fragmented)	23 (7)	1367.5 (416.8)
	GSC loc. 75351 (17 ft/5.2 m above the base) *Ehmaniella*? sp. *Zacanthoides* sp.		
44	**Shale**: pale grey-green to olive-green, partly silty; minor thin lenses of calcareous siltstone. At the base, 2 ft (60 cm) of yellow-grey weathering, calcareous mudstone are overlain by a thin bed of equant-pebble rudstone	36 (11)	1344.5 (409.8)
43	**Limestone**: as Unit 41; becoming flaggy, with prominent partings, in the top 10 ft (3 m). The uppermost bed is flat-pebble rudstone, 10 to 15 cm thick. (Note repetition of the previous cycle.)	39 (11.9)	1308.5 (398.8)
42	**Limestone**: as below, but flaggy and recessive weathering. Base is fairly sharp, top gradational	13.5 (4.1)	1269.5 (386.9)
41	**Limestone**: lime mudstone; dolomitic; scattered intraclasts and skeletal grains; obscure thin bedding with dolomite partings; grades to non-bedded, with dolomite mottlings. This massive, grey weathering unit forms a second-order topographic rib	84 (25.6)	1256 (382.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
40	Poorly exposed: recessive weathering **Shale:** pale greenish grey and silty, grading to olive-green and non-silty; flaky; abundant lenses of micro-crystalline limestone in the upper and lower thirds. In the middle third, lenses of siltstone: grey, calcareous, laminated, with burrows	70.5 (21.5)	1172 (357.2)
39	Covered: recessive weathering	30 (9.1)	1101.5 (335.7)
38	**Limestone**: mottled and parted lime mudstone as below; middle part covered. Thickness approximate, because of surficial slumping. A small fossil collection was made from loose material in the middle of the unit	39.5 (12)	1071.5 (326.6)
	GSC loc. 75350 (about 19 to 24 ft/5.8 to 7.3 m above the base) *Amecephalus* sp. *Ehmaniella* sp.		
37	**Shale**: deeply weathered; abundant thin lenticular beds and lenses of lime mudstone with abundant burrows	14 (4.3)	1032 (314.6)
36	**Shale**: dark grey; as below. (Basal unit of another shallowing-upward, clearing-upward cycle like that of Units 34 and 35.)	9 (2.7)	1017 (310)
35	**Limestone**: parted lime mudstone; regularly thin bedded; partings are orange weathering below, dull yellow weathering above. Near the top, several beds of intraclast and dark-pellet grainstone. The uppermost 2.5 to 5 cm contain large (1.5 cm diameter) oncoids	39 (11.9)	1008 (307.2)
34	**Shale**: brownish grey, deeply weathered; abundant lenses and minor thin beds of trilobite wackestone/packstone; slightly argillaceous	51 (15.5)	969 (295.4)
33	**Limestone**: ooid and skeletal ooid grainstone/packstone; thin, irregular beds with partings of orange weathering dolomite	2.5 (0.8)	918 (279.8)
32	**Shale**: dark grey, splintery, weathering dark greenish grey; minor thin beds of trilobite packstone (coquina) and flat-pebble rudstone	10.5 (3.2)	915.5 (279)
31	**Limestone**: a continuous thrombolite mat with papillate surface and a few holes of irregular shape. Crescentic and ring shapes are common on the constructional surface. Pyrite nodules	2 (0.6)	905 (275.8)
30	**Limestone**: pale-pellet grainstone, with fenestrae; very thick to thin bedded, massive, weathering pale grey. Uppermost unit of a major rib, and final unit of a shallowing-upward cycle	42 (12.8)	903 (275.2)
29	**Limestone**: as Unit 27; mainly flaggy, slightly recessive weathering, with two minor, massive, resistant ribs; bedding fairly planar. Fossils collected from skeletal packstone	47 (14.3)	861 (262.4)
	GSC loc. 75349 (44 to 47 ft/13.4 to 14.3 m above the base) *Glossopleura* sp. *Kochina*? sp. cf. *Ptarmigania* sp. (pygidium only)		
	GSC loc. 75348 (29 to 31 ft/8.8 to 9.4 m) cf. *Nyella* sp. *Ehmaniella* sp. *Glossopleura* sp.		
28	**Limestone**: burrow-mottled lime mudstone; massive; dolomite mottling weathers brown, in contrast to the yellow-grey weathering seen below. Ten feet (3 m) above the base, a 1 ft (30 cm) thick subunit of thin bedded dark-pellet grainstone	21.5 (6.6)	814 (248.1)
27	**Limestone**: as below; in the lower half, alternating parted and burrow-mottled; in the upper half, entirely burrow-mottled and massive; indistinct oncoids scattered throughout	68 (20.7)	792.5 (241.6)
26	**Limestone**: two subunits of poorly organized, jumbled, spheroidal thrombolites ("heap of cabbages"). At the base, a 5 cm thick layer of oncoid packstone	4 (1.2)	724.5 (220.8)
25	**Limestone**: parted lime mudstone; in nodules and irregular, thin beds; partings of brownish grey, flaky shale	6 (1.8)	720 (219.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
24	**Limestone**: trilobite wackestone; dolomitic, patchily recrystallized; scattered intraclasts and indistinct oncoids (diameters of 5 mm and less). Unit is irregularly thin bedded, strongly dolomite-mottled; tending to flaggy	32 (9.8)	714.5 (217.8)
23	**Shale**: olive green, flaky; fracture surfaces smooth	7 (2.1)	682.5 (208)
22	**Limestone**: parted lime mudstone; capped by a bed of thin bedded oolite, 15 cm thick	5.5 (1.7)	675.5 (205.9)
21	**Shale**: olive-green, silty at the base. Rare thin beds of dolomitized trilobite coquina. Near the top, rare very thin beds of lime mudstone and abundant thin lenses of siltstone	72 (21.9)	670 (204.2)
20	**Limestone**: parted lime mudstone (mainly calcisiltite); planar and lenticular, thin and very thin bedded. Minor thin beds of flat-pebble rudstone. Partly silty. Bedding surfaces with well developed burrows and feeding traces are common	63 (19.2)	598 (182.3)
	GSC loc. 75347 (15 ft/4.6 m above the base) *Paralbertella levis*? Walcott, 1917 *Albertella* sp. cf. *Albertella* sp.		
19	**Limestone**: parted lime mudstone; 20 per cent thin and medium beds of fine and medium grained ooid grainstone/packstone. The oolite bed at the top is 30 cm thick	19.5 (5.9)	535 (163.1)
18	**Limestone** and **shale** Nodules of microcrystalline limestone in weathered shale, grading upward to parted lime mudstone at the top	26 (7.9)	515.5 (157.1)
17	**Limestone, siltstone,** and **shale** A lower, 20 cm thick bed of coarse trilobite packstone/grainstone (fossils not collectable), and an upper, 45 cm thick bed of equant-pebble rudstone, separated by interbedded green siltstone and shale, as below	5.5 (1.7)	489.5 (149.2)
16	**Limestone**: parted lime mudstone; partings are silty and micaceous	11 (3.4)	484 (147.5)
15	**Siltstone, shale, limestone,** and **sandstone** Mainly thinly, lenticularly interbedded siltstone: grey, greenish grey, calcareous, and crosslaminated, and shale: pale green, micaceous; burrows and ripple marks are common. Twenty per cent thin beds of limestone and derived dolomite: as below, partly silty. Ten per cent sandstone: grey, pink, fine grained, glauconitic, in thin bedded subunits 1 to 2 ft (30 to 60 cm) thick. Unit contains three purple-red bands. In the middle of the unit, one medium bed of dolomite: calcareous, ex-skeletal ooid grainstone/packstone, coarse grained	98 (29.9)	473 (144.2)
14	**Limestone**: parted lime mudstone, mainly calcisiltite	30 (9.1)	375 (114.3)
13	**Shale**: greyish green and greenish grey, partly calcareous, platy, partly noncalcareous, flaky. Thin beds of crosslaminated, pale greyish green, calcareous siltstone increase upward to predominate in the uppermost 15 ft (4.6 m)	48 (14.6)	345 (105.2)
12	**Sandstone**: pale pink, yellow, purple-red, weathers dull greyish orange; mainly dolomitic; thin and medium bedded, laminated, with partings of purple mudstone; oscillation ripple marks and runzel marks	10 (3)	297 (90.5)
11	**Mudstone/shale** (90%) and **limestone** (10%) Mudstone/shale: purple; as below. Limestone: thin beds and minor subunits; thin bedded, very fine crystalline, and dolomite: pale grey, very fine crystalline, calcareous, yellow weathering. Mudcracks throughout; runzel marks	75 (22.9)	287 (87.5)
10	**Limestone** (70%) and **mudstone** (30%) Limestone: mainly pale grey calcisiltite; thin bedded, with hairline partings. One thick bed of coarse, sandy, flat-pebble conglomerate. Mudstone: pale greyish green to deep purple-red, soft, very calcareous, grading to very argillaceous limestone. Mudcracks and ripple marks are prominent	40 (12.2)	212 (64.6)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	**Limestone**: parted limestone, as below; partly massive, partly flaggy; rare beds are silty, laminated. Minor flat-pebble rudstone. Ripple marks are prominent, especially near the top	43 (13.1)	172 (52.4)
8	**Shale** and **limestone** (interbedded) Shale: pale purple below, green above, calcareous, grading to argillaceous limestone. Limestone: pale grey, very fine crystalline, with scattered trilobite and brachiopod fragments; medium bedded; partly equant-pebble rudstone that is partly green from albite/chlorite replacement. Purple shale is mudcracked	5.5 (1.7)	129 (39.3)
	GSC loc. 75346 (3 ft/1 m above the base) inarticulate brachiopod		
7	**Dolomite**: cryptalgal laminite; pale grey, orange weathering; very fine crystalline, massive	6.5 (2)	123.5 (37.6)
6	**Limestone**: parted lime mudstone; partings are pale green mudstone and pale green, argillaceous limestone. A subunit making up half of the unit, and situated in the middle of the unit, is massive, laminated calcisiltite, with polygonal mudcracks at several levels	10.5 (3.2)	117 (35.7)
5	**Limestone**: parted lime mudstone, mainly calcisiltite; in thin and very thin, partly lenticular, partly crosslaminated beds. Near the base, a 1 ft (30 cm) thick interval of slumped material	35.5 (10.8)	106.5 (32.5)
	GSC loc. 75345 (2 ft/60 cm above the base) *Amecephalus* sp. cf. *Dolichometopsis*? sp. *Plagiura* sp.		
4	**Mudstone** and **limestone** At the base, mudstone: pale green, calcareous. Two feet (60 cm) above the base, lenses of limestone appear; upward gradation into parted lime mudstone, with partings of the same mudstone. Near the base, two medium beds of limestone: grey, very fine crystalline, massive. A recessive weathering unit	29.5 (9)	71 (21.6)

Weed Member
(?41.5 ft/?12.6 m)
(Units 1 to ?3)

The Weed Member is represented here by its characteristic, distinctive rock type. The same rock type recurs repeatedly to much higher levels, however, above units of limestone; thus, the problem is that of choosing an upper contact.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
3	**Sandstone** and **shale** (interbedded) As the upper part of Unit 1, but the shale is in part greyish purple. Several thin beds of conglomerate (as below), and several thin beds of glauconitic, coarse, partly silicified trilobite grainstone/packstone. Unit weathers moderately recessive	3 (0.9)	41.5 (12.6)
2	**Sandstone**: greenish grey, fine grained, glauconitic, thick bedded, resistant	5.5 (1.7)	38.5 (11.7)
1	**Sandstone** and **shale** At the base, entirely sandstone: grey, very fine grained, calcareous, very finely and evenly laminated, platy, with abundant burrows at some levels. Upward, partings of green shale appear, thickening upward to interbeds. At this higher level, the sandstone is partly green and glauconitic, with prominent burrows. Minor flat-pebble conglomerate (sandstone pebbles in a matrix of trilobite grainstone/packstone).	33 (10.1)	33 (10.1)

GOG GROUP

PEYTO FORMATION
(84 ft/25.6 m)

The Peyto Formation is the lowest, conspicuous carbonate interval in the section. The predominantly yellow weathering Peyto is in conspicuous contrast to the dark-appearing, lichen covered sandstone and quartzite beneath. It does not form a resistant rib, as do the carbonate units above the Weed Member, and is topographically neutral.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
14	**Limestone**: as Unit 10	4 (1.2)	84 (25.6)
13	**Dolomite**: as Unit 11, but mainly well laminated	9.5 (2.9)	80 (24.4)
12	**Shale**: pale grey, yellow weathering, dolomitic, recessive	5.5 (1.7)	70.5 (21.5)
11	**Dolomite**: yellow-grey, weathering pale orange; very fine crystalline, indistinct mottling and irregular lamination, massive	4.5 (1.4)	65 (19.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Limestone**: intraclast grainstone; dark grey, fine to medium grained with dolomitized allochems. A single, massive, lenticular bed, very vuggy in the bottom half	2.5 (0.8)	60.5 (18.4)
9	**Dolomite**: grey, weathering pale yellow-grey; very fine crystalline partly planar (cryptalgalaminate), with a layer of domal, LLH stromatolites in the middle	11 (3.4)	58 (17.7)
8	**Limestone**: lime mudstone; partly non-bedded, partly thin bedded with strongly "invading" partings of microcrystalline, pale brown weathering dolomite; massive; large (1 cm) feeding traces are widespread. Basal, 20 cm thick bed contains columnar algal stromatolites, 7.5 cm high	12 (3.7)	47 (14.3)
7	**Shale** and **siltstone** Shale: pale brown. Siltstone: dolomitic, thin bedded, yellow weathering	1 (0.3)	35 (10.7)
6	**Sandstone**: pink, medium grained, with scattered pebbles of dolomite; a single, massive, thin bedded unit	5.5 (1.7)	34 (10.4)
	Erosional contact. At the contact is a red stained, dolomite-pebble conglomerate, invaded from above by sandstone.		
5	**Dolomite**: grey, very fine crystalline, thick bedded, massive, with indistinct, crenulate (cryptalgalaminate) laminae	4.5 (1.4)	28.5 (8.7)
4	Covered: recessive weathering	10 (3)	24 (7.3)
3	**Sandstone**: grey, dull orange weathering; very dolomitic, medium grained, thin bedded	6 (1.8)	14 (4.3)
2	**Quartzite**: as below; a single bed	2.5 (0.8)	8 (2.4)
1	**Dolomite**: dark grey, weathering orange-brown; microcrystalline, silty and sandy. At the base, medium bedded and very sandy, becoming thin bedded and silty upward. Two beds contain poorly preserved algal stromatolites.	5.5 (1.7)	5.5 (1.7)
	Contact concealed.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	SUB-PEYTO STRATA		
4	**Quartzite** (85%), and **sandstone** and **shale** (15%) Quartzite: nearly white, mainly medium grained, minor fine grained, well sorted; thick and very thick beds displaying large-scale, tangential crossbedding.		
	Subunits of shale and sandstone: as below; increasing in proportion upward	60 (18.3)	133 (40.5)
3	**Sandstone**: white and nearly white, mainly fine grained, with subordinate secondary modes of medium and coarse grains; some beds are unimodal, well sorted, fine and medium grained; thick and medium, planar bedded	27 (8.2)	73 (22.3)
2	**Sandstone** (80%) and **shale** (20%) Sandstone: pale grey to white, quartzose, fine grained, well sorted, commonly with brown carbonate (siderite?) mottling; thin to thick bedded. Shale: dark grey, flaky, micaceous, as interbeds between burrowed, thin sandstone beds	17 (5.2)	46 (14)
1	**Quartzite**: pale grey to nearly white, fine and medium grained, well sorted, thin and medium planar bedded.	29 (8.8)	29 (8.8)
	Well exposed section continues downward.		

SECTIONS AC-165/166

Cinnamon Peak-Whitehorn Mountain, Mount Robson District

(Base: lat. 53°05′42″N, long. 119°16′33″W)
(Top: lat. 53°07′34″N, long. 119°16′13″W)
(For access see Appendix C)

The problem encountered in describing this splendidly exposed section is that of establishing a tie between the lower part of the section, passing through Cinnamon Peak, and the upper part, which forms the south-facing, lower cliffs of Whitehorn Mountain. This was achieved by identifying the top of a major, resistant member of limestone, 2190 ft (667.5 m) above the base of the Chetang Formation, in both the lower and upper parts of the section. The tie on lithology is supported by the topographic expression of the marker unit in both parts and by tracing the well expressed bedding on aerial photographs. The lower part of the section (AC-165) is vertical to overturned. The strata of the upper part are upright and gently dipping to almost flat-lying.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base

Numerous fossils (locality numbers prefixed by "87" were collected and identified by W.H. Fritz in the course of an independent measurement of the lower half of this section. His measurement and my own match well, and it is possible to place Fritz's collections, to a close approximation, in my section description.

SECTION AC-166

LYNX FORMATION
(Waterfowl Formation equivalent)
(not measured)

At Whitehorn Mountain, the Arctomys Formation, which is well developed at Mount Robson 4.5 miles (7.25 km) to the east, has undergone a facies change to rocks characteristic of the Waterfowl Formation, which overlies the Arctomys elsewhere. Because a delimitable Sullivan Formation is not present to define the top of the Waterfowl equivalents, the entire post-Pika, Cambrian succession here is appropriately assigned to the Lynx Formation. The Lynx is much more prominently bedded than the rocks beneath it, has a more ledgy topographic expression, and more varied weathered colours.

Immediately overlying beds:

Limestone: white, microcrystalline, laminated, with thin partings of green-grey clay between laminae. Mudcracks of "stacked saucers" type occur throughout. The basal unit weathers very pale yellow-grey. A little higher is **dolomite:** microcrystalline, laminated, orange weathering; and minor subunits of **mudstone:** very pale green, very calcareous. Higher, laminated dolomite alternates with pale greyish green, dolomitic mudstone. The lowest, grey weathering, resistant rib occurs an estimated 100 ft (30 m) above the base; it consists of cryptalgal laminite and flakestone, in both calcitic and dolomitic preservation.

ELDON AND PIKA FORMATIONS
(undifferentiated)
(2748.5 ft/837.7 m)

Upon close examination of the section, a boundary between the Eldon and Pika formations can be identified. This can be regarded, however, as a mappable boundary only for much more detailed mapping than any yet done in the area. Accordingly, the equivalents of the Eldon and Pika formations here are best treated jointly as the Eldon–Pika, undifferentiated.

Pika Formation Equivalent
(1253 ft/381.9 m)
(Units 10 to 38)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
38	**Limestone**: parted lime mudstone; at the base, thin and medium bedded, grading upward through thin and very thin bedded to interlaminated limestone and dolomite at the top; mudcracks occur in the top 1 ft (0.3 m)	28.5 (8.7)	2748.5 (837.7)
37	**Limestone**: parted limestone with beds of intraclast grainstone, as below	29 (8.8)	2720 (829.1)
36	**Limestone**: ooid grainstone/packstone; mostly very coarse grained, thick bedded, massive; ooids are distorted. At the base, a layer of widely spaced thrombolites, 15 to 20 cm in height	6 (1.8)	2691 (820.2)
35	**Limestone**: parted lime mudstone; very thin bedded and nodular bedded, with 30 to 40 per cent orange weathering, dolomitic partings. Five to ten per cent thin beds of intraclast grainstone; rare thin beds of trilobite coquina. Thirty-nine feet (11.9 m) below the top, a 15 cm thick bed of very dolomitic ooid grainstone/packstone occurs. Minor subunits (in the basal quarter only) have partings of brownish grey, calcareous, dolomitic mudstone, grading to grey, calcareous slate	291 (88.7)	2685 (818.4)
	GSC loc. 75364 (108 ft/32.9 m above the base) cf. *Americare* or *Glyphaspis* sp. *Kootenia* sp. *Modocia*? sp. (incomplete pygidium)		
34	Snow covered A persistent, recessive weathering unit. To the west, along the bedding, the unit appears to be parted limestone (as below)	87 (26.5)	2394 (729.7)
	The top of Unit 33 is deformed into folds of 6 m amplitude.		
33	**Dolomite** and **limestone** Alternating, thick subunits of dolomite and limestone. Seventy per cent cryptalgal laminite, as dolomite and interlaminated dolomite and limestone, with thin beds of lime mudstone interspersed; beds and laminae of flakestone (mat-chip breccia) are common. Twenty per cent thick, massive beds of fenestral lime mudstone, commonly with flakes of dolomite. Ten per cent medium and thick beds of dolomitic intraclast packstone/wackestone, and distinctive beds with sparse chips of laminated dolomite "floating" in a lime mudstone matrix	64 (19.5)	2307 (703.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
32	**Limestone**: as Unit 29, but thin to thick beds of intraclast packstone/grainstone are common. This unit is the uppermost in a package of units forming a grey, uniform-appearing cliff	75 (22.9)	2243 (683.7)
31	**Limestone**: intraclast grainstone; non-bedded	7 (2.1)	2168 (660.8)
30	**Limestone**: burrow-mottled lime mudstone	15 (4.6)	2161 (658.7)
29	**Limestone**: parted lime mudstone; many beds have coarse-pustulate or small domal tops. Upward, the unit acquires minor medium and thick beds, chiefly of intraclast packstone	183 (55.8)	2146 (654.1)
28	**Limestone**: intraclast and pellet packstone; mainly very thick bedded, dolomite-mottled; partly irregularly thin bedded with dolomite partings; weathers dark grey, massive, a strong cliff former. The basal unit of a grey, uniform-appearing cliff extending upward to include Unit 32	23 (7)	1963 (598.3)
27	**Mudstone**: as Unit 19	9 (2.7)	1940 (591.3)
	Unit 27 is the uppermost of a package of units comprising a prominently striped member.		
26	**Dolomite** and **limestone** Cryptalgal laminite; as dolomite and interlaminated limestone and dolomite, as below	7.5 (2.3)	1931 (588.6)
25	**Limestone**: mainly intraclast packstone and grainstone below, mainly parted lime mudstone in the upper half; thin bedded; the dolomite partings weather dull greyish yellow	13.5 (4.1)	1923.5 (586.3)
24	**Dolomite** (50%) and **limestone** (50%) (alternating subunits) Dolomite: cryptalgal laminite; weathering very pale yellow-grey, as below. Limestone: fenestral lime mudstone in thin and medium beds	20 (6.1)	1910 (552.2)
23	**Limestone**: fenestral lime mudstone; clotted texture; mostly very thick bedded, partly indistinctly thin bedded; weathers dark grey, massive	12 (3.7)	1890 (576.1)
22	Snow covered: recessive weathering	52 (15.8)	1878 (572.4)
21	**Limestone**: parted lime mudstone; irregularly thin bedded, with dull greyish yellow weathering partings, massive. Becomes partly laminated upward. Fenestrae in the top 6 ft (1.8 m)	46 (14)	1826 (556.6)
20	**Limestone**: ooid grainstone/packstone; dark grey, medium grained, massive; scattered oncoids at the top	5 (1.5)	1780 (542.5)
19	**Mudstone**: brownish grey, calcareous and dolomitic, grading to argillaceous, microcrystalline dolomite; partly laminated, partly pebbly; weathers dull orange. Minor subunits of thin beds and nodules of microcrystalline limestone, increasing upward to predominate at the top	26.5 (8.1)	1775 (541)
18	**Dolomite** and **limestone** Alternating subunits of cryptalgal laminite (dolomitic and calcitic preservation), and fenestral, pale-pellet grainstone; medium and thick bedded. Minor subunits of parted lime mudstone	33.5 (10.2)	1748.5 (532.9)
17	**Dolomite**: grey, weathering pale orange; microcrystalline, massive; partly has faint cryptalgal lamination, partly carries intraclasts, but is mostly featureless	5 (1.5)	1715 (522.7)
16	**Dolomite** (50%) and **limestone** (50%) Alternating, 3 to 10 ft (1 to 3 m) thick subunits of dolomite and limestone. Dolomite: cryptalgal laminite, with minor laminae and thin beds of lime mudstone; very pale grey, weathering very pale yellow-grey; microcrystalline, calcareous. Limestone: lime mudstone; dark grey, clotted, with fenestrae of white calcite and dolomite; massive. At the top, LLH stomatolites 5 cm high	36.5 (11.1)	1710 (521.2)
15	**Limestone**: fine grained intraclast packstone and grainstone, and dolomitic lime mudstone; thin and medium bedded, massive, weathering pale grey	30.5 (9.3)	1673.5 (510.1)
14	**Limestone**: as Unit 12, but the mottling is subdued; pale yellow-grey weathering	23 (7)	1643 (500.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
13	**Limestone**: parted lime mudstone; nodular very thin bedded, massive. One 18 cm-thick bed of coarse intraclast grainstone in the middle	8 (2.4)	1620 (493.8)
12	**Limestone**: burrow-mottled lime mudstone, tending to nodular; massive, becomes nodular thin bedded upward. Rare thin beds of grey, calcareous mudstone. A 30 cm thick bed of fine ooid grainstone/packstone occurs 7 ft (2.1 m) above the base	54.5 (16.6)	1612 (491.3)
11	**Limestone**: intraclast packstone and grainstone; massive, strongly dolomite-mottled. Oncoids 4 to 5 mm in diameter are common in the top 4 ft (1.2 m)	37.5 (11.4)	1557.5 (474.7)
10	**Limestone** and **dolomite** (interlaminated) Cryptalgal laminite; limestone becomes predominant upward; thin beds and laminae of flakestone (mat-chip breccia); scattered ooids occur within the cryptalgal laminae.	24.5 (7.5)	1520 (463.3)

PIKA FORMATION EQUIVALENT
(1495.5 ft/455.8 m)
(Units 1 to 9)

The base of Unit 10 is the most obvious contact within the "Titkana Formation" at this locality and, given the lack of marked contrast between Eldon and Pika equivalents here, is taken as the Eldon–Pika contact.

At this level, the line of section was offset westward about 1.5 miles (2 km), from the ridge descending toward Kinney Lake to a line ascending straight uphill toward the peak of Whitehorn Mountain. The base of Unit 10 is easily recognizable (as are several other unit boundaries) at the new line.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
9	**Limestone**: lime mudstone; massive, "stirred-looking". In the upper half, many "floating" chips of dolomite like that of Unit 10	1.5 (0.5)	1495.5 (455.8)
8	**Limestone**: ooid grainstone/packstone; fine grained, laminated and cross-laminated in thin sets, thick bedded, massive, very uniform, grey weathering	19 (5.8)	1494 (455.4)
7	**Limestone**: (?)calcisiltite; grey, dolomitic; mainly lenticular medium bedded, minor thin bedded. Local scour-and-fill, but pebbles are rare. One channel, 20 cm deep contains a concentration of trilobite fragments (uncollectable). Unit weathers grey	64 (19.5)	1475 (449.6)
6	**Limestone**: as below, but predominantly thin bedded, flaggy; bedding thickens upward to include minor medium beds, and becomes irregular instead of planar. Rare beds with dwelling burrows. A medium bed of intraclast packstone, 67 ft (20.4 m) below the top, contains a few, indeterminate fossil fragments – the first seen since the top of the Tatei Formation. Such particulate beds are common in the uppermost 67 ft (20.4 m)	329 (100.3)	1411 (430.1)
5	**Limestone** and **dolomite** (finely interlaminated) Ribbon-bedded lime mudstone lithofacies. Dark grey, microcrystalline limestone and dolomite, flaggy to platy, forming hard, "ringing" slabs. The percentage of dolomite varies widely, but is everywhere less than 25 per cent. This unit is truly – and originally – unfossiliferous; in all the hectares of bedding surfaces examined, only one trilobite fragment was seen. A few bedding planes carry millimetre-scale, wormlike objects – coprolites? Immediately above the base, a 2 ft (60 cm) thick, lenticular subunit with highly disturbed, slumped bedding. Thin intervals of slumped material recur throughout the unit at intervals of 50 to 100 ft (15 to 30 m)	469 (143)	1082 (329.8)
4	**Limestone**: argillaceous lime mudstone; very dark grey, weathering very dark grey; thin bedded, laminated, flaggy, recessive	53 (16.2)	613 (186.8)
3	**Limestone**: burrow-mottled lime mudstone; thin bedding suggested by aligned mottling; massive, locally flaggy where deeply weathered	168 (51.2)	560 (170.7)
2	**Limestone**: as below, but in thin and minor medium beds, with partings thinner than below; rare beds of rudstone; massive in cliff exposures, flaggy on the ridge. The unit forms an impressive, grey weathering cliff	306 (93.3)	392 (119.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Limestone**: parted lime mudstone; very thin bedded, with prominent partings of argillaceous dolomite; becoming thin bedded and increasingly resistant upward.	86 (26.2)	86 (26.2)

Conformable contact.

(?)TATEI FORMATION
(189 ft/57.6 m)

The Tatei Formation supports a marked, recessive weathering bench, largely covered with brownish grey weathered talus. The thickness attributed to the formation is imprecise, because of awkward outcrop geometry and poor exposure.

The lithological aspect of the formation is that of the Waputik Member of the correlative Stephen Formation; the equivalent of the Narao Member is to be sought in the upper part of the underlying Chetang Formation.

2	**Slate**: dark grey, weathering pale grey; very calcareous, thin bedded, grading upward into argillaceous limestone about 14 ft (4.3 m) above the base, and to parted lime mudstone about 28 ft (8.5 m) above the base	28 (8.5)	189 (57.6)
1	Poorly exposed: recessive weathering **Mudstone** and **limestone**. Five shallowing-upward cycles, each beginning with grey slate or mudstone: calcareous, weathering partly pale grey, partly pale brown; generally with nodules of microcrystalline limestone, in subunits 5 to 25 ft (1.5 to 7.6 m) thick, grading upward to parted lime mudstone, in subunits 4 to 20 ft (1.2 to 6.1 m) thick. Minor, churned-appearing subunits of intraclast packstone. The cycle ending 45 ft (13.7 m) above the base has several thin beds of ooid grainstone/packstone at the top.	161 (49.1)	161 (49.1)

Contact concordant, poorly exposed, (?)conformable.

CHETANG AND (?)TATEI FORMATIONS
(3765 ft/1147.6 m)

The Chetang Formation comprises a great thickness of mainly carbonate strata, interrupted by minor, thin units of mudrocks. Although the formation is a resistant feature-former overall, it includes a number of relatively recessive weathering units of both carbonates and mudrocks.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
71	**Limestone**: as below, but very thin to medium bedded, less flaggy, moderately resistant; thin beds of flat-pebble rudstone, and equant-pebble rudstone with embayed pebbles, are common. Nodular thin bedding appears locally	149 (45.4)	3765 (1147.6)
70	**Limestone**: parted lime mudstone; irregularly very thin bedded, with prominent, orange weathering, dolomitic partings; weathers flaggy, slightly recessive. Rare thin beds of flat-pebble rudstone with sparry cement. Eight feet (2.4 m) above the base, a 25 cm-thick bed of ooid grainstone/packstone occurs	55.5 (16.9)	3616 (1102.2)
69	**Limestone**: parted lime mudstone; very crudely thin bedded; massive. Ill-defined thrombolitic masses occur at three levels	30.5 (9.3)	3560.5 (1085.2)
68	**Limestone**: as Unit 66	20 (6.1)	3530 (1075.9)
67	**Limestone**: three beds of coarse ooid grainstone/packstone, with minor beds of parted limestone	4 (1.2)	3510 (1069.8)
66	**Limestone**: parted lime mudstone, mainly calcisiltite; lenticularly very thin bedded, with prominent, pale orange weathering partings; mainly massive. Twenty per cent thin and medium beds of flat-pebble rudstone	209 (63.7)	3506 (1068.6)
65	**Limestone**: parted lime mudstone, in part calcisiltite, as above. Thin beds and lenses of flat-pebble rudstone are common	49 (14.9)	3297 (1004.9)
64	Covered: recessive weathering	7.5 (2.3)	3248 (990)
63	**Limestone**: parted lime mudstone, mainly calcisiltite; very thin bedded, flaggy, with orange to yellow weathering partings. Beds of flat-pebble rudstone are minor and thin at the base, but become prominent thin and medium beds above 53 ft (16.2 m). Seventy-four feet (22.6 m) above the base, a 20 cm thick layer of low-domal thrombolites occurs. A 30 cm thick bed of ooid grainstone/packstone, capped by low-domal thrombolites, occurs 103 ft (31.4 m) above the base. A 45 cm thick bed of similar oolite occurs 122 ft (37.2 m) above the base	153.5 (46.8)	3240.5 (987.7)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
62	**Limestone**: parted lime mudstone; irregularly thin and very thin bedded, partly lenticular bedded; the dolomite partings are strongly developed in most of the unit. Mainly flaggy, locally massive	60 (18.3)	3087 (940.9)
61	**Limestone**: burrow-mottled lime mudstone; massive (flaggy where deeply weathered)	19 (5.8)	3027 (922.6)
60	**Limestone**: as Unit 57; very rare, thin and medium beds of intraclast grainstone; partings decrease in thickness upward	171 (52.1)	3008 (916.8)
59	**Limestone**: intraclast (?)grainstone/packstone; very fine grained, laminated and crosslaminated, very thin to medium bedded, with dolomitic partings (as below). Ten per cent medium and rare thick beds of pellet grainstone. This unit continues the underlying, grey weathering cliff	38 (11.6)	2837 (864.7)
58	**Limestone**: as below, but the partings are more prominent, weathering dull orange; flaggy, continuously cliff forming. Above 36 ft (11 m), grades back to limestone as Unit 57. Two slump structures occur in the top 6 ft (2 m)	75 (22.9)	2799 (853.1)
57	**Limestone**: ribbon-bedded (?)lime mudstone; irregularly, partly lenticularly thin bedded, with thin, laminated dolomite partings, weathering dull yellow; massive, partly flaggy; cliff forming	78 (23.8)	2724 (830.3)
56	Covered: recessive weathering	50 (15.2)	2646 (806.5)
55	**Limestone**: lime mudstone; irregularly very thin bedded, with partings mainly of mudstone (as below), but minor partings of orange weathering dolomite (as above)	12.5 (3.8)	2596 (791.3)
54	**Mudstone**: pale orange-grey, calcareous, massive, slightly slaty. Several thin beds of lime mudstone and, at the top, one of ooid grainstone/packstone (ooids tectonically elongated). Unit does not indent the profile of the cliff	8 (2.4)	2583.5 (787.4)
53	**Limestone**: alternating subunits of two different limestone types. Fifty per cent limestone, as below; and 50 per cent limestone: grey, microcrystalline, laminated, yellow weathering. Laminae are tectonically crumpled	16 (4.9)	2575.5 (785)
52	**Limestone**: parted lime mudstone; at the base, very thin to medium bedded, with irregular, discontinuous partings of dolomite, becoming irregularly medium bedded upward. Unit forms the base of a major cliff	31.5 (9.6)	2559.5 (780.1)
51	**Limestone**: as Unit 47. In the basal 3 ft (1 m), the partings are slate	24 (7.3)	2528 (770.5)
50	**Slate**: as below, with several thin beds of lime mudstone	2 (0.6)	2504 (763.2)
49	**Limestone**: as Unit 47. At the base, the partings are of slate (as below), grading upward over a few feet into orange weathering dolomite	7 (2.1)	2502 (762.6)
48	**Slate**: medium grey, weathering medium grey with a local green tinge; strong pencil structure, reflective of cryptic thin bedding. At the top, interbeds of limestone (as below) appear, in a gradation into the overlying unit. Slightly recessive	9.5 (2.9)	2495 (760.5)
47	**Limestone**: parted lime mudstone; mainly very thin bedded, partly nodular thin bedded; partings (30%) are dolomite: yellow-grey, weathering dull orange to pale orange-brown, microcrystalline, and argillaceous. Viewed from a distance, the unit appears pale brown and ledgy	49.5 (15.1)	2485.5 (757.6)

Units 47 to 51 form a relatively recessive weathering member.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
46	**Dolomite** and **limestone** Cryptalgal laminite, preserved as interlaminated, microcrystalline limestone and dolomite, and as yellow weathering, microcrystalline dolomite. The characteristic, wavy primary form of the cryptalgal laminae is intensified by tectonic crumpling. Top unit of a major cliff	15 (4.6)	2436 (742.5)
45	**Limestone**: lime mudstone; dolomitic, indistinctly thin bedded, with prominent, undulose, internal lamination; discontinuous partings of dolomite. A massive, cliff forming unit	50 (15.2)	2421 (737.9)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
44	**Limestone**: as Unit 42	51 (15.5)	2371 (722.7)
43	**Limestone**: parted lime mudstone; dark, very thin and nodular thin bedded, with 40 to 50 per cent partings of dark grey, grey weathering, argillaceous dolomite or dolomitic mudstone. Base of the unit forms a step in the cliff	9 (2.7)	2320 (707.1)
42	**Limestone**: as below, but massive; partings thin; intensively burrowed and organically figured surfaces continue	34 (10.4)	2311 (704.4)
41	**Limestone**: as below, but irregularly thin bedded, flaggy, cliff forming; dolomitized burrows and feeding traces are common, dolomitized intraclasts rare	68 (20.7)	2277 (694)
40	**Limestone**: parted lime mudstone; argillaceous, dolomitic, nodular thin bedded, with prominent dolomite partings; recessive weathering	19 (5.8)	2209 (673.3)

SECTION AC-165

(See introduction to Section 165/166. Measured downward because of vertical to overturned bedding; units were re-numbered into upward sequence.)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
39	**Limestone**: burrow-mottled lime mudstone; aligned mottling outlines thin bedding; fabric is crushed and recrystallized, with local suggestions of a particulate texture. In the top 10 ft (3 m), thin and medium beds of intraclast grainstone are prominent. The unit is massive, except for the uppermost 5 ft (1.5 m) and the basal 10 ft (3 m), which are thin bedded and flaggy. Minor, coarse intraclast grainstone 185 ft (56.4 m) below the top. Unit 39 forms the upper part of a major, bipartite grey cliff, the lowest such in the Middle Cambrian here	199.5 (60.8)	2190 (667.5)
38	**Limestone**: parted lime mudstone; regularly thin bedded, with thin (mainly 1 to 5 mm) partings of yellow weathering dolomite; feeding traces are prominent. Unit is massive in these exposures	55.5 (16.9)	1990.5 (606.7)
	Gradational contact		
37	**Limestone**: parted lime mudstone; dark brown, with 40 to 60 per cent orange weathering partings of dolomite; honeycomb weathering. Unit weathers orange-brown overall	19 (5.8)	1935 (589.8)
	Gradational contact		
36	**Limestone**: parted lime mudstone; irregularly bounded, thin and medium beds. Rare beds have a blurred, very finely particulate texture. From 86 ft (26.2 m) below the top downward, the unit becomes very regularly thin bedded and, near the base, largely very thin bedded	173 (52.7)	1916 (584)
	Gradational contact		
35	**Mudstone**: dark grey, weathering greyish orange; calcareous and dolomitic, flaggy to massive; very similar to the usual parting material of the parted lime mudstone facies. Thin beds and lenses of lime mudstone form 10 per cent of the unit at the top, diminishing downward where the mudstone becomes partly platy and shaly. Very rare laminae of skeletal debris. Near the base, one or more surfaces are littered with eocrinoid remains, forming balls about 2 cm in diameter	39.5 (12)	1743 (531.3)
34	**Limestone**: intraclast and pellet packstone; mottled with dark brownish grey weathering dolomite; thin and medium bedded, mainly massive, with dolomite partings at the top. Unit is resistant, and weathers pale grey	35.5 (10.8)	1703.5 (519.2)
33	**Limestone**: as Unit 36. Near the base, nearly spherical objects of dolomite are common – dolomitized oncoids? Minor, spar-filled dwelling burrows throughout. From 43 ft (13.1 m) below the top downward, the unit becomes very thin bedded, with prominent partings of argillaceous dolomite	56.5 (17.2)	1668 (508.4)
32	**Limestone**: parted and burrow-mottled lime mudstone; patchily recrystallized. Again, as in Unit 33, balls of dolomite, about 7 mm in diameter, occur near the gradational base	19.5 (5.9)	1611.5 (491.2)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
31	**Limestone**: parted lime mudstone; scattered trilobite fragments; dolomite partings increase in thickness downward, to become 50 per cent of the whole. Unit is relatively recessive weathering	16.5 (5)	1592 (485.2)
30	**Limestone** and **mudstone** (thinly to very thinly interbedded) Limestone: slightly argillaceous lime mudstone Mudstone: dark grey, very calcareous, slaty By downward gradation, the unit changes to crowded nodules of grey, microcrystalline limestone in a mudstone matrix. The mudstone weathers yellow-grey above, orange below. The unit is resistant weathering at the top, recessive weathering in the lower two thirds	32 (9.8)	1575.5 (480.2)
29	**Limestone**: parted lime mudstone and trilobite wackestone; irregularly to nodularly thin bedded, with partings and mottlings of dull orange weathering dolomite	24.5 (7.5)	1543.5 (470.5)
28	**Limestone**: as Unit 34, thin bedded at the base	38.5 (11.7)	1519 (463)
	GSC loc. 87900 (about 23 ft/7 m above the base) *Amecephalus* sp. *Athabaskia* sp. *Glossopleura* sp. (head only) *Kootenia* sp. *Nisusia* sp. *Olenoides* sp. *Zacanthoides* sp.		
27	**Slate**: grey, well laminated (calcareous laminae); weathers pale green and rusty; not recessive	4.5 (1.4)	1480.5 (451.3)
26	**Limestone** and **mudstone** Mainly limestone, as Unit 29, with minor intervals (as the upper part of Unit 30) in which the proportion of mudstone beds exceeds that of the limestone. Partings increase in proportion in the lower third, to produce subunits like Unit 35. Rare thin beds of intraclast grainstone, including "snowball" intraclasts (oncoids?). Unit weathers slightly recessive, and appears pale brown at a distance	112.5 (34.3)	1476 (449.9)
	GSC loc. 87870 (2 ft/0.6 m below the top) cf. *Ptarmiganoides* sp.		
	GSC loc. 87871 (about 12 ft/3.7 m below the top) *Albertella* sp. *Amecephalus* sp. *Mexicella* sp. *Poliella* sp. *Vanuxemella* sp.		
	GSC loc. 87872 (about 32 ft/9.6 m below the top) *Amecephalus* sp. *Paralbertella* sp. *Vanuxemella* sp.		
25	**Shale**: well laminated, and minor, non-laminated mudstone: pale grey, pale brownish grey, pale greenish grey, mainly very calcareous, slaty. Very minor laminae of microcrystalline limestone; rare silty lenses. Unit weathers dull brownish yellow, pale green, and rusty. Scattered burrows	58.5 (17.8)	1363.5 (415.6)
24	**Limestone**: parted lime mudstone; irregularly thin bedded. Rare thin beds of intraclast and trilobite packstone. Dolomitized, cylindrical dwelling-burrows normal to bedding, and feeding traces in the bedding plane. Forty-six feet (14 m) above the base a 50 cm thick interval of slumped material. Unit is only moderately resistant	214 (65.2)	1305 (397.8)
	GSC loc. 75358 (12 ft/3.7 m below the top) *Albertella levis*? Walcott, 1917 *Paralbertella*? sp. (crandium only) *Mexicella* sp.		
	GSC loc. 87874 (about 152 ft/46.3 m above the base) *Ptarmigania rossensis* (Walcott) *Vanuxemella* sp.		
	GSC loc. 75359 (149 ft/45.4 m above the base) *Albertella levis*? Walcott, 1917 *Ptarmigania* sp. *Ptarmiganoides* sp.		
23	**Slate**: pale grey, weathering very pale green-grey; very calcareous; a few thin beds of lime mudstone. At the top, a 30 cm thick bed of yellow-grey, microcrystalline, orange weathering dolomite	8 (2.4)	1091 (332.5)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 87875 *Albertella* cf. *A. lata* Fritz *Amecephalus* sp.		
22	**Limestone**: mainly calcisiltite; finely laminated, platy and flaggy, partly dolomitized. In the upper half, several beds of coarse intraclast packstone, and three 15 cm-thick beds of breccia, comprising slabs of laminated dolomite in a lime mudstone matrix (?debris flow)	18 (5.5)	1083 (330.1)
21	**Limestone**: argillaceous lime mudstone and trilobite wackestone/packstone; indistinctly thin bedded, strongly dolomite-mottled, slightly slaty	16.5 (5)	1065 (324.6)
20	**Limestone** Three rock types in cyclical repetition, as in Unit 18: 1. Mainly parted lime mudstone; 2. Minor thick beds of fine intraclast grainstone; weathering pale grey; 3. Minor beds, 15 to 30 cm thick, of laminated, orange weathering, microcrystalline dolomite	49.5 (15.1)	1048.5 (319.6)
19	**Mudstone**: with limestone nodules; as Unit 35; recessive weathering	5 (1.5)	999 (304.5)
18	**Limestone** and **dolomite** Three rock types in cyclical repetition, as Unit 20: 1. Sixty per cent parted lime mudstone, partly laminated, platy; 2. Twenty-five per cent laminated dolomite (near the base, silty, and interbedded with slate as seen above); 3. Fifteen per cent intrasparite	54 (16.5)	994 (303)
17	**Limestone**: parted and burrow-mottled lime mudstone. The mottled limestone occurs in medium and minor thick beds, and decreases upward. In the top 2 ft (60 cm), partings are of pale grey, calcareous slate	92 (28)	940 (286.5)
16	Partly snow covered Apparently, all **slate**: pale greenish grey, noncalcareous, with minor, very thin beds of lime mudstone. The slate is very calcareous near the base. Near the top, a 2 ft (60 cm) thick subunit of parted lime mudstone occurs. Prominent feeding traces	51 (15.5)	848 (258.5)
15	**Limestone**: white, microcrystalline, silty, very thick bedded, massive, with laminae and aligned mottling of orange weathering silty dolomite. Stromatolitic lamination is present at the base	8 (2.4)	797 (242.9)
14	**Slate** and **limestone** (thinly and very thinly interbedded) Slate: pale green, mainly calcareous. Limestone: grey (?)calcisiltite. The ratio of slate to limestone varies, in different subunits, from 10 to 0.1. Rare thin beds of grey, very fine grained sandstone. Rare thin beds of very fine grained, skeletal grainstone	59.5 (18.1)	789 (240.5)
13	**Limestone**: calcisiltite; thin bedded, partly laminated, with partings of dolomite. Several thin subunits are dolomitized	36 (11)	729.5 (222.4)
12	**Limestone**: lime mudstone; varies from nodular very thin bedded to massive, dolomite-mottled or with dolomite laminae; dwelling burrows	55.5 (16.9)	693.5 (211.4)
11	**Limestone**: ooid grainstone/packstone; fine grained, crosslaminated, massive	4 (1.2)	638 (194.5)
10	**Limestone**: as Unit 12. At the base, partings of pale grey slate	22.5 (6.9)	634 (193.2)
9	**Dolomite**: nearly white, weathering pale orange; microcrystalline, silty, finely laminated, massive to platy. At the base, much flakestone, suggesting that lamination is cryptalgal. The matrix of the flakestone is partly purple, argillaceous dolomite, partly lime mudstone	18 (5.5)	611.5 (186.4)
8	**Limestone**: mainly white, microcrystalline, with traces of fine particulate texture; thin bedded, flaggy. In the top 4 ft (1.2 m) the limestone is pink with white blotches. This limestone, like that of Unit 15, strongly resembles evaporitic limestone of the Cathedral Formation at Kicking Horse Pass	19 (5.8)	593.5 (180.9)
7	**Limestone**: ooid grainstone; fine grained, dark grey, weathering grey; dolomitic, thin to thick bedded, crosslaminated. Near the base, a 4 ft (1.2 m) thick subunit of parted lime mudstone	38.5 (11.7)	574.5 (175.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 87876 (about 15 ft/4.6 m above the base) *Amecephalus* sp. *Plagiura* sp.		
6	**Limestone**: burrow-mottled lime mudstone; massive	32 (9.8)	536 (163.4)
5	**Limestone**: oolite, as Unit 7	39 (11.9)	504 (153.6)
4	**Limestone** Alternating subunits of two different rock types: 1) Seventy per cent parted lime mudstone, with strongly developed, orange weathering, dolomite partings; 2) Thirty per cent limestone: dark grey, microcrystalline, argillaceous, dolomitic, faintly laminated, in medium and thick, pale brown weathering beds. Beds of mainly bolster-shaped thrombolites occur at intervals of about 10 ft (3 m)	54 (16.5)	465 (141.7)
3	**Limestone**: ribbon-bedded lime mudstone; partly argillaceous, mainly very thin bedded. At the top, some of the partings are grey slate	43 (13.1)	411 (125.3)
	GSC loc. 87877 (about 7 ft/2.1 m above the base) *Amecephalus* sp.		
2	**Limestone**: parted lime mudstone; very argillaceous, dark grey; thin and very thin bedded and laminated, partly slaty; partings are slate locally. Unit weathers very pale orange-brown. About 53 ft (16.2 m) below the top are two, 15 cm thick intervals of slumped material. An extremely uniform and monotonous unit. A few, millimetre-scale (?)coprolites are present, but no burrows or feeding traces	232 (70.7)	368 (112.2)

In outcrop and talus, offset to the southeast of the line of section, are rare, poorly preserved trilobites, mainly entire specimens, as well as one specimen of a *Gogia*-like eocrinoid. These fossils heighten the resemblance of Unit 2 to the Naiset Formation.

Weed Member
(136 ft/41.5 m)

The Weed Member forms dark outcrops (largely due to black lichens) as it does elsewhere, but is less resistant to weathering here than in most other areas.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Siltstone** and **shale** At the top, siltstone: grey, very regularly very thin bedded, finely laminated, with partings of grey shale. Downward, a gradation to shale: dark grey, calcareous, with fine laminae of siltstone. Weathers platy, greenish grey, except where covered with lichens. Abundant feeding traces.	136 (41.5)	136 (41.5)
	GSC loc. 87884 (about 21 ft/6.4 m below the top) *Syspacephalus* sp.		
	Abrupt, concordant contact.		

HOTA FORMATION
(269 ft/82 m)

The Hota Formation forms pale outcrops of moderate resistance, between the dark-appearing clastic strata of the Mahto Formation below and the Weed Member above.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Limestone**: skeletal grainstone; fine and very fine grained, thin and very thin bedded, partly laminated; weathers grey. Scattered medium grains of quartz sand occur in the top 1 ft (30 cm)	36.5 (11.1)	269 (82)
	GSC loc. 75361 (14.5 ft/4.4 m above the base) *Bonnia* sp. *Micromitra* sp. *Nisusia*? sp. *Olenellus* sp. *Onchocephalus* sp. *Zacanthopsina*? sp.		
	GSC loc. 87886 (about 12 ft/3.7 m above the base) *Bonnia fieldensis*? (Walcott) *Micromitra* sp. *Olenellus* sp. *Onchocephalus* sp. *Paterina* sp. *Syspacephalus* sp.		
	GSC loc. 87885 (local float) *Olenellus puertoblancoensis*? (Lochman)		
9	**Limestone**: intraclast packstone/wackestone; lenticular thin bedded, with orange weathering partings of dolomite	19 (5.8)	232.5 (70.9)
	Gradational contact.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
8	**Slate**: dark grey, weathering pale brown; soft, very calcareous. Grades downward into a basal 6 ft (1.8 m) thick subunit of slate: dark greenish grey, noncalcareous, splintery	47.5 (14.5)	213.5 (65.1)
	GSC loc. 87887 (about 28 ft/8.5 m above the base) aff. *Yohoaspis* sp.		
7	**Limestone**: lime mudstone; very dark brown, sooty, crudely thin and medium bedded, with abundant nodules. Limestone between nodules is partly laminated. Unit weathers grey, resistant	19 (5.8)	166 (50.6)
6	**Limestone**: trilobite wackestone; pale grey, weathering pale grey; massive. The unit is topped by irregular mounds 30 cm high	1.5 (0.5)	147 (44.8)
5	**Limestone**: parted lime mudstone; with scattered, dolomitized grains; irregularly thin bedded. A 10 cm thick bed, 25 ft (7.6 m) below the top, consists of fine grained trilobite grainstone/packstone	75.5 (23)	145.5 (44.3)
	GSC loc. 75362 (25 ft/7.6 m below the top) ptychoparioid trilobites zacanthoidid trilobites		
4	**Slate**: grey, weathering dark brown; noncalcareous, hard	10 (3)	70 (21.3)
	Line of (downward) measurement of section was offset about 400 m southeast, offsetting on the unmistakable Unit 4.		
3	**Limestone**: trilobite grainstone/packstone; fine to coarse grained, thin and medium bedded, partly nodular, partly crosslaminated. One bed carries crosslaminae of medium grained, quartz sand	17 (5.2)	60 (18.3)
	GSC loc. 87888 (about 9 ft/2.7 m above the base) *Bonnia* sp. *Olenellus puertoblancoensis*? *Paterina* sp.		
2	**Limestone**: skeletal grainstone/packstone; grey, fine grained, very sandy, grading in part to medium and coarse grained, calcareous sandstone; thick bedded, massive, with prominent, tangential crosslaminae in sets 10 cm and less thick	23.5 (7.2)	43 (13.1)
1	**Limestone**: skeletal packstone/wackestone; very dark grey, very fine grained; grading downward into coarse grained trilobite grainstone/wackestone at the base; irregularly thin bedded, with dolomite partings and mottling.	19.5 (5.9)	19.5 (5.9)
	GSC loc. 75363 (9 ft/2.7 m above the base) *Olenellus* sp.		
	Contact abrupt, concordant; the upper surface of the underlying sandstone is slightly dished.		

GOG GROUP

The section was continued downward through the predominantly sandy, clastic strata of the Mahto Formation (1267 ft/386.2 m), and the distinctively tripartite (two thick members of limestone, separated by a clastic member) Mural Formation (1044 ft/318.2 m) beneath it. Only the four uppermost units of the Mahto, immediately underlying the Hota Formation, are described here.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Sandstone**: deep "pistachio" green, weathering dark grey; fine grained, with chloritic matrix; thick bedded, massive, lichenous	12 (3.7)	254.5 (77.6)
3	**Sandstone/quartzite**: pale brownish grey to nearly white, rust specked (ferruginous carbonate cement), weathers grey to greenish grey; very fine grained, very well sorted, quartzose; mainly thick bedded; some internal lamination, in part destroyed by burrowing; feeding traces on some bedding surfaces, lichenous	135 (41.1)	242.5 (73.9)
2	Mainly **sandstone**: grey, brown weathering; medium grained, very calcareous, partly (?)glauconitic, thin bedded, crosslaminated. In the middle, a 15 cm thick bed of sandy oolite, partly dolomitized, overlain by 30 to 60 cm of medium to coarse grained, dolomite-mottled, skeletal grainstone/packstone with trilobite fragments	19 (5.8)	107.5 (32.8)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
1	**Sandstone**: pale greyish green to green, mainly fine grained, poorly sorted, with some fine grained matrix (at the base, very fine grained, well sorted); thin to thick bedded, commonly laminated, with a few burrows. Local, deep red, hematitic blotches. Very rare, thin interbeds of dark green, sandy shale. Cemented in part with ferruginous carbonate.	88.5 (27)	88.5 (27)

SECTION AC-171

Lower slopes of Mount Weed, above the Banff-Jasper Highway

Type section of the Weed and Chephren members of the Mount Whyte Formation, and reference section for the Peyto Formation.

(lat. 51°47′06″N, long. 116°32′17″W)

PIKA FORMATION

The Pika Formation was not measured or described. It is characterized by flaggy and platy parted lime mudstone and calcisiltite, with many beds of flat-pebble rudstone, and is recessive weathering relative to the Eldon Formation. Near the base are a bed of yellow weathering, laminated dolomite (cryptalgal laminite); a bed of massive, orange weathering, microcrystalline dolomite; and a bed with algal stromatolites.

The following fossil collections were made by W.H. Fritz:

GSC loc. 89443 (138 ft/42.1 m above the base)
Modocia sp.

GSC loc. 89442 (91 ft/27.7 m above the base)
cf. *Marjumia* sp.
Rowia? sp.

GSC loc. 89441 (66 ft/20.1 m above the base)
Rowia sp.

The basal contact and basal strata of the Pika Formation are covered.

ELDON FORMATION
(1084 ft/330.4 m)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
30	**Dolomite** A cycle similar to Unit 29; flaggy dolomite at the base grading up to massive dolomite at the top	18 (5.5)	1084 (330.4)
29	**Dolomite**: ex-burrow-mottled lime mudstone; pale grey to medium grey and fine crystalline, with mottling of dark grey, very fine crystalline dolomite aligned along the plane of bedding; mainly tends to flaggy, but is massive in the top 7 ft (2.1 m). Weathering is grey up to about 55 ft (16.8 m) below the top (this level varies), where it changes to pale orange	79 (24.1)	1066. (324.9)
28	Covered	14 (4.3)	987 (300.8)
27	**Dolomite**: as Unit 25	40 (12.2)	973.6 (296.6)
26	**Dolomite**: ex-burrow-mottled limestone; a single massive bed of dolomite, with notably intense burrowing	2 (0.6)	933 (284.4)
25	**Dolomite**: ex-grainstone as below, in part definitely ex-oolite; generally thin bedded, partly laminated, commonly crosslaminated; continues weathering grey, vuggy. Unit is recessive weathering at the base, with 3 ft (1 m) covered, and is increasingly resistant upward	28 (8.5)	931 (283.8)
24	**Dolomite**: ex-grainstone; speckled medium grey, fine equicrystalline, thin to thick bedded, massive, resistant, prominently crosslaminated, vuggy. Bedding is revealed by thin beds of dark grey, very fine crystalline dolomite	35 (10.7)	903 (275.2)
23	**Dolomite**: as Unit 21. In the basal 13 ft (4 m) the unit displays a flaggy, slightly recessive weathering tendency; higher, the unit becomes resistant and slightly burrowed	45 (13.7)	868 (264.6)
22	**Dolomite**: grey weathering ex-grainstone; as below, with minor thin interbeds and partings of dark grey, very fine crystalline dolomite	34 (10.4)	823 (250.9)
21	**Dolomite**: alternating mottled and parted dolomite, as Unit 12. Minor intervals of ex-grainstone (as below), in part definitely ex-oolite	51 (15.5)	789 (240.5)
20	Covered: recessive weathering	25 (7.6)	738 (224.9)
19	**Dolomite**: as Unit 15; minor ex-ooid grainstone near the top	26 (7.9)	713 (217.3)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
18	**Dolomite**: as Unit 16; largely ex-oolite; prominently crosslaminated	29 (8.8)	687 (209.4)
17	**Dolomite**: as Unit 7; lacking ex-oolite	34 (10.4)	658 (200.6)
16	**Dolomite**: as Unit 9; ex-grainstone, partly ex-oolite; massive, grey weathering	14 (4.3)	624 (190.2)
15	**Dolomite**: as below, with darker grey mottlings and partings; thin bedded, flaggy at the base, becoming more massive and resistant upward	37.5 (11.4)	610 (185.9)
14	**Dolomite**: as below, but tending to slightly flaggy, less resistant. Unit contains some massive lenses of mottled dolomite, up to 3 ft (1 m) thick, around which the bedding diverges	38.5 (11.7)	572.5 (174.5)
13	**Dolomite**: as below, but coarsely mottled, indistinctly bedded, and massive	32 (9.8)	534 (162.8)
12	**Dolomite**: as Unit 2, ex-burrow-mottled lime mudstone; massive, pale grey mottled with dark grey, alternating with dolomite: flaggy, dark and pale grey, thinly interbedded (ex-parted lime mudstone)	103 (31.4)	502 (153)
11	**Dolomite**: ex-grainstone, as Unit 9; mainly thin bedded below, becoming medium to very thick bedded, massive, above; crosslamination widespread. Minor intervals of mottled dolomite (as below)	122 (37.2)	399 (121.6)
10	Covered	22 (6.7)	277 (84.4)
9	**Dolomite**: ex-grainstone, at least partly ex-ooid grainstone; speckled medium and dark grey, fine crystalline; thick bedded, massive, resistant. Near the top, minor stromatactoid dolomite	19 (5.8)	255 (77.7)
8	**Dolomite**: as below, but with abundant feeding burrows, 2 to 10 mm in diameter; massive, weathering dark grey	9 (2.7)	236 (71.9)
7	**Dolomite**: mottled medium and dark grey, fine and very fine crystalline, indistinctly thin bedded, mainly massive. Minor intervals of ex-oolite (as Unit 6)	38 (11.6)	227 (69.2)
6	**Dolomite**: ex-ooid grainstone; speckled dark grey on pale grey, weathering dark grey; fine equicrystalline; thick bedded and massive, and thin bedded and weakly flaggy, with widespread crosslamination. Near the top, some beds contain dolomitized intraclasts and oncoids	49 (14.9)	189 (57.6)
5	**Dolomite**: coarsely and irregularly mottled, as below; indistinctly bedded, massive	12 (3.7)	140 (42.7)
4	**Dolomite**: flaggy, as below; changes upward to thinly interbedded pale grey and dark grey dolomite (as below). Unit weathers recessive at the base, becoming more resistant upward	22 (6.7)	128 (39)
3	**Dolomite**: as below, but slightly thicker bedded, more resistant, and more massive	37 (11.3)	106 (32.3)
2	**Dolomite**: derived from limestone (as Unit 1); pale grey, fine crystalline, with partings and mottling of dark grey, very fine crystalline dolomite. Increasingly resistant upward, weathering striped dark grey and pale orange	21 (6.4)	69 (21)
	Contact between limestone and dolomite crosses the bedding.		
1	**Limestone**: dark, parted lime mudstone; thin and very thin bedded, strongly flaggy; bedding surfaces weather deeply to pale orange and orange-grey and display rare complete trilobite skeletons.	48 (14.6)	48 (14.6)
	GSC loc. 88000 (36 ft/11 m above the base) *Alokistocare*? sp. *Spencella* sp.		
	Contact conformable, arbitrary.		

STEPHEN FORMATION
(448 ft/136.6 m)

The Stephen Formation in the vicinity forms a recessive weathering, ledged interval. Good exposures are available only in and near gullies.

Waputik Member
(288 ft/87.8 m)
(Units 11 to 19)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
19	Poorly exposed: recessive weathering **Shale:** as below; partly with specks of green chlorite. Five feet (1.5 m) above the base, a 10 cm thick bed of limestone (pink and green rudstone) occurs. Thirty-five feet (10.7 m) above the base, a 20 cm thick, massive bed of ooid grainstone. Forty-six feet (14 m) above the base, a 2 ft (60 cm) thick subunit of ooid grainstone/packstone, irregularly thin bedded. The upper half of the unit contains thin lenses of calcareous quartz siltstone	63 (19.2)	448 (130.6)
18	**Limestone:** as Unit 13. Forms a resistant rib	23 (7)	385 (117.3)
17	**Shale:** pale brown, pale green, calcareous	5 (1.5)	362 (110.3)
16	**Thrombolites** Unit of large, faintly layered, domal thrombolites with pitted surfaces. These bodies had at least 4 ft (1.2 m) of synoptic relief	10 (3)	357 (108.8)
15	**Limestone:** calcisiltite; crosslaminated, very thin lenticular beds, with prominent, orange weathering partings of silty dolomite. Minor thin beds of trilobite wackestone with calcisiltite matrix	6 (1.8)	347 (105.8)
14	**Shale:** pale greyish green, weathering pale silvery green; calcareous, very recessive, slight slaty cleavage. Upward, lenses and laminae of limestone (crosslaminated silty calcisiltite) appear, as this unit grades into the overlying unit	10 (3)	341.0 (103.9)
13	**Limestone:** lime mudstone and calcisiltite; lenticular thin and very thin bedded; partly silty, and partings of shale (as below) and of dolomitic siltstone; weathers grey (locally black) and orange-brown, flaggy and platy. Minor thin beds of flat-pebble rudstone and medium beds of argillaceous lime mudstone (as in lower units)	114 (34.7)	331 (100.9)
	GSC loc. 87999 (72 ft/21.9 m above the base) *Spencella* sp. *Ehmaniella burgessensis* Rasetti, 1951		
12	**Shale:** dark grey, weathering green-grey; calcareous; fissile, with weak slaty cleavage; grading to interlaminated shale and siltstone which, higher in the unit, become partings between very thin beds of lime mudstone	15.5 (4.7)	217 (66.1)
11	Covered: recessive weathering	41.5 (12.6)	201.5 (61.4)
	Narao Member (160 ft/48.8 m) (Units 1 to 10)		
10	**Limestone:** oncoid floatstone, with dolomitized oncoids; a single, massive bed	1 (0.3)	160 (48.8)
9	**Limestone:** parted lime mudstone; irregularly thin bedded; feeding traces prominent on bedding surfaces; minor flat-pebble rudstone	30 (9.1)	159 (48.5)
	GSC loc. 87998 (from the top of the unit) cf. *Amecephalus* sp. or *Kochina* sp.		
8	**Limestone:** as Unit 5	7 (2.1)	129 (39.3)
7	**Limestone:** as Unit 4	17 (5.2)	122 (37.2)
6	Covered: recessive weathering	7 (2.1)	105 (32)
5	**Limestone:** burrow-mottled lime mudstone; dark grey, with a few laminae of dolomite	10 (3)	98 (29.9)
4	**Limestone:** lime mudstone and calcisiltite; lenticularly thin bedded, flaggy, with dolomite partings; partly silty (quartz). Minor 15 to 30 cm thick beds of massive, argillaceous lime mudstone. Minor thin beds and lenses of trilobite wackestone (calcisiltite matrix). At 12 and 29 ft (3.7 and 8.8 m) above the base, beds of flat-pebble rudstone, 5 to 10 cm thick, occur. Unit weathers brownish grey	50 (15.2)	88 (26.8)
	GSC loc. 87996 (4 ft/1.2 m above the base) *Amecephalus* sp. *Glossopleura boccar* (Walcott) *Glossopleura stenorhachis* Rasetti, 1951 *Kochina* sp.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GSC loc. 87995 (from basal 2 ft/0.6 m) *Amecephalus* sp. A *Amecephalus* sp. B *Glossopleura stenorhachis* Rasetti, 1951 *Kochina*? sp. *Zacanthoides* sp.		
3	Covered: recessive weathering Float of flaggy limestone, as above, with abundant trilobites	15 (4.6)	38 (11.6)
2	**Dolomite** Resistant rib of dolomite, as below, but regularly thin bedded, and flaggy	5.5 (1.7)	23 (7)
1	Covered: recessive weathering.	17.5 (5.3)	17.5 (5.3)

CATHEDRAL FORMATION
(thickness questionable because of a fault in the section)

The Cathedral Formation is more resistant than the Stephen. At this locality, however, it is less of a monolithic feature former than generally, partly because of extensive dolomitization and partly because of shattering near the fault in the section.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
27	**Dolomite**: ex-burrow-mottled lime mudstone; pale grey and medium crystalline, mottled with black, very fine crystalline; thick bedded, massive, blocky. Local stromatactoid dolomite	18 (5.5)	887 (270.4)
26	**Dolomite**: as below, but more regularly thin bedded, less shattered	75 (22.9)	869 (264.9)
25	Covered	22 (6.7)	794 (242)
24	**Dolomite**: ex-burrow-mottled lime mudstone; mainly brownish or yellowish white and fine crystalline, mottled with dark grey, very fine crystalline; flaggy to massive, with fracture-controlled pods of megacrystalline white dolomite; weathers orange-grey, and is partly black, lichen covered. Severely shattered. Thickness open to question	83 (25.3)	772 (235.3)
23	Covered	64 (19.5)	689 (210)
	Fault. The solution for the fault displacement is highly questionable. The cover may conceal the Trinity Lakes Member.		
22	**Dolomite**: massive; as below	149 (45.4)	625 (190.5)
21	**Dolomite**: as below, but flaggy	25 (7.6)	476 (145.1)
20	**Dolomite**: cf. Unit 3; obviously derived from limestone (as Unit 19). Basal 5 ft (1.5 m) are flaggy; higher beds are massive	75 (22.9)	451 (137.5)
19	**Limestone**: parted lime mudstone	34 (10.4)	376 (114.2)
	GSC loc. 87994 (middle of the unit) *Paralbertella limbata* Rasetti, 1951 *Paralbertella stenorhachis* Rasetti, 1951 *Nyella macrops* (Rasetti), 1951		
18	Covered: recessive weathering	48 (14.6)	342 (104.2)
17	**Dolomite**: ex-burrow-mottled lime mudstone; pale grey, fine and very fine crystalline, mottled with dark grey; weathers pale orange, massive; stylolitic bedding planes	21 (6.4)	294 (89.6)
16	**Dolomite** Stromatactoid dolomite	42 (12.8)	273 (83.2)
15	**Dolomite**: cf. Unit 3; derived from limestone (as Unit 14). Flaggy in basal 6 ft (1.8 m); higher beds are massive	11 (3.4)	231 (70.4)
14	**Limestone**: lime mudstone; partly parted, thin bedded, and flaggy; partly massive and burrow-mottled; sooty weathering at the base. The upper contact is of the replacement type and crosses the bedding	48 (14.6)	220 (67.1)
	GSC loc. 87993 (base of the unit) *Paralbertella* sp. *Nyella*? sp. *Pachyaspis*? sp.		

Ross Lake Member
(25 ft/7.6 m)
(Units 10 to 13)

The Ross Lake Member is recessive weathering and supports a distinct topographic notch.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
13	**Shale/slate**: grey, lustrous, weathers very pale brown; calcareous; recessive	7 (2.1)	172 (52.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
12	**Limestone**: parted lime mudstone; argillaceous, dolomite-mottled, flaggy; becomes less argillaceous and more resistant upward; weathers black and orange. Top bed is oncoid floatstone, 15 cm thick	11 (3.4)	165 (50.3)
11	**Slate**: grey, papery, very recessive weathering	4 (1.2)	154 (46.9)
10	**Limestone**: as below, with thin interbeds of shale (as above)	3 (0.9)	150 (45.7)
9	**Limestone**: parted lime mudstone; orange weathering dolomitic mottling; thin bedded, flaggy; rare fossil fragments. Near the top, the limestone becomes sheared and slaty	9 (2.7)	147 (44.8)
8	**Limestone**: as below, but mainly medium bedded; feeding traces prominent on bedding planes	12.5 (3.8)	138 (42.1)
7	**Limestone**: calcisiltite; dolomitic, pyritic; finely laminated and cross-laminated; weathering dark grey, flaggy, recessive	5 (1.5)	125.5 (38.3)
6	**Dolomite**: as below, but thin bedded, flaggy	3.5 (1.1)	120.5 (36.7)
5	**Dolomite**: as below; partly stromatactoid at the base	49 (14.9)	117 (35.7)
4	**Limestone**: grey, fine crystalline (recrystallized mudstone?), very thin bedded, flaggy	3 (0.9)	68 (20.7)
3	**Dolomite**: ex-parted lime mudstone; grey and white with dark grey mottling, weathers greyish orange; fine and locally medium crystalline, locally vuggy; indistinctly thin and medium bedded	19 (5.8)	65 (19.8)
2	**Limestone**: at the base, skeletal wackestone, irregularly thin bedded and parted, passing upward into mainly burrow-mottled lime mudstone with minor parted lime mudstone. Minor beds of dark-pellet grainstone; scattered oncoids. Replacement contact with the overlying dolomite crosses at least 19 ft (5.8 m) of strata	35 (10.7)	46 (14)
	GSC loc. 87992 (12 ft/3.7 m above the base) *Paralbertella* sp.		
1	**Limestone**: parted lime mudstone, grading to skeletal wackestone.	11 (3.4)	11 (3.4)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Contact gradational, interbedded.		

MOUNT WHYTE FORMATION
(415.5 ft/126.6 m)
(Reference Section)

The Mount Whyte Formation supports a ribbed topography: resistant limestone units alternating with recessive weathering units of fine siliciclastic strata.

Chephren Member
(263.5 ft/80.3 m)
(Type section, Units 2 to 23)

23	Covered: recessive weathering	8 (2.4)	415.5 (126.6)
22	**Limestone**: as Unit 16	6 (1.8)	407.5 (124.2)
21	Poorly exposed **Shale**: as below; subordinate thin beds of limestone (as below)	8 (2.4)	401.5 (122.4)
20	**Limestone**: as Unit 16	3 (0.9)	393.5 (119.9)
19	**Shale**: lenses of limestone; as Unit 17. One 2.5 cm thick bed of skeletal wackestone	7 (2.1)	390.5 (119)
18	**Limestone**: oncoid floatstone; scattered oncoids supported by skeletal wackestone; dolomitic	1.5 (0.5)	383.5 (116.9)
17	**Shale**: as below, with lenses of limestone (?calcisiltite)	3.5 (1.1)	382 (116.4)
16	**Limestone**: trilobite wackestone; thin bedded	3 (0.9)	378.5 (115.4)
	GSC loc. 87991 (2 ft/60 cm above the base) *Amecephalus* sp. *Fieldaspis* cf. *F. celer* (Walcott) *Kochaspis*? sp.		
15	**Shale**: as below. One 5 cm thick bed of limestone (as below) in the middle	10 (3)	375.5 (114.5)
14	**Limestone**: as Unit 12; oncoids prominent, matrix argillaceous	5.5 (1.7)	365.5 (111.4)
13	**Shale/slate**: grey, weathering green-grey	5.5 (1.7)	360 (109.7)
12	**Limestone**: nodular trilobite wackestone; argillaceous; minor intervals of oncoid floatstone	5 (1.5)	354.5 (108.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
11	**Shale/slate**: brown to greenish grey, partly calcareous, recessive weathering	5 (1.5)	349.5 (106.5)
10	**Limestone** Unit of heterogeneous limestones. At the base, silty calcisiltite, grading upward to thin and medium bedded trilobite-echinoderm packstone/grainstone, partly oolitic; several medium beds of oncoid packstone. Locally, 2 ft (60 cm) of dolomitized limestone at the top. Thrombolites have been reported by Hockley (1973)	53 (16.2)	344.5 (105)
	GSC loc. 87990 (41 ft/12.5 m above the base) *Nyella* sp. *Coreospira* sp. *Poliella* sp.		
9	**Limestone**: mainly ooid grainstone/packstone; lenticular thin to thick bedded, resistant. Gradational into the overlying unit	23 (7)	291.5 (88.8)
8	**Limestone** and **siltstone** (very thinly interbedded to interlaminated) Limestone: calcisiltite, partly silty, argillaceous Siltstone: calcareous, argillaceous, crosslaminated Feeding traces prominent on bedding planes. Thin and medium beds and lenses of trilobite packstone and wackestone increase upward	28 (8.5)	268.5 (81.8)
	GSC loc. 87989 (11 ft/3.4 m above the base) *Kochaspis*? sp. *Plagiura* sp.		
7	**Limestone**: silty calcisiltite; thin bedded; silty dolomitic partings; minor thin beds of ooid grainstone/packstone. The thin bedding is interrupted by stromatolitic thrombolite masses, 0.5 to 6 ft (0.15 to 2 m) in diameter	19 (5.8)	240.5 (73.3)
	GSC loc. 87988 (11 ft/3.4 m above the base) *Amecephalus* sp. *Plagiura* sp.		
6	Covered: recessive weathering	12 (3.7)	221.5 (67.5)
5	**Limestone**: ooid grainstone; commonly very coarse grained, thin to thick bedded, massive. Minor skeletal grainstone/packstone. Near the top, some very coarse brachiopod grainstone in medium beds	16 (4.9)	209.5 (63.9)
	GSC loc. 87987 (1 ft/30 cm below the top) *Nisusia* sp. *Plagiura*? sp.		
	GSC loc. 87986 (4 ft/1.2 m above the base) cf. *Kochina* sp. *Onchocephalus*? sp. *Wimanella* sp.		
4	**Limestone**: mainly thin bedded calcisiltite with silty dolomitic partings. Minor ooid grainstone at the base	11 (3.4)	193.5 (59)
3	**Limestone**: massive unit of stromatolitic thrombolites	7 (2.1)	182.5 (55.6)
2	**Limestone**: mainly calcisiltite; partly silty, very thin bedded; partings of siltstone common. Minor flat-pebble rudstone	23.5 (7.2)	175.5 (53.5)
	Rapidly gradational contact		
	Weed Member (152 ft/46.3 m) (Type Section)		
1	**Siltstone**: greenish grey, calcareous, argillaceous, and micaceous. Minor sandstone: very fine grained, thin and very thin bedded and laminated. Minor partings of shale: greenish grey, laminated, partly calcareous. Feeding burrows and general bioturbation are prominent throughout. At 141.5, 143.5, and 154 ft (43.1, 43.7 and 46.9 m) above the base, medium lenticular beds of limestone, ooid grainstone and rudstone (?) occur.	152 (46.3)	152 (46.3)
	Erosional contact.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GOG GROUP		
	PEYTO FORMATION (113.5 ft/34.6 m) (Reference Section)		
	Except for thin shale units near the top, the Peyto Formation is resistant, and forms a marked topographic rib.		
11	**Sandstone, shale,** and **limestone** (intermixed) Sandstone: grey, quartzose, very fine grained Shale: green-grey, calcareous, appearing rotten Limestone: sandy trilobite grainstone Near the base and in the middle, the sandstone occurs as decimetre-scale pods. This suggests that the sand was introduced into solution openings in the limestone, and that the unit has been altered by weathering at the sub-Mount Whyte Formation contact	6 (1.8)	113.5 (34.6)
	GSC loc. 87985: *Olenellus* sp. *Onchocephalus* sp. GSC loc. 89440: *Olenellus* sp. *Onchocephalus* sp.		
10	**Shale**: as below	17.5 (5.3)	107.5 (32.8)
9	**Limestone**: mainly ooid and skeletal grainstone; irregularly thin bedded	16 (4.9)	90 (27.4)
	GSC locs. 87982 to 87984 Loc. 87984 *Olenellus* sp. *Onchocephalus* sp. Loc. 87983 *Antagmus* sp. *Bonnia fieldensis* (Walcott), 1916 *Micromitra* sp. *Olenellus* sp. aff. *Syspacephalus*? *uncus* (Walcott), 1917 Loc. 87982 *Bonnia fieldensis* (Waclcott), 1916 *Olenellus* sp. *Paterina* sp. aff. *Syspacephalus*? *uncus* (Walcott), 1917		
8	**Shale**: olive, silty, fissile, noncalcareous	4 (1.2)	74 (22.6)
7	**Limestone**: trilobite-hyolithid packstone; dolomitic, irregularly thin bedded	2 (0.6)	70 (21.3)
6	**Sandstone** and **shale** (interlaminated) Sandstone: pink, calcareous, very fine grained. Shale: green-grey, silty, micaceous. The sandstone is laminated in planar and lenticular styles	4 (1.2)	68 (20.7)
5	Covered: recessive weathering	21 (6.4)	64 (19.5)
4	**Limestone**: fine skeletal grainstone; oolitic, sandy, with minor thin beds of oolite. Middle third consists of ooid grainstone: dolomitic, thin and medium bedded, crosslaminated. Locally (near a small fault) the limestone is altered to grey, orange weathering, medium crystalline dolomite	24 (7.3)	43 (13.1)
3	**Dolomite**: medium grey, weathering pale orange; medium crystalline; bedding style is inherited from limestone (as Unit 2). Sandy (quartz) in the top 1 ft (30 cm)	8.5 (2.6)	19 (5.8)
2	**Limestone**: skeletal grainstone; fine grained, nodular, thin bedded, massive to rubbly, resistant, grey weathering	5.5 (1.7)	10.5 (3.2)
1	**Limestone**: skeletal grainstone; very sandy, medium bedded, weathers grey and brown, massive.	5 (1.5)	5 (1.5)
	GSC locs. 87976 (lowest) to 87981 (highest) were collected in ascending order from units 1 through 4, inclusive. All are assigned to the *Bonnia-Olenellus* Zone. Loc. 87981 *Onchocephalus* sp. Loc. 87980 *Onchocephalus* sp. Loc. 87979 *Antagmus* sp. *Bonnia columbensis* Resser, 1936 *Onchocephalus* sp. *Olenellus* sp. monoplacophoran		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	Loc. 87978 *Antagmus*? sp. *Olenellus* sp. *Periomma* sp.		
	Loc. 87977 *Antagmus* sp. *Olenellus* aff. *O. gilberti* Meek, 1874 *Onchocephalus* sp. *Periomma* sp.		
	Loc. 87976 *Antagmus*? sp. *Olenellus* sp. *Olenellus* aff. *O. thia* (Walcott) cf. *Sombrerella* sp. or *Periomma* sp.		
	Gradational contact.		

SUB-PEYTO STRATA

The sub-Peyto sandstone beds of the Gog Group are about as resistant as the overlying Peyto Formation, and form topographic ribs, separated by notches above the subordinate, recessive weathering shale units.

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
8	**Sandstone**: yellow-white and pink, brown weathering; mainly medium grained, very calcareous. Tangential crosslamination occurs in 15 to 30 cm thick sets. One 7 cm thick shale bed is present near the top	22.5 (6.9)	90.5 (27.6)
7	**Shale** (90%)and **quartzite** (10%) Shale: greenish grey, fissile Quartzite: ocurs as very thin beds; white, green speckled, very fine grained, bioturbated The unit grades upward into mainly bioturbated siltstone.	7.5 (2.3)	68 (20.7)
6	**Sandstone** and **quartzite** Mainly sandstone, carbonate cemented as below, with minor quartzite; locally dull purple-red; mainly medium grained. Unit shows an upward gradation from thick sets of low-angle tabular crossbeds to sets of tangential crossbeds, 7 to 30 cm thick. The upper part of the unit has a thin bedded appearance	22 (6.7)	60.5 (18.4)
5	**Shale**: greenish grey, chippy	3 (0.9)	38.5 (11.7)
4	**Sandstone** Unit dominated by very calcareous (or sideritic?) sandstone (as below), with 25 per cent, 10 to 30 cm thick intervals of sandstone with dolomite intraclasts, sandstone with dolomitized oncoids, and minor grey, very sandy limestone. Unit weathers mainly rusty brown	11 (3.4)	35.5 (10.8)
	GSC loc. 87975 *Bonnia* sp. *Olenellus* sp.		
3	**Sandstone** and **quartzite**: as Unit 1	9 (2.7)	24.5 (7.5)
2	**Shale**: greenish grey, rusty weathering, very fissile	5.5 (1.7)	15.5 (4.7)
1	**Sandstone** and **quartzite** Alternating carbonate cemented sandstone and quartzite; mainly fine and medium grained; as underlying beds. The top 1 ft (30 cm) is coarse grained.	10 (3)	10 (3)
	Exposures continue downward.		

SECTION AC-172

(Peyto and Mount Whyte formations only; for Cathedral Formation and its Ross Lake Member see under "Cathedral Formation".)

Ross Lake
(lat. 51°25′22″N, long. 116°17′59″W)

CATHEDRAL FORMATION
(1231.5 ft/375.4 m)
(Reference section)

Section continues upward to Stephen Formation

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
4	**Dolomite** and **limestone** At the base, parted limestone as below, passing upward after 10 ft (3 m) into dolomite: pale brownish grey to pale grey and pink; partly fine equicrystalline, partly inequicrystalline. Weathers distinctive pale tan. Beds with indistinct thrombolites are common up to at least 50 ft (15.2 m) above the base	53.5 (16.3)	109.5 (33.4)
3	**Limestone**: parted limestone; as below. Top 4 ft (1.2 m) consist of discontinuous, pillow-like thrombolites	11.5 (3.5)	56 (17.1)

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
2	**Limestone**: a continuous thrombolite biostrome, with 30 cm or more of domal relief at the top	11.5 (3.5)	44.5 (13.6)
1	**Limestone**: parted lime mudstone and parted skeletal wackestone with abundant oncoids. Bedding is thin and very irregular at the base, becoming thicker, more planar, and better defined upward.	33 (10.1)	33 (10.1)
	Conformable contact.		

MOUNT WHYTE FORMATION
(253 ft/77.1 m)

The Mount Whyte Formation forms a more ledgy interval, with many talus covered ledges, below the lower Cathedral, in which the resistant units are thicker and dominant. For fossil lists, see Rasetti (1951).

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
10	**Siltstone** (60%) and **limestone** (40%) (Covered at base) Siltstone: pale grey, greenish grey, brownish grey, micaceous, calcareous to very calcareous, with lenses and nodules of silty limestone. Centimetre-scale planar lamination due to variations in clay and calcite contents; partly ripple crosslaminated. Abundant feeding traces on bedding planes Limestone: grainstone as below, in 2 to 7 ft (0.6 to 2.1 m) thick subunits. A ledgy weathering unit	43.5 (13.3)	253 (77.1)
9	**Limestone**: ooid-skeletal grainstone; partly massive, partly crudely flaggy. Fifteen feet (4.6 m) above the base is the base of a pillow-shaped thrombolite at least 8 ft (2.4 m) high. Other thrombolites, widely spaced, occur laterally at the same level	30 (9.1)	209.5 (63.9)
8	**Siltstone**: lenses and nodules of limestone; as Unit 10	8 (2.4)	179.5 (54.7)
7	**Limestone**: ooid-skeletal and skeletal-ooid grainstone/packstone; very irregularly thin bedded, with local crosslamination in sets 15 cm thick. Massive outcrop passes laterally into flaggy outcrop	20 (6.1)	171.5 (52.3)
6	**Sandstone/siltstone**, and **shale** (interlaminated) Sandstone/siltstone: very fine grained, very pale grey, quartzose, calcareous. Sandstone is mostly planar laminated, with well developed feeding traces Shale: green Just below the top, two thin beds of ooid grainstone/packstone occur	9.5 (2.9)	151.5 (46.2)
5	**Siltstone** and **limestone** (interlaminated) As below, with two beds of compound, bulbous thrombolites, some exceeding 1 m in height. The lower thrombolite bed is based on a 2 to 5 cm thick bed of ooid grainstone	9 (2.7)	142 (43.3)
4	**Siltstone**: pale pinkish and brownish grey below, pale grey and green-grey above; micaceous, calcareous to very calcareous, with lenses and nodules of silty limestone. The centimetre-scale, planar lamination is due to variations in the content of clay and calcite; some ripple-scale crosslamination. The limestone content increases upward, as the unit grades into interlaminated siltstone and limestone. Bedding planes are intensively figured with biogenic traces. A 5 to 8 cm thick bed of flat-pebble rudstone occurs 45.5 ft (13.9 m) above the base	56.5 (17.2)	133 (40.5)
3	Covered: recessive weathering	29 (8.8)	76.5 (23.3)
2	**Slate**: grey below, green-grey above, weathering green-grey; very finely laminated	33 (10.1)	47.5 (14.5)
1	**Limestone** and **siltstone** A nodular unit. Centimetre-scale, ovoid nodules of argillaceous lime mudstone, with trilobite fragments, in a matrix of green-grey to dark grey, argillaceous siltstone. The nodule content for most of the unit is 70 per cent, but decreases at the top.	14.5 (4.4)	14.5 (4.4)
	The change in the aspect of the fauna, from the coarse, mainly olenellid, material of Unit 3 of the Peyto Formation, to the minute trilobites and inarticulate brachiopods of Unit 1 of the Mount Whyte Formation, is striking.		
	Abrupt contact.		

Unit No.	Lithology	Thickness ft (m) Unit	Total from base
	GOG GROUP		
	PEYTO FORMATION (55 ft/16.8 m)		
	The Peyto Formation at Ross Lake does not form a clearly discernible unit from a distance. It is essentially a limy interval at the top of the Gog sandstone succession that is interpreted as the basal part only of a formerly thicker Peyto, thinned by erosion at the sub-Mount Whyte unconformity.		
4	**Shale** and **sandstone** At the base, interlaminated green shale and grey, very fine grained, noncalcareous, brown weathering sandstone. The sandstone forms lenticular laminae with traces (scratches) made by trilobite appendages on the upper surfaces. Shale is 60 per cent at the base, decreasing to 10 per cent at the top. Near the top, trough crosslamination is visible in a 15 cm thick bed of sandstone	8 (2.4)	55 (16.8)
	Contact is abrupt, grossly planar, with corrugations of 2 to 3 cm scale. The assignment of Unit 4 is questionable; it could be the basal unit of the Mount Whyte Formation.		
3	**Sandstone** and **shale** At the base, thinly interbedded sandstone (as below), and shale (as below). The shale dies out 5 ft (1.5 m) above the base. Above that, massive sandstone (as below) occurs in oblique crossbed sets up to 25 cm thick. Locally, there are lenses and individual cross-strata of sandy, coarse, trilobite grainstone, with olenellid fragments	19.5 (5.9)	47 (14.3)
2	**Sandstone**: dull greyish red and brown, brown weathering; fine grained, well sorted, dolomitic, slightly calcareous; abundant trilobite fragments; small-scale trough crosslamination (mostly sets less than 5 cm thick); massive	8.5 (2.6)	27.5 (8.4)
1	**Sandstone**: grey, brown weathering; mainly fine, minor medium grained, dolomitic. Many centimetre-thick lenses of dense, ferruginous limestone. Olenellid fragments throughout, with a few thin beds and lenses of coarse, sandy trilobite grainstone (coquina). Irregularly, lenticularly thin and minor medium bedded, with low-angle cross-lamination. Ten per cent partings and beds, 1 to 30 cm thick, of pale grey-green slate.	19 (5.8)	19 (5.8)
	SUB-PEYTO STRATA		
	Sandstone: dark greyish red, pink, and white, weathering dark brownish red; fine grained, dolomitic, thick bedded, massive; crosslaminated in sets mostly 10 cm and less thick.		

APPENDIX C

ACCESS TO DESCRIBED SECTIONS [1, 2]

Section AC–3

Mount Bosworth West
(Reference section for the Eldon Formation)

Two glacial cirques indent the southern side of the Mount Bosworth/Paget Peak massif. The eastern of these, with the summit ridges of Mount Bosworth forming its eastern wall, is drained by an incised stream that reaches Highway 1 about 300 m east of Wapta Lake. The stream gully and, above it, the southwest ridge descending from Mount Bosworth, provide good exposures of the Eldon Formation and its contacts with the Stephen and Pika formations. No mountaineering problems are encountered.

Map: GSC 1483A

Section AC–4

Mount Bosworth
(Type section of the Stephen Formation and its Waputik and Narao members)

The unnamed normal fault that cuts the east "nose" of Mount Bosworth crosses Highway 1 and Sink Lake, about 0.7 km east of the junction with Highway 1A and 2.5 km east of Wapta Lake. From this point, access to the good outcrops higher up on the southeastern slopes of Mount Bosworth is easy, by virtue of the avalanche paths that have cleared most of the mature trees from this part of the slope. The route first crosses intermittent outcrops of the Gog Group quartzites, and a covered interval representing the Mount Whyte and Peyto formations, and then traverses good outcrops of the Cathedral Formation (Ross Lake Member – hidden). The eastern of the two gullies draining the east "nose" should be kept on the right during the ascent. The type section of the Narao Member is on the "nose" between the two gullies (Fig. 31), and that of the Waputik Member is immediately west of the western gully, in order to catch the best exposures. The section is offset at the member contact. Both sections provide fairly good exposures of the Stephen Formation.

Map: GSC 1483A

Section AC–24

Helena Ridge (Castle Mountain)
(Type section of the Pika and Eldon formations)

An excellent and much travelled trail leads from the vicinity of the Warden's Station near Eisenhower Junction on Highway 1A to Rockbound Lake, in the big cirque at the southeastern end of the Castle Mountain/Protection Mountain massif. To reach the section on the eastern side of Helena Ridge, this trail should be followed to either Tower Lake below Rockbound Lake, or, for the more impatient and energetic, to the point short of Tower Lake at which the gully or canyon draining Rockbound Lake becomes visible. Leave the trail, cross the gully, and ascend via alpine meadows to the skyline saddle supported by the Mount Whyte Formation. From this point a more or less skyline route (for digressions, see the description of the section) crosses the Mount Whyte, Cathedral, Stephen, and type Eldon and Pika formations.

Map: GSC 1274A

Composite Section AC–26/28/109

Ghost River

The Ghost River sections can be reached by taking the gravel road that runs westward from the Cochrane–Nordegg Forestry Trunk Road at the Bar C Ranch.

An incomplete section of the Mount Whyte Formation (AC–109) was measured at outcrops on the

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[1]The map citation provided at the end of each access description identifies the map(s) (at 1:50 000 scale where available) that cover the line of section and the access route. All maps indicated as "GSC" provide topographic and geological information; the remainder are 1:50 000 scale topographic maps, designated by their identification number in the National Topographic System.

[2]Canadian Parks Service policy on the use of helicopters changes from time to time, and was as stated below (Sections AC–142/143) at the time of writing. During the field season of 1987, however, helicopter access to remote sites by serious investigators could be arranged in certain of the parks. Canadian Parks Service policy in this regard should, therefore, be checked each year with the superintendent of each part of interest, prior to finalizing fieldwork plans.

south bank of Ghost River, just above river level, at a point about 5.5 km upstream from the Ghost River Diversion. The westward descent of the easily recognized Cathedral Formation to low levels near this point is an aid in locating the limited Mount Whyte outcrops.

The interval from the base of the Cathedral Formation to the base of the Pika (Section AC–28) was measured in the northern of two deep gullies on the northeast shoulder of Orient Point (Fig. 82). This gully is reached via a seismic survey cut-line that descends from the mountain through wooded slopes almost to the gravels of the Ghost River floodplain. The floodplain may be driven upon by rugged vehicles most of the year. Passage through the Eldon Formation, the main obstacle, is via a steep, narrow gully or "chimney" on the west side of the main gully. A tie with sub-Cathedral beds was obtained in the southeasternmost of the two gullies on the northeastern side of Orient Point.

A deep cross-valley separates Black Rock Mountain from the massif of the Devil's Head to the west. The Pika Formation (Section AC–26) was measured high on the west wall of this valley. Access is attained by a scramble up the steep "nose" between the cross-valley and the Ghost River valley (Fig. 82); when the Pika Formation is reached on this "nose", a well exposed section can be reached by traversing a few hundred metres northward along the strike.

Maps: GSC 1265A, GSC 1374A

Section AC–39

Windy Point, North Saskatchewan River

Windy Point can be reached by travelling westward from Nordegg or eastward from Saskatchewan River Crossing along the paved David Thompson Highway. At Windy Point, overlooking Abraham Lake, there is an enormous roadcut in limestones of the Eldon Formation. To reach good, structurally coherent outcrops of the Middle Cambrian formations, it is necessary to climb the nearly white shoulder of Eldon outcrop (Fig. 69), from the vicinity of the roadcut to the skyline, a climb of 1 1/2 to 2 hours. This route traverses the immediate hanging wall of a splay-fault from the McConnell Thrust, a splay that places the Eldon against Upper Cambrian and Devonian strata of the footwall. Once at the skyline, the route is more or less westward to a saddle in the Stephen Formation. North of this saddle, a coherent section from Cathedral to Arctomys may be measured. Care must be taken, in this area, to recognize and avoid the several cross-faults that affect the structural panel (Fig. 69).

Maps: GSC 55-34; 83 C/8

Section AC–41

Banff National Park Boundary, North Saskatchewan River

At the eastern boundary of Banff National Park, immediately north of North Saskatchewan River, a long spur extends southeast from the general massif of Mount Cline, immediately east of Owen Creek. From the southward termination of this main spur, three sparsely vegetated, subsidiary spurs or cuestas descend toward the river (Fig. 7). From east to west, these cuestas are supported by the Peyto Formation, the Cathedral Formation, and the Eldon Formation, the park boundary following the Cathedral. In order to see a completely exposed Gog/Peyto contact, it is necessary to bushwack northward for about 2 km from the David Thompson Highway, staying east of the Peyto cuesta, until the first creek east of Owen Creek is reached, where exposure of the contact is excellent. From this point, the route of measurement for Section AC–41 is more or less straight uphill, across the Peyto and Mount Whyte formations, until the base of the Cathedral is reached (this involves straightforward scrambling over partly treed exposures).

The cliffs of the Cathedral Formation are crossed precisely at the "corner" where the contours swing from south-southeast to west; at this point, dolomitization of the limestone provides a route with good holds. The route is not for the timid, and the brief use of a rope, for protection at the steepest part, is recommended. The ledge formed by the Trinity Lakes Member leads out a short distance to the west, where broken cliffs of the upper Cathedral provide a route to the Cathedral dip slope. Follow the dip slope back to the "corner", where exposure of the Stephen Formation is superb.

Above the Stephen Formation, only the basal 100 to 200 ft (30.5 to 60.1 m) of the Eldon is climbable at and near the "corner"; accordingly, the route of measurement is to the west and only slightly upslope, until a major crack (the trace of a minor, steeply dipping fault) is reached. This provides a spectacular but practicable route through the Eldon cliffs. At the top of the Eldon Formation, the basal beds of the Pika

are stripped back for perhaps half a kilometre (Fig. 7), and measurement of the last few feet of the Eldon involves guesswork.

Map: 83 C/2

Section AC-48

Beauty Creek/Trinity Lakes
(Reference Section for the Cathedral Formation)
(Type section of its Trinity Lakes Member)

Beauty Creek reaches the Banff-Jasper Highway just north of the foot of the highway's steep descent from the Columbia Icefields. From the new highway, the concrete bridge of the old highway can be seen spanning the creek to the east across the gravel flats. From the old bridge, follow the north bank of Beauty Creek upstream. A strong trail leads as far as Stanley Falls, but fades away beyond. The forest is reasonably open, however, and foot travel is not difficult. The only major obstacle is 2.8 km above the falls, where a tributary stream enters Beauty Creek from the east. With high flows, such as occur on hot afternoons and evenings during the first half of summer, crossing this stream can be difficult and dangerous. Not far beyond the tributary crossing, the valley of Beauty Creek, here a strike valley, opens out into alpine meadows, and travel is easy and delightful.

The section was measured on the walls of the cross-valley (Fig. 32) containing Trinity Lakes and draining to Beauty Creek, roughly 6 km from the highway, as measured along the creek. The section, commencing near the top of the Gog sandstones, was measured on the south wall (north-facing) of the Trinity Lakes valley, up to the base of the Stephen Formation. Exposures are excellent, but the successive shaly formations and members must be studied high on the valley wall in order to obtain the best exposures, while the successive cliff-forming limestones, dipping west, impose downdip excursions until points are reached where they have broken down sufficiently to allow a through route. This is physically demanding.

The Stephen Formation and the basal beds of the Eldon were measured fairly high on the north side of the valley, but stratigraphically upward, glacially scoured outcrops in the bottom of the Trinity Lakes and Beauty Creek valleys allow the Eldon and Pika to be measured with ease.

Map: 83 C/6

Section AC-53/55

Vermilion Pass

The Cathedral and Stephen formations (Section AC-53) were measured on the east slopes of the northeast spur of Mount Whymper, east of the prominent normal fault that separates the northeast spur from the peak. The exposures are accessible along broad avalanche paths that are clear of nearly all timber down to the level of Highway 93, about 5 km uphill from Marble Canyon.

The Eldon and Pika formations (undifferentiated) and the Field Member of the Eldon Formation were measured on a spur directly opposite the exposures described above, across Vermilion River. The spur descends from an unnamed peak between Stanley Park and Storm Mountain. This spur and Section AC-55 are reached by following the well marked Stanley Glacier trail from the highway to a point beneath the small knob or tower at the point of the spur. From this point, it is necessary to climb straight up a steep hillside through heavy bush until outcrop (Cathedral Formation) is reached. Passage upward to the top of the Stephen Formation is straightforward. Measurement commenced at the top of the Stephen, and followed a steep gully, almost a chimney, upward to the ledge formed by the Field Member. The exposures of the Field Member at the terminus of the spur are richly fossiliferous. From this point, direct upward progress is barred. The section continues upward, following the rather frightening ledge formed by the basal Field Member along the south face of the spur for about 0.8 km (protective headgear is essential), to a second chimney that permits upward progress to the base of the Arctomys Formation. This route is not feasible for those lacking mountaineering experience.

Maps: GSC 1295A, GSC 1476A

Sections AC-86/87

Roche Miette

The section was studied in two parts. The upper part, Section AC-86, commences low in the Eldon Formation and extends upward into Upper Cambrian strata, and was measured at reasonably accessible exposures near the top of a long, largely unforested spur projecting northwestward from the northeast shoulder of Roche Miette toward Highway 16 (see

Figure 73). At this locality, the base of the Eldon Formation is covered, as are lower formations.

The lower part of the section, Section AC–87, spans the interval from the uppermost beds of the Gog Group to the lower Eldon Formation, and was measured on the northeast slopes of a minor summit (elevation 7300 ft/2225 m) that lies midway between Capitol Mountain and Utopia Mountain, 9 km south-southeast of Roche Miette, directly overlooking Miette Hot Springs to the northeast. The two sections are correlated on the contact between two distinct lithological units of the Eldon Formation, and, hence, some duplication or loss of section cannot be ruled out. The somewhat disturbed section of the Eldon at Section AC–87 does not precisely duplicate the sequence of rock units at Section AC–86, and appears to be 55 ft (17 m) thinner, on the basis of the correlation described above. Access to Section AC–87 involves a climb of nearly 3000 ft (914.4 m) up steep, mainly forested slopes.

Maps: GSC 40-1959; 83 F/4

Section AC–89

Chetamon Mountain
(Type section of the Snake Indian Formation)

Two streams, nearly parallel to one another, drain the southeast face or terminus of Chetamon Mountain. Section AC–89 was measured in the more easterly of the two streams. Access is from the road to Celestine Lake, which joins Highway 16 a little north of the Snaring River bridge (the road may be restricted to one-way traffic at certain times of the day). We found that, to access the Snake Indian Formation, it is preferable to climb the "nose" between the two streams described above (Fig. 60), as the lower part of the easterly stream occupies a difficult canyon. From this "nose", at an elevation about level with the base of the section in the stream to the east, it is not difficult to traverse "along the contours" and into the stream bed, following well developed game trails.

For the part of the section involving the upper Eldon Formation and younger strata, the best approach is via the same "nose", continuing upward until the dip slope (here forested) atop the Eldon Formation is gained. From this point, the cuesta can be followed northward until continuous exposures are reached.

Maps: GSC 47-1963; GSC 1499A (1:250 000 scale); 83 E/1

Section AC–94

Mount McDonald

The section at Mount McDonald is one of the less accessible sections described here, unless reached by helicopter (an allowable alternative, because it lies outside the national parks). If the helicopter option is not available, access must be on foot or horseback, and, because of the distance, camping equipment must be carried to the vicinity of the mountain. No horses are available for rental on the highway near the point of commencement and, accordingly, horses, if required, must be trucked to the area.

The trail to the upper Brazeau River, through Nigel Pass, departs from Highway 93 near the junction of Hilda and Nigel creeks, about 8 km southeast of Sunwapta Pass (the boundary between the Banff and Jasper national parks), and is best sought on the east bank of Nigel Creek. The lower part of the section (Fig. 80) is best approached from a camp set up on the north side of the Mount McDonald massif, or in the general vicinity of the warden's cabin, about 25 km by trail from the highway. A camp so located will serve as a base for the examination of the whole section. For the upper part only, certainly down through the Pika Formation and if necessary down through the Stephen, a camp west of the massif and considerably closer to the highway will serve.

There is only the one trail in the area. The line followed in measuring AC–94 is indicated on Figure 80, and the choice of route from the horse trail to the various parts of the line of section is left to the mountaineering judgement of the visitor.

Maps: 83 C/6 and 7

Section AC–102

Eon Mountain

The section on Eon Mountain was measured using a helicopter for access. Such an approach is still possible, as the section lies outside the national and provincial parks, and the Stephen Formation forms a ledge broad enough for helicopter landings on the south slopes of the mountain. On the other hand, by 1981, logging

roads that apparently follow Cross River upstream from Kootenay River were observed from the air to have reached Mount Brussilof, thus permitting vehicular access to within 6 km of the foot of Eon Mountain. Nevertheless, the day spent measuring the section from the Stephen Formation to the top of the Waterfowl Formation on Eon Mountain was a strenuous one; with a start at the level of the creek, the climb would be brutal. Although the slopes of Eon Mountain are steep and imposing (Fig. 74), my assistant and I found them surprisingly easy to traverse.

Maps: 82 J/11, 12, 13, and 14

Section AC–103

Mount Wedgewood
(Reference section for the Naiset Formation)

Lake Magog, in Mount Assiniboine Provincial Park, is accessible on foot or horseback by two or more routes. Conditions of road access to the trails and the availability of horses change from year to year, and those wishing to visit the area are advised to obtain up-to-date information in Banff and/or Canmore. Access by helicopter also may be available, through one or more firms providing so called "heli-hiking" trips.

Section AC–103 commences at the base of the Naiset Formation on an outward bulge on the east side of the Wedgewood Peak/Sunburst Peak ridge, 700 m west of the southern tip of Lake Magog and roughly 300 m above lake level. A zigzag route upward across the bulge, following a chain of ledges and easy chimneys, leads the climber to the Stephen Formation beneath Wedgewood Peak (Fig. 25). The route offers no severe mountaineering difficulties, but the use of a rope for protection is advisable at one or two particularly exposed pitches.

Map: 82 J/14

Sections AC–112/114

Mount Stephen, North Gully and Fossil Gully
(Type section of the Takakkaw Tongue of the Cathedral Formation)

The north face of Mount Stephen is approached from the railway line that crosses its foot; the railway is reached from the long downgrade from Kicking Horse Pass on Highway 1, on the south side of Kicking Horse River. The Naiset Formation was measured at good exposures (Section AC–112) immediately east of North Gully (Fig. 37). The Cathedral and Stephen formations were reached by ascending the steep, timbered "nose" between Middle Gully and Fossil Gully to the base of the Takakkaw Tongue of the Cathedral, and then climbing diagonally upward and westward toward Fossil Gully. Travel is easiest in Fossil Gully itself, but the Fossil Gully Fault has localized some severe dolomitization in this gully that has obscured lithological detail and destroyed fossils. Accordingly, our route of measurement stayed east of the gully and departed increasingly from it upward, the only climbing problem being the outward-sloping bedding planes of a large, half-dome-like feature that must be crossed (Fig. 37). A narrow gully immediately east of the half-dome provides a route upward and into the Stephen Formation. A straight traverse upward through the Stephen encounters progressively steepening cliffs and dangerous exposure to rockfall. Accordingly, about halfway through the Stephen Formation we offset our line of measurement to a gully that lies a few hundred metres west of the Cathedral Escarpment (Fig. 37); this route provided easier climbing to the base of the Eldon Formation, with less risk of bombardment, owing to the reduced area of cliffs overhead.

Map: GSC 1483A

Sections AC–122/123

Kicking Horse Pass

The outstandingly informative roadcuts forming these sections are on Highway 1, a short distance west of the outlet of Wapta Lake. The base of the continuously exposed part of the section is at the bridge over Kicking Horse River, and the top at Sherbrooke Creek. A broad, graded area south of the highway, opposite the upper leg of the Section (AC–123) provides safe parking. The Peyto Formation and the base of Mount Whyte are accessible but poorly exposed (and, in recent years, heavily overgrown) on the south side of the river, near the west abutment of the old, abandoned highway bridge.

Map: GSC 1483A

Sections AC-142/143

Chaba River

The section along the Alberta/British Columbia boundary, following the ridge immediately west of Chaba River, near Fortress Lake (Fig. 81), is the finest Cambrian section in the region. It extends, unfaulted and virtually completely exposed, from the lowest known Lower Cambrian fossiliferous unit (Mural Formation) well into the Ordovician. Biostratigraphically useful fossils are well distributed throughout the section. Unfortunately, it is also one of the least accessible of the sections of prime importance.

Access on foot is all but out of the question. The Athabasca River constitutes an impassable barrier most of the year to access from Sunwapta Falls. On the other hand, the distance from Athabasca Falls to the east end of Fortress Lake is over 40 km, and that only partly over established trails. Access is preferably by helicopter, from either Valemount, British Columbia, or Golden, British Columbia. Helicopter access is now generally prohibited in the national parks; therefore, the landings must be on the British Columbia side of the boundary, in Hamber Provincial Park. The positions of our camps are marked on Figure 81 (Air Photo.).

A lower cost, but more physically demanding approach would be to land at Fortress Lake by float plane, and proceed on foot to the section, along the banks of Chaba River or Chisel Creek. This scheme would involve carrying at least two fly camps from the lake to sites within striking distance of the section.

The line of section offers little in the way of mountaineering difficulties except for the barrier of the Eldon Formation, whose literally unscalable cliffs caused us to leave it incompletely measured and examined.

Map: 83 C/5

Section AC-160

Tokumm Creek

Section AC-160, on the eastern slopes of the ridge connecting Mount Biddle and Mount Oke, lies about 8 km from Lake O'Hara Lodge. Most of that distance is over excellent trails, but care should be exercised in traversing Opabin Glacier in Opabin Pass. Lake O'Hara Lodge is accessible by bus, on a twice-a-day schedule, from Lake Louise and from Wapta Lodge at Wapta Lake.

The slopes of the section are steep, but offer no serious mountaineering difficulties.

Map: GSC 1483A

Sections AC-161/162

Upper Mount Field

The section exposing the basinal aspect of the Stephen Formation on the upper western portion of the south face of Mount Field (Fig. 39) can be reached directly from below, along the line of the first gully west of the old portals of the Kicking Horse Mine. This route is not recommended, however, because it involves much dangerous scrambling and some fairly serious rock climbing.

The preferred approach is from Burgess Pass, accessible via excellent trails from Field and Emerald Lake (about 2 hours). From the point at which the trail turns northward to contour the Mount Field/Wapta Mountain ridge, the route angles upward and southeastward, over talus and sloping slabs of outcrop, to the step in the profile of Mount Field caused by the Fossil Gully Fault. From the step, the gully eroded along the fault provides a steep but easy descent route to the top of the Cathedral Formation. The route of measurement stays east of the main Fossil Gully Fault, but does encounter some minor subsidiary faults. From the top of the Stephen Formation, steep but traversable slopes on the Eldon dolomites east of the gully lead to the southwest "nose" of the peak, which is reached at about the level of the Field Member. It is worthwhile to persist and continue to the peak of Mount Field itself, to observe there the peritidal, "rim" facies of the Eldon Formation.

Map: GSC 1483A

Section AC-164

Mount Henry

Mount Henry lies about 11 km west-northwest of Jasper townsite, in an area devoid of established trails. The "cleaver" (Fig. 83) extending northward from the peak, between the cirques flanking Mount Henry on

the east and west, provides an excellently exposed, steeply dipping section (overturned toward the north at higher stratigraphic levels).

The section was accessed by helicopter, an option probably no longer available because of changes in Parks Canada policy. It would appear that the best approach would be for foot travellers to obtain (from the Jasper Park Information Bureau) up-to-date information on trails leading to the chain of small lakes south of the Mount Henry/Cairngorm ridge. From the end of the trail providing the closest approach, the route to the section passes through the Mount Henry/Cairngorm col. To provide sufficient time on the section, it would be necessary to carry in equipment and camp in the vicinity.

The only serious barrier to progress along the ridge is found at the top of the Eldon Formation, where a nearly vertical dip slope descends to the base of the Pika Formation. We descended this cliff by the rappel technique, securing the rope to a piton.

Maps: GSC 47-1963; GSC 1499A (1:250 000); 83 D/16

Sections AC-165/166

Cinnamon Peak/Whitehorn

I worked the Cinnamon Peak/Whitehorn section from a fly camp (established by helicopter) at timberline in the east-draining cirque that heads at the Cinnamon Peak/Whitehorn col. This campsite is about 8 km on foot from the end of the road at Kinney Lake. The route follows the Berg Lake horse trail as far as the bridge crossing to the west side of Robson River, and then strikes uphill, westward, into the cirque.

The line of section is shown in Figure 84. The only geological problem is that of establishing a tie between the lower part of the section (AC-165) and the upper (AC-166). Bedding emphasized by glacial scour, clearly visible in the air photograph, provides confirmation of the tie based on correlation of lithic units.

Mountaineering difficulties are few, and are confined to the upper part of the section. Progress up the southeast spur of Whitehorn Mountain eventually becomes impracticable (Fig. 84), and involves another offset to a line almost directly below the south ridge of the peak itself. On this line, in mid-August, 1966, my assistant and I were narrowly missed by a large, wet-snow avalanche.

Maps: GSC 1499A (1:250 000); 83 E/3

Section AC-171

Mount Weed

(Reference section of the Peyto Formation and type section of the Weed and Chephren members of the Mount Whyte Formation)

The stream occupying the gully along which Section AC-171 was measured is an inconspicuous feature, commonly dry, where it crosses Highway 93 (Fig. 6). It can be found by striking uphill from a point on the highway 2.9 km south of Silverhorn Creek. The forest is fairly open, and the banks of the stream, once encountered, provide a good route to the outcrops.

Map: 82 N/15

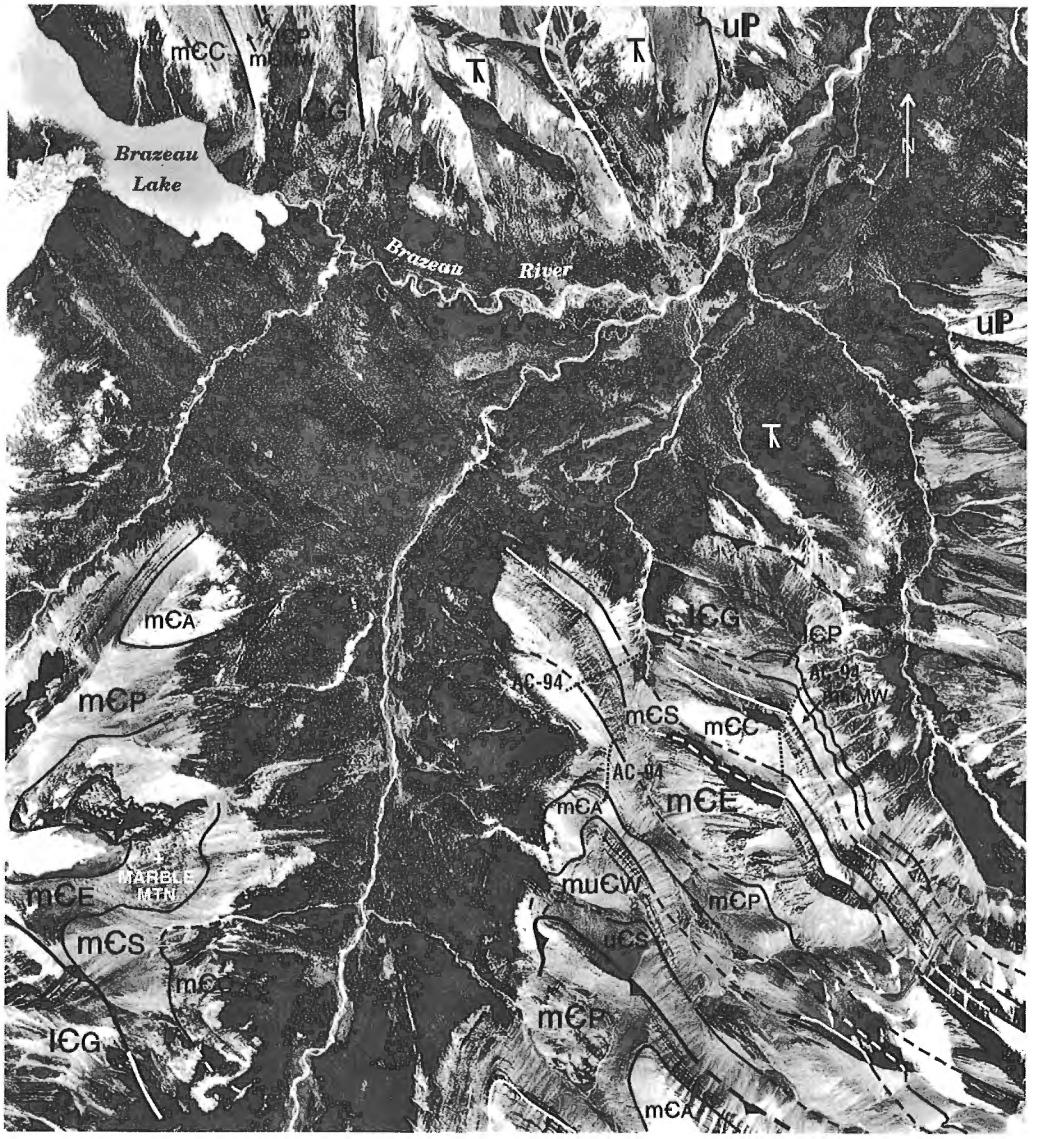

Figure 80. *Cambrian strata at Brazeau Lake and Mount McDonald (lower right). The dotted line marks the route of measurement for Section AC–94.* lЄG*–sandstones of the Gog Group;* lЄP*–Peyto Formation;* mЄMW*–Mount Whyte Formation;* mЄC*–Cathedral Formation;* mЄS*–Stephen Formation;* mЄE*–Eldon Formation;* mЄP*–Pika Formation;* mЄA*–Arctomys Formation;* muЄW*–Waterfowl Formation;* uЄS*–Sullivan Formation;* uP*–upper Paleozoic strata;* Ʈ*–Triassic strata. National Air Photo Library, part of Air Photo A14812-46.*

Figure 81. *Cambrian strata at Chaba River and Fortress Lake. Annotation as for Figure 80, with the following additions:* lЄMc*–McNaughton Formation;* lЄMu*–Mural Formation;* lЄMa*–Mahto Formation;* mЄA-W*–Arctomys and Waterfowl formations, undivided;* uЄS*–Sullivan Formation;* uЄL*–Lyell Formation;* uЄBC*–Bison Creek Formation;* uЄM*–Mistaya Formation;* O*–Ordovician. Dotted lines mark the routes of measurement for Sections AC–142 and AC–143. National Air Photo Library, part of Air Photo A14812-85.*

Figure 82. *Cambrian strata of the frontal (McConnell) thrust sheet at Ghost River. Annotation as for Figure 80, with the following additions:* muЄA-Lx*–Arctomys Formation and Lynx Group, undivided;* D*–Devonian strata;* K*–Cretaceous strata. National Air Photo Library, part of Air Photo A13252-176.*

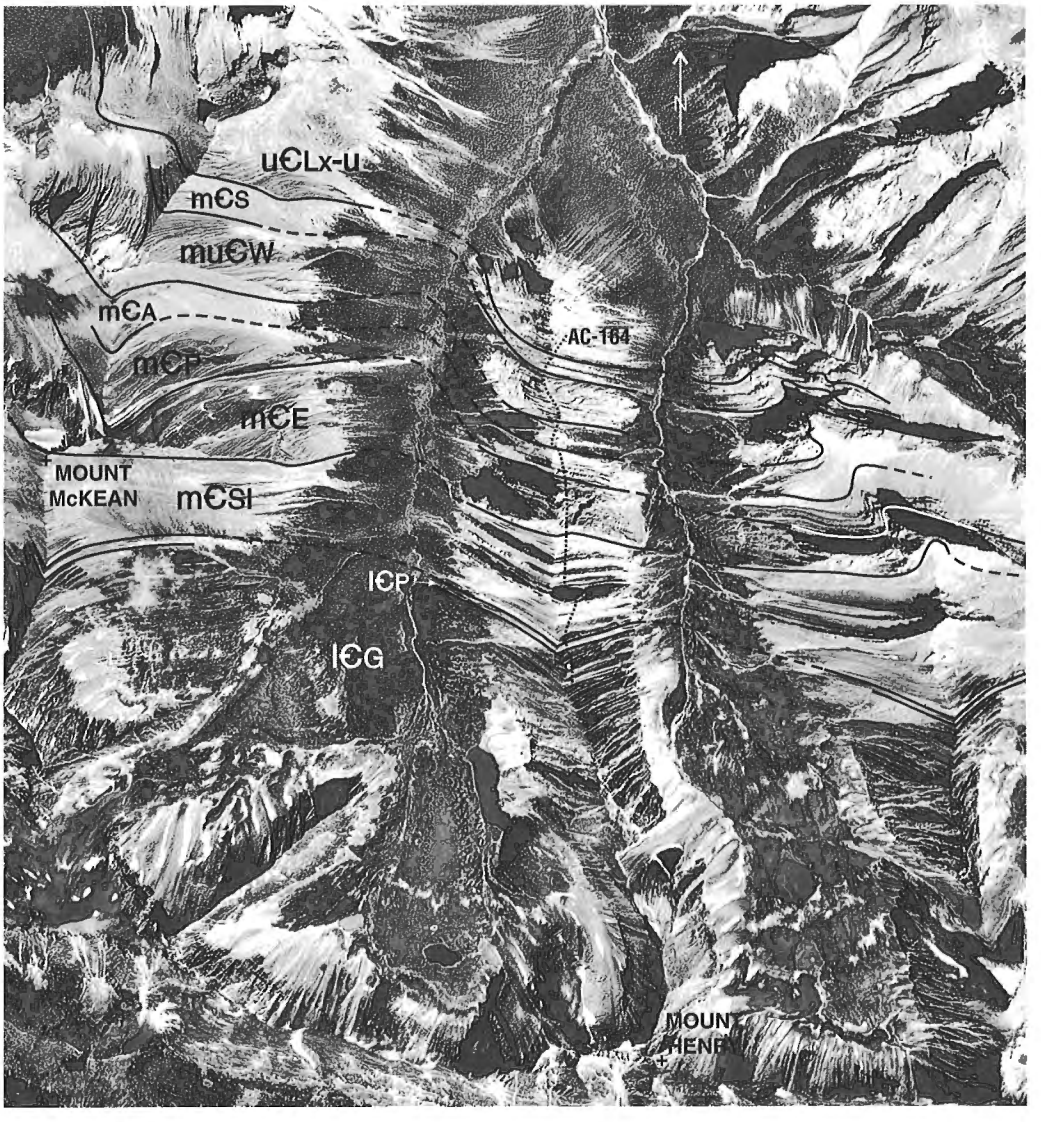

Figure 83. *Cambrian strata near Mount Henry. Annotation as for Figure 80, with the following additions:* mЄSI*–Snake Indian Formation;* uЄLx*–Lynx Group (upper division). The dotted line marks the route of measurement for Section AC–164. National Air Photo Library, part of Air Photo A13514-265.*

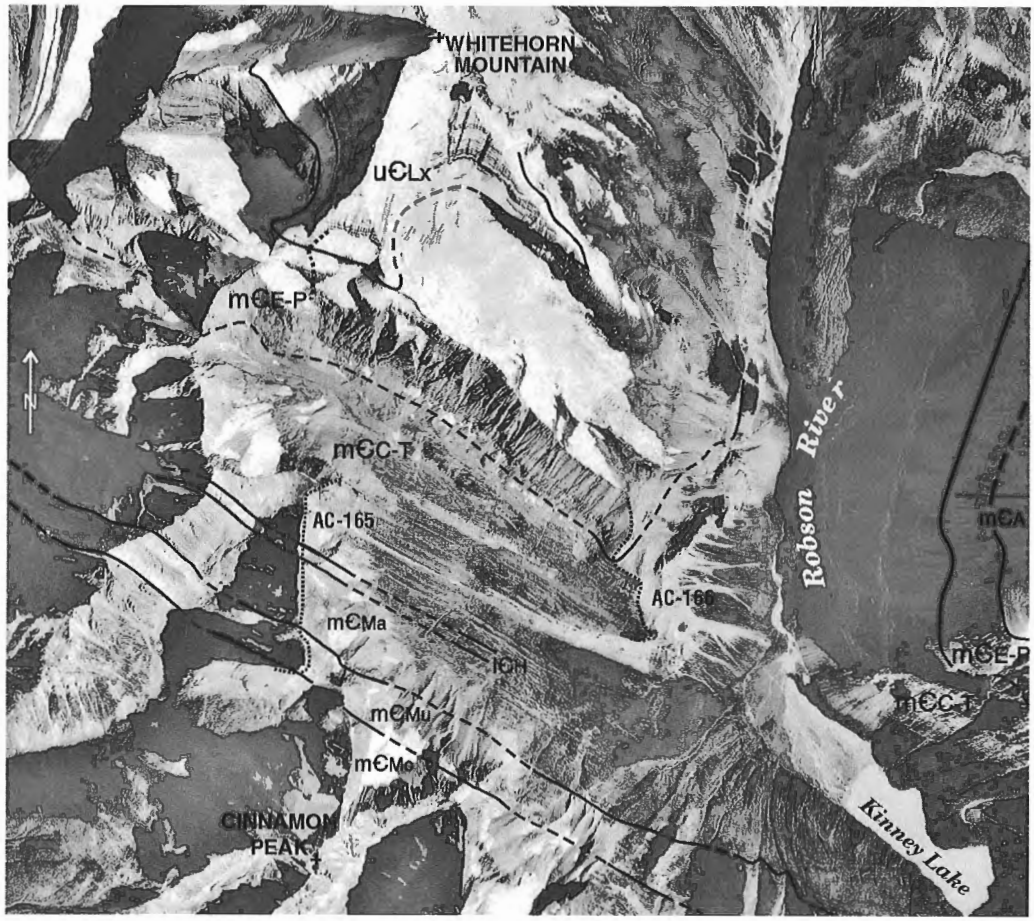

Figure 84. *Cambrian strata at Cinnamon Peak/Whitehorn Mountain (Mount Robson district).* lЄMc*–McNaughton Formation;* lЄMu*–Mural Formation;* lЄMa*–Mahto Formation;* lЄH*–Hota Formation;* mЄC-T*–Chetang and Tatei formations, undivided;* mЄE-P*–Eldon and Pika formations, undivided;* mЄA*–Arctomys Formation;* uЄLx*–Lynx Formation (with Arctomys equivalents at its base). Dotted lines mark the routes of measurement for Section AC–165 (lower part) and Section AC–166 (upper part). National Air Library, part of Air Photo A13525-29.*

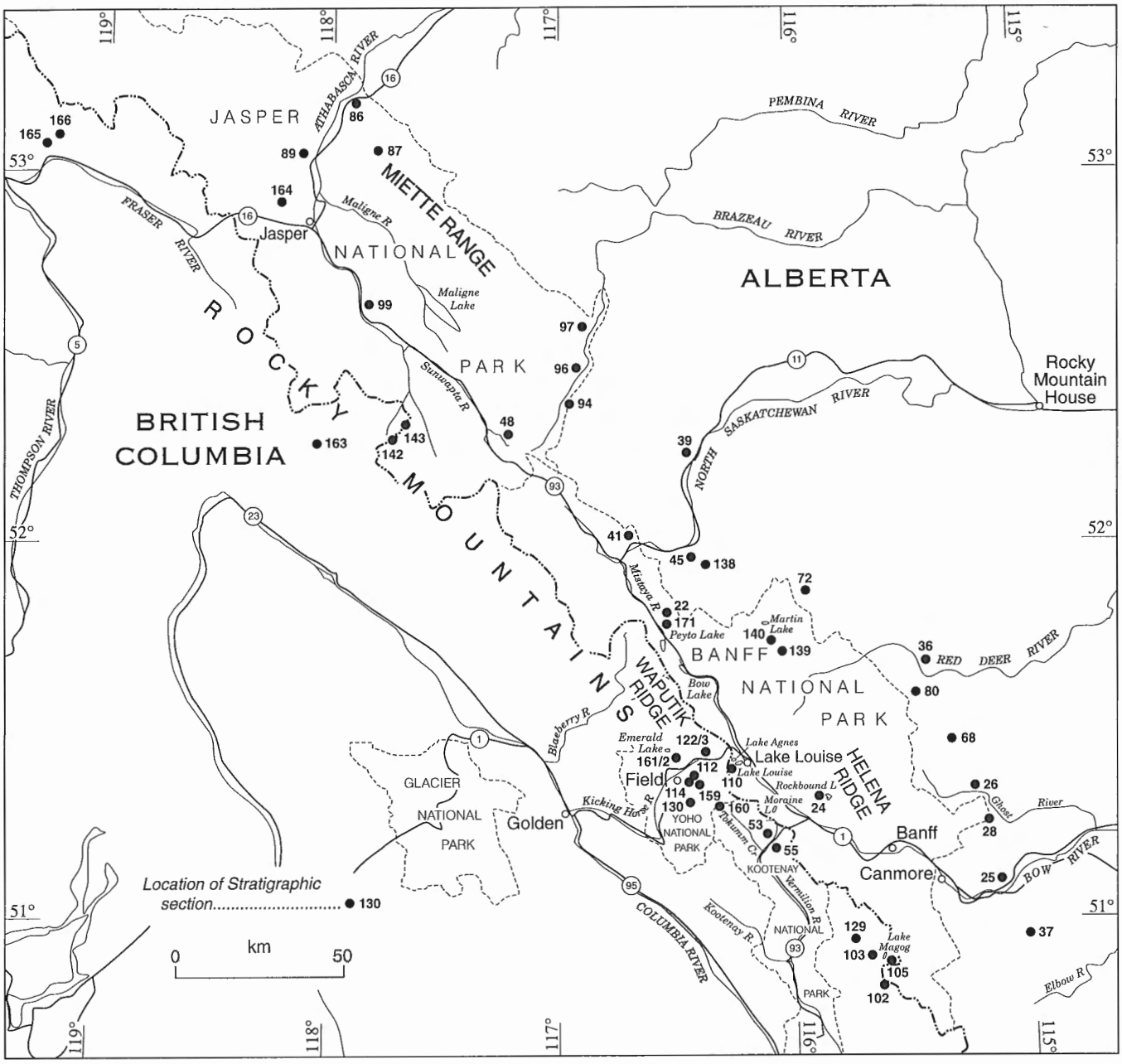

Figure 85. *Index map identifying all stratigraphic sections measured and described for the present study. All numbers are preceded by the letters AC, which identify the author's collections.*

APPENDIX D

PUBLISHED GEOLOGICAL MAPS WITHIN THE BOUNDARIES OF THE STUDY AREA

Map area	NTS	Map no.	Author
SCALE 1:250 000			
Calgary	(82 O)	1457A	N.C. Ollerenshaw
Kananaskis Lakes	(82 J E1/2)	O.F. 263	N.C. Ollerenshaw
Kananaskis Lakes	(82 J W1/2)	O.F. 634	G.B. Leech
Canoe River	(83 D)	15-1967	R.B. Campbell
Mount Robson	(83 E)	1499A	E.W. Mountjoy
SCALE 1:50 000			
Mount Head	(82 J/7 E1/2)	1052A	R.J.W. Douglas
Stimson Creek	(82 J/8 E1/2)	934A	G.S. Hume
Pekisko Creek	(82 J/8 W1/2)	698A	G.S. Hume and C.O. Hage
Dyson Creek	(82 J/10 E1/2)	827A	C.O. Hage
Bragg Creek	(82 J/15 E1/2)	654A	G.S. Hume and H.H. Beach
Moose Mountain	(82 J/15 W1/2)	688A	H.H. Beach
Mount Goodsir	(82 N/1 E1/2)	1476A	R.A. Price and E.W. Mountjoy
Mount Goodsir	(82 N/1 W1/2)	1477A	R.A. Price and E.W. Mountjoy
Golden	(82 N/7 E1/2)	1496A	R.A. Price, D.G. Cook, J.D. Aitken, and E.W. Mountjoy
Lake Louise	(82 N/8 E1/2)	1482A	R.A. Price, D.G. Cook, J.D. Aitken, and E.W. Mountjoy
Lake Louise	(82 N/8 W1/2)	1483A	R.A. Price, D.G. Cook, J.D. Aitken, and E.W. Mountjoy
Hector Lake	(82 N/9 E1/2)	1476A	R.A. Price, E.W. Mountjoy, and D.G. Cook
Hector Lake	(82 N/9 W1/2)	1477A	R.A. Price, E.W. Mountjoy, and D.G. Cook
Siffleur River	(82 N/16 E1/2)	1465A	R.A. Price and E.W. Mountjoy
Siffleur River	(82 N/16 W1/2)	1466A	R.A. Price and E.W. Mountjoy
Jumpingpound Creek	(82 O/2 W1/2)	1420A	N.C. Ollerenshaw
Canmore	(82 O/3 E1/2)	1265A	R.A. Price
Canmore	(82 O/3 W1/2)	1266A	E.W. Mountjoy
Banff	(82 O/4 E1/2)	1294A	R.A. Price and E.W. Mountjoy
Banff	(82 O/4 W1/2)	1295A	R.A. Price and E.W. Mountjoy
Mount Eisenhower	(82 O/5 E1/2)	1296A	R.A. Price
Mount Eisenhower	(82 O/5 W1/2)	1297A	R.A. Price
Lake Minnewanka	(82 O/6 E1/2)	1347A	N.C. Ollerenshaw
Lake Minnewanka	(82 O/6 W1/2)	1272A	R.A. Price and N.C. Ollerenshaw
Burnt Timber Creek	(82 O/11)	11-1965	N.C. Ollerenshaw
Barrier Mountain	(82 O/12 E1/2)	1273A	R.A. Price
Barrier Mountain	(82 O/12 W1/2)	1274A	R.A. Price
Scalp Creek	(82 O/13 E1/2)	1275A	R.A. Price and N.C. Ollerenshaw
Scalp Creek	(82 O/13 W1/2)	1276A	R.A. Price and N.C. Ollerenshaw
Fall Creek	(83 B/4 E1/2)	883A	J.F. Henderson
Cripple Creek	(83 B/4 W1/2)	46-22	O.A. Erdman
Whiterabbit Creek	(83 C/1 E1/2)	1388A	E.W. Mountjoy and R.A. Price
Whiterabbit Creek	(83 C/1 W1/2)	1389A	E.W. Mountjoy and R.A. Price
Medicine Lake	(83 C/13)	O.F. 372	E.W. Mountjoy