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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

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BY

D. J. McLAREN

EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
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PREFACE

As information on the Devonian rocks of the Alberta Plains increases with the drilling of each new well, the complexity of the sedimentation and facies changes becomes more apparent. Many of the problems arising can be solved by study of the formations where they outcrop in the eastern Rocky Mountains. This report is the result of such a study.

The author has examined sections in detail along a 170-mile stretch of the mountains. As a result he was able to trace the changes in lithology of strata as they passed from one environment of deposition to another. This has led to the establishment of certain correlations and the erection of several new formational names. These, and the detailed description of the rock types included in the report, will help in the interpretation of the subsurface information from the deeply buried formations farther out on the Plains.

Included with the report are five figures that illustrate the facies changes and the correlations established, as well as the stratigraphic position of the new formations proposed.

GEORGE HANSON,
Director, Geological Survey of Canada.

OTTAWA, April 20, 1955.

DEVONIAN FORMATIONS IN THE ALBERTA ROCKY MOUNTAINS BETWEEN BOW AND ATHABASCA RIVERS

INTRODUCTION

This report is a continuation and modification of deWit and McLaren (1950)[1] and McLaren (1953a and 1953b). It is an interim and not a final, stratigraphic report on the nomenclature and subdivision of the Devonian rocks in the Rocky Mountains between Bow and Athabasca Valleys, with especial emphasis on the facies changes within the Fairholme group. A study of the petrology and genesis of the sediments, and regional correlation of the Rocky Mountains Devonian is in preparation.

To simplify illustration of the facies changes within the Fairholme group, all measured stratigraphic sections have been split up into a limited number of broad facies units or informal members. Selected sections are illustrated in Figures 2, 3, 4 and 5, and the inter-relations of the facies units shown. Each facies unit includes beds of more than one type, that is, it unites several similar facies that are believed to be related or to have similar environmental significance. In this respect the grouping is interpretive, but no more so than the normal areal extension of a formational name. In many instances the variation within a facies unit has a diagenetic cause. For convenience of terminology the facies units are grouped into existing or new formations and are designated by informal descriptive member names.

Figures 2 to 5, therefore, give a simplified picture of the type of changes that take place within the Fairholme group. Figure 1 shows the approximate areal distribution of the major facies in the Fairholme group as a whole. The formations are briefly described and their lateral and vertical relations with other formations discussed, together with any changes or modifications in existing usage. Some of the important fossils that occur in each formation are mentioned but correlation with other regions is not considered. At present, the correlations suggested by McLaren (1954) are believed to be substantially correct.

Whatever their age, the Ghost River and Exshaw formations are excluded from the present discussion.

A few selected sections are described in the Appendix to furnish detailed lithological descriptions of the formations and members employed in this report, and to illustrate the type of faunal distribution.

The report embodies some of the results of field work done during the seasons of 1951, 1952, and 1953. Acknowledgment must be made to many

[1] Dates in parentheses are those of references listed on page 8.

oil company geologists for helpful discussions both in field and office, especially to Mr. G. E. Hargreaves of Canadian Superior Oil of California Limited, and Dr. J. L. Usher of Queen's University, Kingston, and Socony-Vacuum Exploration Company. R. J. W. Douglas made many helpful suggestions concerning the critical Wapiabi Gap sections and is employing on his map of that area the formational classification here proposed (Douglas, 1955). He also provided the summary section of Windy Point (section 8) used in this report. Finally, Dr. R. deWit, who introduced the writer to the Devonian of the Rockies, is gratefully acknowledged as the first to propose a satisfactory classificatory scheme for the Devonian rocks of the whole region.

Able assistance was given in the field by M. H. Havers and J. D. Moore in 1951, F. Frebold, W. A. Curle, and E. L. Fitzgerald in 1952, and R. R. H. Lemon, R. G. Greggs, and G. R. A. Manson in 1953.

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FORMATIONAL NOMENCLATURE

The history of formational nomenclature of the Devonian rocks of the Alberta Rocky Mountains has been recently discussed by Fox (1951) and McLaren (1953a). Excluding the Palliser and Alexo formations from consideration at present, a twofold formational scheme has been generally adopted; a series of names for sequences of rocks containing a high proportion of terrigenous clastic material, and a single name for sequences of rocks formed chiefly of limestone or dolomite. The following table summarizes this classificatory scheme:

'Clastic' sequence	'Carbonate' sequence
Mount Hawk formation Perdrix formation Flume formation	Fairholme formation

DeWit and McLaren (1950) described the 'clastic' sequence in the Athabasca Valley, erecting one new formation, the Mount Hawk, and adopting Raymond's earlier formations, the Flume and Perdrix (1930). In the Bow Valley region they modified Beach's Fairholme formation, erected for a largely carbonate sequence (1943), by splitting off the Alexo at the top.

Subsequent field work by many geologists has shown that, between Bow and Athabasca Valleys, transition zones occur between the two types of rock sequence. (*see* Figure 1). The Fairholme carbonate succession gives way to a shaly sequence of rocks in the region of North Ram River on the Front Range, in the Hummingbird Range, and in the Whiterabbit Range. Northwards another carbonate sequence is encountered at Wapiabi Creek in the Bighorn Range, at the headwaters of Job Creek, and at Mount Coleman. Yet farther north shaly rocks are encountered again at Mount Mackenzie, and at the headwaters of Medicine Tent River. These shaly rocks continue to the Athabasca Valley, the type area of the present subdivisions of this sequence. Northward from the Athabasca Valley further major facies changes are known to occur.

At first it seemed logical to distinguish the rock sequence of the carbonate development in the Bighorn Range-Southesk River area by a new name or group of names, to emphasize its apparent separation from the Fairholme formation of the Bow Valley. Comparison of such developments as those at Southesk and Cairn Forks (section 3) or Blackstone Gap (section 4) with typical developments of the Fairholme in Bow Valley, e.g., White Man Pass (section 15) or Fairholme Mountains (Beach 1943, p. 13), made it clear, however, that the rocks of the two areas are closely similar lithologically and genetically. Any classification that ignored this similarity would obscure one of the most striking features of these carbonate developments.

Further regional study showed that the twofold division of the Fairholme formation into members, lower and upper, was easily recognizable in every purely carbonate sequence studied, but that within these members,

and especially the upper, there tended to be detailed lithological variation from place to place. To give formal expression to this, the Fairholme is now raised to the rank of group and two new formations, corresponding to its lower and upper members, are proposed, the Cairn and Southesk formations, respectively. These formations are referred to a type section near the junction of Southesk and Cairn Rivers (section 3) but are readily recognizable in the Bow Valley area and at the type Fairholme section (Beach, 1943). Within these new formations several lithological members of more restricted geographic extent are recognized and given informal descriptive names.

In the 'clastic' development of the North Saskatchewan Valley, the same formational units previously described in the Athabasca Valley have been employed. There are, however, many facies changes in detail within these formations and the Athabasca Valley names are probably being overextended. No new names are proposed although informal descriptive members are introduced in some sections. It becomes virtually impossible to give a single over-all description of each of the formations, i.e., the Flume, Perdrix, and Mount Hawk; compare, for example, the Perdrix development at Medicine Lake (section 18) with that at Job Creek East (section 24), or the Mount Hawk at Morro Peak (section 17) with the same formation at Job Creek East (section 24). Nor may the formation boundaries be drawn on biostratigraphic evidence, although the occurrences of faunas at certain horizons have afforded valuable clues to the equivalence of some strata. For instance, the faunas in the thin detrital beds immediately above the Perdrix suggest that this formation is anomalously thin in the sections at Wapiabi Gap Southeast Side (section 7) and Deception Creek (section 2), and that the overlying beds should properly be included in the Mount Hawk. This conclusion is supported by the existence of phosphatic material in the detrital beds. The more fossiliferous sections are easily subdivided by biostratigraphic methods (McLaren, 1954) but, with the possible exception of the Mount Hawk-Alexo boundary, the faunal changes do not necessarily exactly correspond to formational boundaries. The Fairholme group is extended to include the 'clastic' sequence formations.

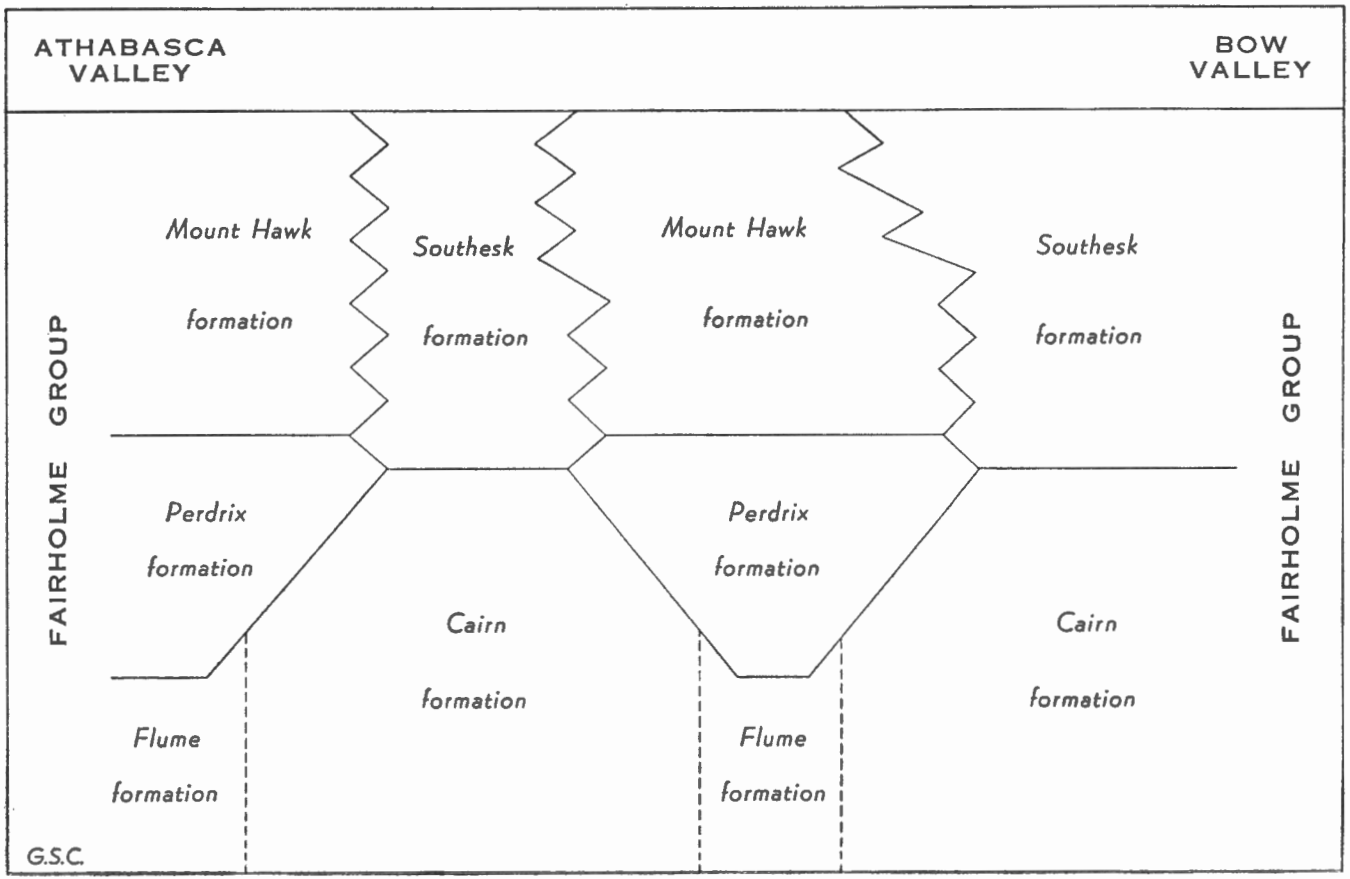
The areas where transitional facies and intertonguing relations are developed between the 'carbonate' and 'clastic' sequences present the most problems in formational nomenclature. In many sections, beds previously assigned to the Flume formation are now included in the Cairn. On approaching areas of major carbonate development the Flume (in the earlier sense) becomes increasingly biostromal and thickens at the expense of the Perdrix formation, e.g., Deception Creek (section 2) and North Ram River Gap (section 9). Further approach to carbonate areas shows the 'Flume' to be overlain by the Southesk formation, both formations being composed of almost pure carbonate rock. It would plainly obscure the stratigraphic relations of the region to extend the Flume thus far. Consequently, the term is restricted to thin developments of bedded cherty dolomites, more or less biostromal, overlain by the argillaceous upper member, e.g., Roche Miette

(section 1) and Job Creek East (section 24). The thicker, strongly organic, more massive developments, cherty in their lower part only, lacking the characteristic upper member, and traceable laterally into areas where the Southesk formation is also present, are included in the Cairn formation.

The Cairn formation has a wider geographical distribution than the Southesk but the Cairn always thickens as a Southesk development is being approached, and forms a broader 'base' for the Southesk. The Cairn, as here defined, may be overlain by the Perdrix or Southesk formation, the Flume only by the Perdrix.

Similar overlapping relations exist between the Mount Hawk and Southesk formations. At Wapiabi Gap Northwest Side (section 6) the Southesk is only partly developed. It rests on a thin tongue of Perdrix and is overlain by some 300 feet of typical Mount Hawk beds. At this section, therefore, the stratigraphic succession is Cairn, Perdrix, Southesk, Mount Hawk. Elsewhere there is a more intimate intertonguing of the two formations. At Job Creek East (section 24) beds of Southesk type occur in a predominantly Mount Hawk facies assemblage, the latter term being here applied to the whole sequence. At Job Creek West (section 23), however, the reverse occurs, and beds of Mount Hawk type occur in a sequence of predominantly Southesk facies. In transitional sections, therefore, the name Southesk or Mount Hawk is applied depending on which types of facies predominate in the sequence, again a necessarily arbitrary distinction.

It was failure to recognize the importance of thickening at the expense of the Perdrix by the Cairn (as now defined) that led McLaren (1953b) to correlate the lower Fairholme with the Flume and the upper with the Perdrix and Mount Hawk in the sections along the Ram Range between North Ram River and Cripple Creek headwaters. The correct correlations are shown on Figure 2 in this report (sections 10, 11, and 12) where the Cairn of section 10 is shown to grow at the expense of the Perdrix in sections 11 and 12; the Southesk being the approximate equivalent of the Mount Hawk only. Further details of correlation are discussed under each formation. The formational nomenclature now proposed is summarized on the following table:


ATHABASCA VALLEY
BOW VALLEY
FAIRHOLME GROUP
FAIRHOLME GROUP
Mount Hawk formation
Southesk formation
Mount Hawk formation
Southesk formation
Perdrix formation
Perdrix formation
Cairn formation
Cairn formation
Flume formation
Flume formation
G.S.C.

FLUME FORMATION

(Raymond 1930)

The type section of the Flume formation is on Roche Miette (section 1 and *see* Appendix). There the lower member consists of 101 feet of dark grey to brown, fine-grained limestone, thick bedded to massive, with some thinner beds of dolomite. In the upper part of the member stromatoporoids and *Amphipora*[1] are common and are partly replaced by chert; chert nodules are also present. The lower part has a smaller proportion of organic constituents, although scattered *Amphipora* occur.

The upper member is made up of 50 feet of fossiliferous, dark grey to black, argillaceous limestone, with some interbedded black shale.

The Flume as now restricted rarely exceeds much more than 200 feet in thickness. In the Athabasca Valley region 233 feet are developed on the Palisade (section 16), 208 feet at Morro Peak (section 17), 187 feet at Medicine Lake (section 18), and 170 feet at Rocky Forks (section 19). In the North Saskatchewan Valley region similar thicknesses are encountered; 205 feet at Job Creek East (section 24) and 157 feet at Cline and North Saskatchewan Forks (section 25).

The Flume is characterized by the well-bedded lower member of dolomite or limestone that is variably biostromal and commonly cherty, and the thinner argillaceous limestone or dolomite of the upper member.

The sections described in detail (in the Appendix) from Medicine Lake and Job Creek East may be taken as typical of the Flume in the two main regions of outcrop. It should be noted that in the section measured at North Saskatchewan River Gap (section 26), which was previously reported to include 295 feet of Flume formation (deWit and McLaren, 1950), no beds are exposed below the Perdrix.

The Flume is the lowest formation of undoubted Devonian age in the central Alberta Rockies. It rests with low angle unconformity on a variety of strata commonly of undetermined age, but which are known to be Ordovician at some localities, e.g., the Palisade (section 16). The transgression that initiated the major Devonian cycle of sedimentation in the Rockies appears to have spread across an almost plane surface. The sub-Devonian unconformity has been discussed in a general way by Harker, Hutchinson, and McLaren (1954), but the beds lying under the Devonian have not been studied systematically and the problem is complicated by dearth of faunal evidence. The Flume is everywhere overlain by the Perdrix formation. The contact is sharp in the Athabasca region where the lower part of the Perdrix is non-calcareous, but it is transitional near North Saskatchewan Valley where the Perdrix is more calcareous, e.g., at Job Creek East (section 24).

The lower Flume is sparingly fossiliferous but characteristic fossils from some sections include:

Atrypa multicostellata Kottlowski
Allanaria cf. *allani* (Warren)
Eleutherokomma jasperensis (Warren)
Athyris small sp.

---

[1]*Amphipora* is probably an aberrant stromatoporoid, but because of its characteristic form it is distinguished from the encrusting and massive stromatoporoids by name throughout this report.

This fauna was correlated with a rich fauna found in the lowermost Devonian strata at Kakwa Lake, B.C., and assigned to the zone of *Pugnoides kakwaensis* McLaren (1954). This in turn was considered to be an age equivalent of the Waterways formation of northeastern Alberta. Its age is latest middle or early Upper Devonian.

The upper Flume is normally fossiliferous, with an abundant fauna, which includes *Nudirostra athabascensis* (Kindle) and *Eleutherokomma jasperensis* (Warren). *N. athabascensis* is also known from the lowermost beds of the Perdrix and gives its name to the second rhynchonellid zone of the Devonian of the Rockies. The age of the fauna is probably early Upper Devonian.

PERDRIX FORMATION

(Raymond 1930)

The type section of the Perdrix formation is on Roche Miette (section 1 and *see* Appendix). There deWit and McLaren (1950) include 536 feet of beds in this formation, but, to make the classification more consistent regionally, it is proposed to limit the application of the term Perdrix to the lower 380 feet described by them. These beds consist of black calcareous shale with bands of calcareous nodules grading downwards into black non-calcareous friable shale. The upper 156 feet, more correctly described as grey calcareous mudstone interbedded with various amounts of argillaceous limestone, are included in the Mount Hawk formation (q.v.).

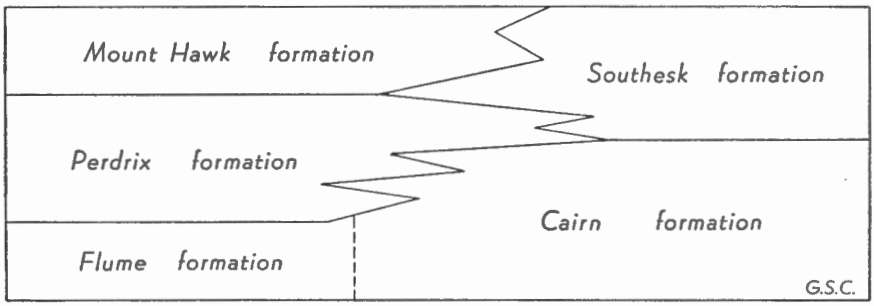
In the Athabasca Valley region the Perdrix is similar in development to the type section and of comparable thickness: 359 feet on the Palisade, 357 feet on Morro Peak, 350 feet at Medicine Lake, and 224 feet near Rocky Forks.

Farther to the south the Perdrix becomes more calcareous and is appreciably thicker. At Job Creek East (section 24) there are 468 feet of black argillaceous limestone interbedded with black calcareous mudstone and shale. This section is described in detail in the Appendix and may be taken as typical for this region. A similar development occurs near Cline and North Saskatchewan Forks (section 25), 481 feet in thickness. At Brazeau Gap there are 252 feet of similar facies exposed in the incomplete section (section 26).

In all of the sections mentioned above, the Perdrix rests on the Flume formation and is overlain in turn by the Mount Hawk. On nearing carbonate bank areas, however, thickening by the subjacent Cairn formation occurs at the expense of the Perdrix, and this continues until it wedges out between the Cairn and Southesk formations. Thus at North Ram Gap (section 9) there are 201 feet, at the head of Cripple Creek Northwest Side (section 10) only 130 feet remain, and the formation is absent on the southeast side of Cripple Creek (section 11). Non-deposition seems further to have complicated the pattern of Perdrix development. At Wapiabi Gap Southeast Side (section 7 and *see* Appendix) only 54 feet of strata assignable to the Perdrix are developed above the Cairn formation and they are overlain by phosphatic and pyritic limestone with rolled bone fragments, strongly suggesting a remanié deposit and a period of non-deposition that continued into the Mount Hawk. Similar fragmental beds overlie the 65

feet of Perdrix at Deception Creek (section 2, and *see* Appendix) and a period of non-deposition may here, too, be postulated. At both of the above-mentioned localities (sections 7 and 2) intertonguing with the underlying Cairn formation was observed.

The Perdrix in transitional areas is commonly overlain by the Mount Hawk formation, the Southesk being normally of more restricted extent than the Cairn as here defined, but a thin tongue may even extend beneath the marginal developments of the Southesk. At Wapiabi Creek Northwest Side (section 6), 25 feet of Perdrix underlie massive grey dolomites of the Southesk formation and a certain amount of intertonguing occurs between them (Belyea, 1954). The following diagram summarizes the possible stratigraphic relations of the Perdrix formation:



In the Athabasca Valley region the Perdrix is almost unfossiliferous with only a few very small species of *Lingula, Buchiola, Entomis,* and *Tentaculites.* In more calcareous sections, however, a brachiopod fauna may occur sporadically throughout. At Job Creek East *Nudirostra athabascensis* (Kindle) occurs in the lowest beds assigned to the formation and throughout the remainder *N. insculpta* McLaren is the commonest fossil. This marks a widespread although limited horizon. At several localities *Warrenella nevadensis* (Walcott) occurs, a form common to the upper *insculpta* and lower *albertensis* zones. This fauna also occurs in the lowest part of an interesting development of about 190 feet of black shale and argillaceous dolomite at the top of the Cairn formation at Red Deer Gap (section 13). As this is an isolated occurrence, this facies is merely distinguished as a separate member of the Cairn formation rather than Perdrix, of which, however, it is the undoubted equivalent, lithologically and faunally.

MOUNT HAWK FORMATION

(DeWit and McLaren, 1950)

The type section of the Mount Hawk formation is on Roche Miette (section 1, and *see* Appendix). DeWit and McLaren (1950) included 475 feet of beds within the formation, but, as with the Perdrix, the formation is here redefined to accord with the regional development of similar beds and as redefined is 549 feet in thickness. The upper 156 feet of the Perdrix, as described by deWit and McLaren (1950) are now included in the Mount Hawk, and the upper 82 feet of their Mount Hawk are now

classified with the Alexo formation. Three main lithologic types, distinguished by informal descriptive member names, are present, the lowest being 247 feet of light grey calcareous mudstone interbedded with argillaceous limestone and designated the grey mudstone and limestone member. This grades upwards into 197 feet of the richly fossiliferous argillaceous limestone member, which also includes minor amounts of black mudstone. This is overlain with a sharp change in lithology by 105 feet of the grey limestone member, which is thick-bedded to massive and highly variable in thickness along the hillside.

Owing to the highly variable facies types, which are seen to constitute the Mount Hawk formation when it is followed for any distance, informal descriptive member names have been introduced in many of the described sections. The type section is in fact a transitional development between a fully carbonate bank sequence, referable to the Southesk formation, and a normal basinal development of thin, dark grey to black, argillaceous limestone or dolomite. The standard basinal facies may be seen at the Palisade (section 16) where 259 feet of black argillaceous limestone interbedded with calcareous shale is exposed; similar developments occur at Morro Peak, and Medicine Lake, the thickness at both places being 219 feet. There is evidence of reduced deposition or non-deposition at the top of the formation in many sections where a basinal type facies is developed and several feet of siltstone or sandstone may underlie the Alexo.

Southeastward from Roche Miette a similar grey calcareous mudstone and limestone lower member is found near Rocky Forks and Deception Creek, also overlain by an argillaceous limestone member. The thickness of the formation at these localities is 535 and 465 feet respectively. This lower member may be traced over most of the North Saskatchewan Valley region varying principally in the proportion of calcareous bands within the grey or greenish grey mudstone. This is the 'green shale' of some field geologists in this region. At Wapiabi Gap Southeast Side 581 feet of this member are developed, and westwards, 298 feet at Cline and North Saskatchewan Forks and 370 at Job Creek East. Approaching carbonate banks, this grey mudstone member thins and lenses out, overlying the lower dolomite member of the Southesk formation (q.v.), e.g., Wapiabi Gap Northwest Side and Job Creek West. It, therefore, forms one of the facies members of the Southesk formation in some sections (*see* Mount Coleman, section 22), as well as being a member of the Mount Hawk.

The upper beds of the Mount Hawk in the central region consist of argillaceous limestones and dolomites with a varying proportion of beds of one or more facies types that are fully developed in the Southesk formation—mainly coral beds and massive grey dolomites or granular limestones that are described in the discussion of the Southesk. These upper members may occur in any order, for instance, at Job Creek East the grey calcareous mudstone and limestone member is overlain by 74 feet of argillaceous limestone, 65 feet of coral beds, and 67 feet of grey dolomite; whereas at Cline and North Saskatchewan Forks (section 25) the grey calcareous mudstone member is overlain by 82 feet of biohermal grey dolomite and 202 feet of coral beds. The over-all thickness of the Mount Hawk is highly variable in this central region, ranging from 863 feet at Wapiabi Southeast Side to 399 feet at North Ram Gap and from 815 feet at Brazeau Gap to 478 feet

at Job Creek East. The remarkable and abrupt thinning of the formation between Wapiabi Gap Southeast and Northwest Sides, from 863 to 323 feet, is due to the sudden development of 529 feet of massive grey dolomite of the Southesk formation. This dolomite mass rests on the Perdrix formation and its deposition must have commenced before the grey calcareous mudstone of the lower Mount Hawk began to be deposited.

Brief mention should be made of the development of bioherms in the upper part of the formation. On the northern flank of Cardinal Mountain (south of Mountain Park), near Cline and North Saskatchewan Forks, and elsewhere, small carbonate bioherms, some 200 feet long by 150 feet thick, were observed in bedded limestones. Although commonly dolomitized they appear to be formed of stromatolitic material, and were presumably algal in origin.

With the exception of the section at Wapiabi Gap Northwest Side where it rests on the lower part of the Southesk formation, the Mount Hawk rests on the Perdrix and is everywhere overlain by the Alexo formation. It was never observed in contact with the Cairn formation.

The Mount Hawk is richly fossiliferous in some sections, although the typical basinal facies is commonly barren. Faunules tend to be restricted to grey argillaceous limestone facies and may occur at any horizon. Allowing for local variation, the fauna of the whole formation appears to be remarkably uniform and little or no zonation is apparent. In addition to abundant corals the following brachiopods are especially diagnostic:

Devonoproductus ex gr. *walcotti* (Fenton and Fenton)
Nudirostra albertensis (Warren)
Cyrtospirifer cf. *whitneyi* (Hall)
Indospirifer n.sp. cf. *I. orestes* (Hall and Whitfield)
Tenticospirifer cyrtiniformis (Hall and Whitfield)
Thomasaria rockymontana (Warren)

In the lower beds, *Warrenella nevadensis* (Walcott) overlaps the ranges of upper part of the *insculpta* zone and lower part of *albertensis*.

At Red Deer Gap (section 13) the upper part of 178 feet of argillaceous dolomite at the base of the Southesk formation contains *Cyrtospirifer*, a genus unknown below the *albertensis* zone.

CAIRN FORMATION

The name Cairn formation is proposed for the brown to black organic dolomites that are typical of the lower part of the Fairholme group in the Bow Valley and Southesk-Bighorn regions. The type section is chosen on the northern spur of Mount Dalhousie, immediately south of the Southesk and Cairn Rivers junction.

The Cairn may be divided into two members, which are widely recognizable. The lower, designated the cherty dolomite member, is 101 feet thick at the type section and consists of dark grey, fine-to medium-grained dolomite with nodules, bands, and stringers of chert abundant in the upper 70 feet. Some stromatoporoids occur in the top 65 feet, and *Amphipora* is abundant in bands below.

The upper or organic dolomite member is 457 feet thick at the type section, and is formed of grey to dark brownish grey to brown, medium-grained dolomite, medium- and thick-bedded to massive and slightly

argillaceous, with very abundant traces of organic remains. The thicker and massive units are largely composed of spheroidal stromatoporoids with scattered *Amphipora* and corals all of which weather a lighter grey than the matrix. Scattered calcite filled vugs occur and most beds emit a fetid odour when broken. These masses constitute the "black reefs" of McLaren (1953a). The thinner bedded units contain fewer stromatoporoids but *Amphipora* is very abundant and tends to be restricted to definite bands, interbedded with laminated and apparently detrital dolomites. These are the "stromatoporoid and *Amphipora* beds" and the "bedded dolomites" of McLaren (1953a). Rapid alternations of these dominant types of facies occur and the thick-bedded to massive stromatoporoidal developments appear to be broadly lenticular. There is evidence of numerous breaks in the succession—minor erosion surfaces, channelling, and sudden facies changes. The main diagnostic features of the whole formation are its dark colour and more or less well-bedded, strongly biostromal carbonate character.

Elsewhere in the Southesk-Bighorn region the Cairn is similarly developed. Two miles northwest of Wapiabi Gap (section 5) there are 443 feet, 164 feet of which are assigned to the cherty dolomite member. At Blackstone Gap (section 4) 767 feet are present, the lower 285 feet belonging to a cherty dolomite and limestone member, although this thickness may be unreliable owing to faulting.

To the west, the Cairn is well developed at Job Creek West (section 23) with at least 509 feet present, the base of the 88-foot cherty dolomite and limestone member being cut out by faulting. At Mount Coleman the thickness has risen to 837 feet, including 374 feet of cherty dolomite at the base. Southwards towards the Bow Valley the thicknesses appear more consistent, with the lithology remaining essentially similar. At the head of Cripple Creek Southeast Side (section 11) 637 feet were measured, 654 feet at Twin Falls Creek (section 21), 639 feet at White Man Pass (section 15), and 644 feet at the Fairholme type section (Beach, 1943). In many of these sections various proportions of strata may be undolomitized or partly dolomitized, and the degree of dolomitization may vary along strike. At James Pass, on the northwest side of the valley, most of the Cairn is dolomite, except for part of the cherty member at the base. To the southeast, however, most of the lower part of the formation is grey, medium-grained, biostromal limestone. In all the above sections the Cairn formation is overlain by the Southesk, with which it may intergrade for as much as 50 feet of beds.

In areas transitional between the mainly clastic successions where the Flume is the lowest formation of the Fairholme group and the carbonate bank successions made up of the Cairn and Southesk formations, the Cairn is overlain by a reduced Perdrix. As previously discussed, all the transitional area developments of biostromal carbonates that have thickened at the expense of the Perdrix and which may be traced into a full carbonate sequence, are arbitrarily referred to the Cairn formation in order to emphasize their essential unity with the full carbonate successions. The lithology of the Cairn in these transitional areas is similar to the full developments but with a reduced upper, organic dolomite member. At Mount Mackenzie (section 20) a typical development occurs. Here 125 feet of the cherty dolomite member are overlain by 233 feet of strongly

stromatoporoidal, thick-bedded and massive, dark grey to brown dolomites interbedded with thinner *Amphipora* beds. The thickness of the formation is highly variable along the hillside and is overlain by a variable thickness of Perdrix. Similar developments occur at North Ram Gap (section 9), Wapiabi Gap Southeast Side (section 7), and Deception Creek (section 2). In the two last named sections intertonguing relations with the Perdrix have been observed

The Cairn rests on a variety of strata of various ages. In the Front Ranges beds of undetermined age, referable to the Ghost River formation, separate the Cairn from Middle and Upper Cambrian formations. Farther west the Cairn rests on Ordovician formations ranging in age from low Canadian to possible Richmond. The base of the Cairn is continuous with the base of the Flume and deposition of the two formations is believed to have begun simultaneously. Further general discussion of the sub-Devonian unconformity is given in Harker, Hutchinson, and McLaren (1954).

The Cairn, although largely composed of organic remains, contains few diagnostic fossils. *Atrypa* and other brachiopod traces occur throughout and in some sections *Eleutherokomma jasperensis* (Warren) and *Allanaria* sp. have been found in the lower beds. The cherty dolomite member plainly corresponds approximately to the lower Flume formation although the upper limits of chert development are somewhat irregular. Hence the organic dolomite member is commonly equivalent to the upper Flume and most of the Perdrix formation. All of the Cairn is, therefore, of pre-*albertensis* age.

SOUTHESK FORMATION

The name Southesk formation is proposed for the thick-bedded to massive, grey dolomites and limestones and coral beds that are typical of the upper part of the Fairholme group in the Bow Valley and Southesk-Bighorn regions. The type section is chosen on the northern spur of Mount Dalhousie, immediately south of the Southesk and Cairn Rivers junction. The formation is complete on this hillside, but the granular limestone member is more conveniently examined on the southeast side of the mountain that rises immediately to the west of the junction between Cairn and Southesk Rivers. The exposures on both mountains are excellent and correlation between them positive.

At the type section the Southesk, which is 528 feet thick, may be divided into three members. The lower, designated the grey dolomite member, consists of 281 feet of thick-bedded to massive, coarse-grained, structureless dolomite, grey to light grey or brownish grey in colour. In the lower part there are some thin-bedded, darker coloured horizons, slightly argillaceous and with some stromatoporoid and coral remains. Towards the base the dolomites become increasingly calcareous and some bedded limestones are developed. The lowest beds of the member grade downwards into the Cairn formation. The middle, coral bed, member is 45 feet thick and is formed of dark brownish grey, slightly argillaceous, medium-grained dolomite, thick-bedded to massive and with abundant *Amphipora,* massive stromatoporoids, tabulate and rugose corals that show white on weathered surfaces. The upper and lower contacts of this member are commonly

sharp. The upper, or granular limestone member, consists of 202 feet of light brownish grey, granular limestone, thick-bedded to massive. The lower 70 feet are variously altered to light grey, medium- and coarse-grained dolomite. The granular limestone is composed of irregularly rounded granules of aphanitic limestone up to 0·1 mm. in diameter in a clear calcite matrix; various amounts of bioclastic debris are present in some beds and calcispheres are abundant throughout. *Amphipora* is found at all horizons although it is scarce and far from being an important rock-building constituent. A few spherical stromatoporoids were observed.

Elsewhere in the Bighorn-Southesk region the upper member of the Southesk is more dolomitized. At Blackstone Gap (section 4), where the formation is 589 feet thick, the 171-foot upper member is formed of grey to light grey, calcareous, medium- to coarse-grained dolomite, only the upper 13 feet being of coarse dolomitic limestone. The lower part of the underlying 78-foot coral bed member consists of richly fossiliferous argillaceous limestone, the upper beds being of brown argillaceous dolomite with corals, similar to the type section. The lower grey dolomite member is similar to the upper and is 340 feet thick. The bedding of both grey dolomite members at Blackstone Gap varies along strike. Massive units over 100 feet thick change laterally into a prominently thick-bedded succession, the over-all impression being of vaguely defined massive biohermal structures separated by bedded dolomites. This type of bedding is seen in many areas. The grey dolomites are the "white reefs" of McLaren (1953a).

The development of coral beds is variable, both in thickness and in stratigraphic horizon. For instance, 2 miles northwest of Wapiabi Gap (section 5) only two members are recognized in the Southesk; a grey dolomite member below of 401 feet, and a coral bed member above, 284 feet in thickness, the latter member continuing to the top of the formation.

In the Bow Valley region the development of the Southesk formation commonly includes three members. At White Man Pass (section 15), a lower grey dolomite, a coral bed, and an upper grey dolomite member, with respective thicknesses of 201, 160, and 244 feet, are present.

In some areas beds of Mount Hawk facies types occur within a predominantly Southesk development. Thus at Job Creek West (section 23) four members may be distinguished: lower grey dolomite (401 feet), grey mudstone and limestone (126 feet), coral bed (139 feet), and upper grey dolomite (96 feet). A similar sequence is developed at Mount Coleman (section 22). At Twin Falls Creek (section 21) the four members from bottom to top are: grey dolomite (378 feet), grey mudstone (40 feet), argillaceous limestone and dolomite (120 feet), and coral bed (285 feet). At Wapiabi Gap Northwest Side (section 6) 529 feet of grey dolomite, equivalent to the lower member farther to the northwest, underlie a normal but attenuated Mount Hawk formation. At this section the Southesk rests on a thin development of Perdrix with which it partly intertongues.

The Southesk normally rests on the Cairn formation, the junction commonly being transitional over some 20 to 50 feet of beds. It is everywhere overlain by the Alexo formation with a sharp change in facies.

The grey dolomites of the Southesk contain few diagnostic fossils and the granular limestones, although in places strongly bioclastic, are also barren of stratigraphically valuable forms. The coral beds, however, sometimes contain beds of argillaceous limestone in which a rich Mount Hawk

brachiopod fauna is developed, including *Pugnoides* sp., *Cyrtospirifer* cf. *whitneyi* (Hall), *Indospirifer* ex gr. *I. orestes* (Hall and Whitfield), and *Tenticospirifer* cf. *cyrtiniformis* (Hall and Whitfield). The fauna and the intertonguing relations of the Southesk and Mount Hawk formations make correlation positive, although the base of the Southesk may be equivalent to high Perdrix, at least in some areas.

ALEXO FORMATION

(DeWit and McLaren, 1950)

The type section of the Alexo formation is at Brazeau Gap (section 26). DeWit and McLaren (1950) included 224 feet of beds within the formation but the upper unit of their Mount Hawk is now considered part of the Alexo. As remeasured, 240 feet are included within the Alexo at the type section. The formation is conveniently divided into two members and this division is recognizable over almost the whole region. The lower member at the type section is 163 feet thick and grades up from interbedded silty dolomitic and argillaceous flagstones and dolomite at the base, through strongly laminated, brownish grey, silty dolomite and dolomitic siltstone, to thick-bedded, vuggy, grey dolomite at the top. The lower part of the member is thinly bedded and small-scale sedimentary structures indicative of shallow water deposition are present, e.g., ripple-marks and minor cross bedding. The upper member, 77 feet thick, is a highly variable series of grey and greenish grey, and varicoloured, argillaceous siltstones and silty dolomites, all thin- and medium-bedded and strongly laminated. Many individual beds are strongly contorted, suggesting slumping, and brecciated bands are common. The Alexo rests with a sharp break on the thick-bedded, dark brownish grey dolomites of the Mount Hawk, the more resistant lower formation forming a prominent step on the hillside. Similarly the upper beds of the lower member are resistant to weathering and the soft upper member rests on them with a prominent break. The upper beds of the formation grade upwards into the Palliser without sudden break.

In the eastern ranges there is a tendency for the Alexo to be thicker over a predominantly clastic succession and thinner over carbonate banks. At Wapiabi Creek Southeast Side (section 7) the lower member is 249 feet thick and is strongly argillaceous as well as silty and sandy towards the base. The 148-foot upper member is laminated and flaggy and grades into the Palliser without a break. The total thickness of the Alexo at Wapiabi Gap Northwest Side (section 6) is only 267 feet and at Blackstone Gap (section 4) it is reduced to 157 feet. North of the Bighorn-Southesk carbonate bank development the Alexo thickens again and the lower member becomes fossiliferous and increasingly argillaceous. At Deception Creek (section 2) the lower member is 174 feet thick and consists of greenish grey to grey, silty mudstone grading upwards into dolomitic and calcareous siltstones with an abundant brachiopod fauna. The 118-foot upper member largely consists of thin, laminated and slumped, silty dolomites. In this region the upper part of the lower member tends to develop into thick-bedded to massive limestone or dolomite at the expense of the lower silty and argillaceous beds. At a section on the northeastern spur of Cardinal Mountain, 4½ miles south of Mountain Park, the upper beds

of the lower member, 80 feet thick, consist of 50 feet of thick-bedded to massive, granular limestone and dolomite. The limestones contain a high proportion of bioclastic debris and grade downwards into silty and argillaceous, thinner-bedded limestone and dolomite. About 3 miles to the east on Mount Mackenzie (section 20) 145 feet of thick-bedded to massive, light grey, granular limestone comprise most of the lower member and are underlain by thinner-bedded limestone and a covered interval, the member totalling 178 feet in thickness The 73-foot upper member is normal, mainly consisting of laminated silty dolomites.

Farther away from the bank areas the Alexo continues to thicken and reaches 601 feet at Medicine Lake (section 18) and 620 feet at Morro Peak (section 17). A detailed lithological description of the Medicine Lake section appears in the Appendix. It should be noted that the maximum thickness is reached in sections where the Fairholme group is entirely of basinal facies.

The thickness of the Alexo appears to be less related to underlying facies in the western and southern regions. At Job Creek East (section 24) the formation is only 142 feet, above a transitional type of Mount Hawk and at Job Creek West (section 23) it has risen to more than 190 feet, and is 241 feet thick at Mount Coleman (section 22).

At the head of Cripple Creek Southeast Side (section 11) the formation is 172 feet thick, and at the Fairholme type section 286 feet thick (Beach, 1943). No thicknesses comparable with those found in the Athabasca Valley region have been encountered farther south.

The Alexo rests on the Southesk or Mount Hawk formations with a marked lithological change. In many areas there is evidence of erosion before the Alexo was deposited and in others there appears to have been a period of non-deposition. Although it seems probable that deposition began earlier in the basinal than in the bank areas, the Alexo-Fairholme group contact is taken as a datum plane in the appended diagrams as constituting the most easily recognizable lithological and faunal break in the whole succession. The contact between the Alexo and Palliser formations is less obviously drawn and, in many sections, is transitional over some tens of feet.

The Alexo is unfossiliferous over most of the region except for rare tabulate and rugose corals in some of the limestone beds of the lower member. North of the Bighorn-Southesk bank development, however, a brachiopod fauna is found in the argillaceous beds of the lower member. The fauna includes: productellids similar to forms found in the *Cyrtospirifer* zone of the Devil's Gate formation in Nevada (Merriam, 1940), *Nudirostra gibbosa walcotti* (Merriam), and *Cyrtospirifer* cf. *portae* (Merriam).

PALLISER FORMATION

(Beach, 1943)

No type section has been named for the Palliser formation, but Beach (1943) discusses the development in the Moose Mountain-Morley map-areas and in the Fairholme Mountains, where it varies in thickness from 800 to 950 feet. It is not proposed to discuss the formation in any detail in the present report as it has been described by Beach, Fox (1951), and

deWit and McLaren (1950) who divided it into a lower, Morro, and an upper, Costigan, member. No changes in the existing usage of the name are proposed. Beales (1954) has recently described the petrology of the limestones in some detail.

In brief, the Morro member consists of thick-bedded to massive, granular, variably dolomotized limestones. It is characterized by a mottling produced by partial dolomitization (Beales, 1953). The Costigan member is a variable succession of thin-bedded limestone and dolomite, in places brecciated and sporadically silty, capped by thin-bedded, fossiliferous limestone. The relative thicknesses of the two members vary widely, the Morro varying between 230 and 950 feet and the Costigan between 60 and 414 feet.

With some exceptions, the Palliser thickens westwards across the ranges. For instance, in the Athabasca Valley there are 675 feet at Roche Miette, 865 at Morro Peak, and 936 at the Palisade. At Blackstone Gap 761 feet are developed whereas at Southesk and Cairn Forks there are 941 feet. In the Clearwater Valley, in the vicinity of Limestone Creek, the Palliser is 643 feet thick, 687 feet at James Pass, 838 feet at Mount Costigan, and 1,050 feet near Grotto Mountain in Bow Valley. At Sulphur Mountain near Banff, however, it is only 990 feet thick.

In the sections measured farthest east of the Front Ranges, at Brazeau Gap and Clearwater Valley the formation is largely dolomitized with some interbedded mottled limestones. In the Front Ranges farther south, at James Pass, the formation is still more than 50 per cent dolomite, whereas at Mount Costigan there is more limestone than dolomite in the succession. Elsewhere, within the Rocky Mountains proper, the formation is predominantly limestone although much of it is partly mottled with dolomite. At Sulphur Mountain the sequence is again largely dolomitized.

The Palliser everywhere rests upon the Alexo and is overlain unconformably by the Exshaw over most of the region, although this formation is absent in the western part of the Athabasca Valley where the Banff formation rests upon the Palliser, e.g., at Medicine Lake.

Two faunas are present in the Palliser, the lower being present in the main body of the formation and the upper in the highest beds of the Costigan member. They are discussed in McLaren (1954), but it should be emphasized that there is no evidence to suggest that any of the Palliser formation is younger than late Upper Devonian in age.

INDEX OF SECTIONS ILLUSTRATED

(*=sections described in the Appendix)

1.* Northeast shoulder of Roche Miette, Athabasca Valley, 21 miles north-northeast of Jasper town.
2.* East side of Deception Creek, 7½ miles southwest of Mountain Park.
3.* Mountain sides west and south of junction between Cairn and Southesk Rivers, 22 miles south-southeast of Mountain Park.
4. Blackstone River Gap, Bighorn Range.
5. Two miles northwest of Wapiabi River Gap, Bighorn Range.

6.* Northwest side of Wapiabi River Gap, Bighorn Range.
7.* Southeast side of Wapiabi River Gap, Bighorn Range.
8. Two miles southwest of Windy Point, on north side of North Saskatchewan River in the Front Range.
9. Northwest side of North Ram River Gap, in Ram Range.
10. Northwest side of Cripple Creek headwaters, in Ram Range, 3 miles southeast of North Ram River Gap.
11. Southeast side of Cripple Creek headwaters.
12. North side of James Pass, 4½ miles north of Red Deer River Gap in Front Range.
13. North side of Red Deer River Gap in Front Range.
14. Southwestern slopes of Mount Costigan, near eastern end of Lake Minnewanka.
15. North side of White Man Pass, at southeastern end of Mount Rundle, Bow River Valley.
16. Gully on mountain face, near north end of the Palisade, 9 miles north of Jasper town.
17. West side of Morro Peak, Athabasca Valley, 12 miles north of Jasper town.
18.* Ridge between Medicine and Beaver Lakes, 15 miles east of Jasper town (the Palliser was measured on Proposal Mountain, at the south end of Medicine Lake).
19. West of junction between Medicine Tent and Rocky Rivers, about 8½ miles southwest of Mountain Park.
20. Northwest slopes of Mount Mackenzie about 5½ miles south-southeast of Mountain Park.
21. Southeast side of Twin Falls Creek, in the Whiterabbit Range, 13 miles southeast of the confluence of Whiterabbit Creek and North Saskatchewan River.
22. West side of Mount Coleman, 12 miles southeast of Sunwapta Pass.
23.* Northwest side of Job Creek headwaters, 17 miles east-northeast of Sunwapta Pass.
24.* East side of Job Creek, 4 miles downstream from source, 21 miles east-northeast of Sunwapta Pass.
25. Mountain side 2 miles northwest of confluence of Cline and North Saskatchewan Rivers.
26. North side of North Saskatchewan River Gap in Brazeau Range.

APPENDIX—STRATIGRAPHIC SECTIONS

Roche Miette (Section 1)

Summary Section

The following summary is modified from deWit and McLaren (1950). Most of it was measured on the northeast shoulder of Roche Miette, a mountain 21 miles north-northeast of Jasper town, but the Palliser formation was more conveniently studied along the road on the west side of the mountain, at Disaster Point

It should be noted that the bases of the Alexo and Mount Hawk formations are drawn, respectively, 82 and 156 feet lower than in the original published section. The Flume formation is underlain by some 230 feet of beds of unknown age with a lithology similar to the Ghost River formation farther south. Below these beds are strata containing a trilobite fauna of Late Cambrian (Franconian) age.

PALLISER FORMATION

Costigan Member?

	Thickness in Feet
Dark grey, fine-grained[1] limestone; massive; underlain by silty laminated limestone	60

MORRO MEMBER

Dark grey to black, dense limestone; thick-bedded to massive; scattered brachiopods	615
Total thickness of Palliser formation	675

ALEXO FORMATION

Upper Member

Grey to brown, silty limestone; mainly thin-bedded, laminated; interbedded with calcareous or dolomitic siltstone and silty argillaceous dolomite; largely soft weathering	120

Lower Member

Grey, medium-grained limestone; massive; grading downwards into silty and argillaceous limestone and dolomite; laminated and thinner-bedded with some beds of light yellowish grey siltstone; stromatoporoids, tabulate corals, and bryozoa in lower part of member; small covered interval at base	172
Total thickness of Alexo formation	292

MOUNT HAWK FORMATION

Grey Limestone Member

Grey, medium-grained, dolomitic limestone; thick-bedded to massive; scattered coral remains: *Thamnopora,* compound disphyllids, and *Macgeea;* member highly irregular in thickness along strike	105

Argillaceous Limestone Member

Grey to black, well-bedded, argillaceous limestone, with minor black mudstone; richly fossiliferous: *Disphyllum* cf. *stramineum* (Billings), *Gypidula* sp., *douvillinids, Chonetes* sp., *Nudirostra albertensis* (Warren), *Pugnoides* sp., *Atrypa* sp., *Grunewaldtia* cf. *americana* Stainbrook, *Indospirifer* ex gr. *I. orestes* (Hall and Whitfield), *Thomasaria rockymontana* (Warren), *Manticoceras* sp.	197

Grey Mudstone and Limestone Member

Light grey calcareous mudstone interbedded with medium beds of argillaceous limestone, becoming darker in colour downwards; similar brachiopod fauna to above member	247
Total thickness of Mount Hawk formation	549

[1]The grain sizes referred to in the descriptions are approximately as follows:

very coarse-grained	1-2 mm. diam.
coarse-grained	½-1 mm. diam.
medium-grained	¼-½ mm. diam.
fine-grained	⅛-¼ mm. diam.
very fine-grained	1/16-⅛ mm. diam.
aphanitic	less than 1/16 mm. diam.

The thicknesses of bedding referred to in the descriptions are approximately as follows:

massive	sporadic bedding planes or none
thick-bedded	over 2 feet between bedding planes
medium-bedded	3 inches to 2 feet between bedding planes
thin-bedded	less than 3 inches between bedding planes

Lamination is distinct from bedding and is described separately.

	Thickness in Feet
PERDRIX FORMATION	
Black, calcareous shale with bands of calcareous nodules, grading downwards into black, non-calcareous, friable shale; fossiliferous in upper part: *Lingula, Buchiola, Entomis, Tentaculites* spp.; *Nudirostra albertensis* (Warren) in beds at very top of formation.....	380
FLUME FORMATION	
Upper Member	
Dark grey to black, argillaceous limestone; thin- and medium-bedded with some interbedded black shale; fossiliferous: *Nudirostra athabascensis* (Kindle), *Atrypa multicostellata* Kottlowski, *Eleutherokomma jasperensis* (Warren), *Eleutherokomma* large sp., *Tentaculites, Bactrites* spp.	50
Lower Member	
Dark grey to brown, fine-grained limestone; thick-bedded to massive with some thinner beds of dolomite; abundant chert and stromatoporoids and *Amphipora* in upper part of unit; scattered *Amphipora* lower down.	101
Total thickness of Flume formation.....	151

East Side of Deception Creek (Section 2)

Deception Creek joins Medicine Tent River from the north about 7½ miles southwest of Mountain Park, and 1¾ miles upstream from the junction of Medicine Tent and Rocky Rivers. The following section was begun 1½ miles upstream on the east side of Deception Creek.

The Palliser is cut by the creek, which flows in a small canyon through the formation, and was measured on the hillside about ½ mile to the east of the canyon. There are several minor bedding plane thrusts of unknown throw within the Palliser, consequently, the true thickness is unknown. Its description is, however, included, to show the type of lithological succession. It is probable that the total measured thickness is of the correct order of magnitude.

The remainder of the Devonian also was measured on the hillside east of the creek, and is affected by an anticlinal fold that has undoubtedly influenced the thicknesses of the shale units. For instance, there is a considerable change in thickness of the lower Alexo along strike. On the east side of the creek this member was found to be 174 feet thick, whereas about ¾ mile to the west, on the hillside on the other side of the creek, 390 feet were measured. Fox (1951, p. 832) records 182 feet of beds assignable to the lower Alexo along Deception Creek, about half-way between the sections mentioned above. These changes are believed to be due to tectonic and not depositional effects, and the thickness of the easternmost sequence is probably most nearly correct.

About half-way up the hillside, the Cairn formation thickens by some 120 feet and is seen to interfinger with black mudstones and shales of the Perdrix formation. Much of this junction is covered but it is highly irregular, the Cairn undergoing rapid variation in thickness at the expense of the Perdrix. The thickness of the Perdrix and lower Mount Hawk may have been influenced by movement but the irregular top of the Cairn formation is probably original.

Unit No.		Thickness in Feet Unit	Total from base
	BANFF FORMATION (MISSISSIPPIAN)		
3	Limestone, grey, argillaceous, fine-grained; thin regular beds alternating with equal thickness of brownish grey shale		
2	Shale, black, fissile; soft weathering	46	89
1	Shale, dark grey to black, fissile; regularly interbedded (every 6 to 8 inches) with thin beds (¾ to 1 inch) of dark grey, fine-grained limestone	43	43
	Total thickness of Banff formation measured	89	
	EXSHAW (?) FORMATION		
1	Shale, black, fissile; sheared, with calcite veins; some thin limestone bands and lenses; abundant well-formed pyrite cubes	16	16
	Total thickness of Exshaw (?) formation	16	
	PALLISER FORMATION		
	Costigan Member		
54	Limestone, dark grey to black, dolomitic, slightly silty, fine-grained; thin- to medium-bedded; upper surface of unit irregularly pitted, and iron stained; productellids, *Camarotoechia nordeggi* Kindle, *Cyrtospirifer* sp.	7	1,849
53	Covered interval; scattered outcrops of grey dolomitic limestone	35	1,842
52	Limestone, dark grey to black, dolomitic, medium-grained; thin- to medium-bedded	26	1,807
51	Covered interval; talus of silty dolomitic limestone fragments	10	1,781
50	Limestone, light grey, fine-grained; medium-bedded	2½	1,771
49	Limestone, brownish grey, dolomitic, silty, medium-grained; thin- and medium-bedded; laminated and crossbedded	6	1,768½
	Thickness of Costigan member	86½	
	Morro Member		
48	Limestone, dark brownish grey, dolomitic, medium-grained; medium-bedded; dolomitic tracery	52	1,762½
47	Limestone, dark grey to black, dolomitic, fine-grained; vaguely thick-bedded to massive; pronounced dolomitic tracery; two joint systems at right angles give a brecciated appearance to weathered surfaces; fossiliferous 110 feet from top of unit: *Camarotoechia* sp., *Cyrtiopsis* sp., *Athyris* sp	125	1,710½
46	Limestone, dark grey to black, dolomitic, fine- to medium-grained; medium-bedded; dolomitic tracery. Unit 46 is bounded by thrust planes; the rock is shattered in proximity to the thrusts and there is local calcite veining. The dislocations are visible along the hillside owing to the weathering back of the fractured rock.	21	1,585½
45	Limestone, dark grey, dolomitic, fine- to medium-grained; medium-bedded to massive; pronounced dolomitic tracery. Units 45 and 44 are separated by a thrust of unknown throw. The bedding below can be seen to be truncated at a very low angle.	135	1,564½

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	PALLISER FORMATION—*Cont.*		
44	Limestone, dark grey, dolomitic, slightly argillaceous, trace of silt, medium-grained; medium-bedded to massive; pronounced dolomitic tracery; fossiliferous 45 and 80 feet down in unit: *Cyrtiopsis* cf. *normandvillana* Crickmay, *Athyris* sp.	205	1,429½
43	Limestone, dark grey, slightly dolomitic, fine-grained; medium-bedded; minor development of dolomitic tracery	49	1,224½
42	Dolomite, dark grey, slightly silty, medium- to coarse-grained; medium-bedded	10	1,175½
41	Limestone, dark grey, dolomitic, slightly argillaceous, fine- to medium-grained; medium-bedded; limestone finely granular with abundant calcispheres; irregularly dolomitized in bands and fine mottling	13	1,165½
	Possible movement at base of unit 41; junction with underlying unit deeply weathered.		
	Measured thickness of Morro member (unreliable)	610	
	Total measured thickness of Palliser formation (unreliable)	696½	
	ALEXO FORMATION		
	Upper Member		
40	Dolomite, dark grey, silty, fine- and medium-grained; medium-bedded; upper beds laminated	29	1,152½
39	Limestone, dark grey, fine-grained; single bed; small vugs, calcite filled	1½	1,123½
38	Dolomite, light grey, silty, fine- to medium-grained; medium-bedded, becomes thin and flaggy on weathering; laminated and crossbedded	22	1,122
37	Dolomite, dark grey, silty, medium- to coarse-grained; medium-bedded	6	1,100
36	Dolomite, grey, strongly silty, medium-grained; medium-bedded, becoming thin-bedded and flaggy on weathering; laminated with crossbedding and minor slump structures	36	1,094
35	Dolomite, dark grey, silty and pyritic, medium- to fine-grained; medium-bedded; crossbedding, laminations and small slump structures; rare fossil fragments: large productellid, *Schuchertella?* sp., *Cyrtiopsis?* sp., *Athyris* sp.	5	1,058
34	Dolomite, brownish grey, strongly silty, medium-grained; thin irregular bedding; crossbedded and laminated	15	1,053
33	Dolomite, dark grey, silty, fine- and medium-grained; laminated; thin-bedded; light greyish brown weathering	4	1,038
	Thickness of upper member	118½	
	Lower Member		
32	Siltstone, brownish grey, dolomitic, argillaceous; medium- to thick-bedded; weathers into thin flagstones; lower 20 feet more massive; fossiliferous at base: *Atrypa* sp. (small, medium costate form), *Cyrtospirifer portae* Merriam	40	1,034
31	Siltstone, grey, dolomitic, argillaceous; thin- to medium-bedded; rubbly irregular weathering, mottled brown and grey; *Cyrtospirifer portae* Merriam	8	994

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION—*Cont.*		
30	Siltstone, grey to greenish grey, calcareous, argillaceous; thin-bedded, fissile; some thin nodular bands of fine-grained, argillaceous limestone; richly fossiliferous: *Productella* sp. (Devil's Gate *Cyrtospirifer* zone form), *Nudirostra gibbosa walcotti* (Merriam), *Cyrtospirifer portae* Merriam	36	986
29	Mudstone, grey to greenish grey, calcareous, silty; thin-bedded, fissile; with higher proportion of irregular, nodular limestone bands than in unit 30; abundantly fossiliferous: *Productella* sp. (Devil's Gate form), *Cyrtospirifer portae* Merriam, *"Conularia"* sp.; specimens from mudstone are smaller than those from limestone bands	16	950
28	Shale, dark greenish grey, calcareous, strongly silty, fissile; *Productella* sp. (Devil's Gate form), *Cyrtospirifer portae* Merriam	16	934
27	Mudstone, grey to brownish grey, calcareous, silty; medium-bedded with thin shale partings; *Productella* sp. (Devil's Gate form), *Cyrtospirifer portae* Merriam	18	918
26	Covered; probably calcareous shale	6	900
25	Mudstone, black to dark grey, calcareous and silty; vague, rubbly, medium-bedded; buff weathering; *Productella* sp. (Devil's Gate form), *Camarotoechia banffensis* Warren subsp, nov., *Cyrtospirifer portae* Merriam, *Athyris angelicoides* Merriam	6	894
24	Mudstone, grey, calcareous, strongly silty; interbedded with thin nodular limestone; partly covered; *Cyrtospirifer portae* Merriam, *Athyris angelicoides* Merriam	28	888
	Thickness of lower member	174	
	Total thickness of Alexo formation	292½	
	MOUNT HAWK FORMATION		
	Argillaceous Limestone Member		
23	Dolomite, grey, silty, slightly calcareous; one thick bed that grades into unit below; prominent yellow-brown weathering; a few *Atrypa* sp.	6	860
22	Limestone, argillaceous, interbedded with thin calcareous shale; grading into massive limestones, slightly dolomitic; scattered fossils: *Schizophoria* sp., *Hypothyridina* small sp., *Nudirostra albertensis* (Warren), *Pugnoides* sp., *Atrypa* sp.	12	854
21	Limestone, dark grey, argillaceous; thinly interbedded with calcareous shale; grading upwards into thick-bedded, dolomitic limestones; two alternations; top beds of unit massive and mottled; scattered *Atrypa* sp.	31	842
20	Dolomite, grey, slightly calcareous; two thick beds; brownish yellow weathering	7	811
19	Limestone, black, argillaceous; thin-bedded, with shale partings; grading up into medium- to thick-bedded, slightly dolomitic limestone, fine-grained; angular fracture; three alternations	38	804
18	Limestone, dark grey, argillaceous, fine-grained, alternating with black calcareous shale every 1 inch to 6 inches; grades upwards in about middle of unit into more thick-bedded, slightly dolomitic, argillaceous limestone	41	766

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	MOUNT HAWK FORMATION—*Cont.*		
17	Dolomite, dark grey, silty, medium-grained; medium-bedded; weathers pale brownish grey; pitted bedding planes, fucoidal?	19	725
16	Limestone, dark grey, argillaceous, slightly silty, pyritic; strongly medium-bedded, nodular: some beds of irregular and tubular nodular forms with fish remains	10	706
15	Limestone, dark grey to black, strongly argillaceous, sandy and silty; interbedded in thin to medium beds with calcareous mudstones; subrounded to angular fine quartzitic sand and silt; *Atrypa* sp., and fish bones	18	696
14	Mudstone, black, strongly calcareous; thin fissile beds, with interbedded thin and medium argillaceous limestone beds increasing upwards	42	678
13	Limestone, black, strongly argillaceous; thin, fissile bedding; becomes increasingly resistant upwards and thicker-bedded; *Tentaculites*, fish and small crustacean fragments	38	636
12	Limestone, dark grey to black, argillaceous, slightly silty; vaguely medium-bedded, becoming thin-bedded on weathering; *Tentaculites* common, and fish bones and teeth	8	598
	Unit 12 makes a slight feature on the hillside and is followed by the softer weathering unit 11.		
	Thickness of argillaceous limestone member	270	
	Banded Grey Mudstone and Limestone Member		
11	Mudstone, dark grey, calcareous, fissile, and limestone, black, argillaceous; thin- and medium-bedded in approximately equal alternations; partly covered; scattered pyrite nodules; *Tentaculites* in bands, and single specimen of *Manticoceras* sp.	184	590
10	Limestone, black, argillaceous and slightly silty, pyritic; medium-bedded, interbedded with calcareous shale; abundant fragmentary fossils, detrital: *Thamnopora* sp., *Disphyllum* sp., *Schizophoria* cf. *mcfarlani* (Meek), *Schizophoria* sp., *Gypidula* sp., *Nudirostra albertensis* (Warren), *Atrypa* spp., *Cyrtospirifer* sp., *Cyrtina* sp.	11	406
	Thickness of banded grey mudstone and limestone member	195	
	Total thickness of Mount Hawk formation	465	
	PERDRIX FORMATION		
9	Dolomite, black, argillaceous, fine-grained; thin- and medium-bedded, interbedded with black dolomitic mudstone; some *Amphipora* beds	65	395
	Total thickness of Perdrix formation	65	
	CAIRN FORMATION		
	The following units were measured on the eastern side of Deception Creek, several hundred yards up the hillside, beginning in the gully that is formed by the top bed of the Cairn dolomites in contact with the overlying soft shales and dolomitic mudstones of the Perdrix. Following up this gully the Cairn is seen to thicken at the expense of the overlying units; maximum thickening is about 120 feet.		

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	CAIRN FORMATION—*Cont.*		
8	Dolomite, grey, coarse-grained; variable bedding from medium to massive along hillside; abundant calcite-filled vugs, many after stromatoporoids and corals....	46	330
7	Dolomite, grey and dark grey, fetid, medium- to coarse-grained; strongly medium-bedded; stromatoporoids and *Amphipora* very abundant.....	54	284
6	Dolomite, dark grey to light grey, coarse-grained; thick-bedded to massive; commonly vuggy, vugs filled with fetid white calcite; sporadic grey chert; abundant signs of stromatoporoids and *Amphipora*.....	88	230
5	Dolomite, dark grey, argillaceous, medium-grained; medium-bedded	27½	142
4	Dolomite, dark grey, argillaceous, medium-grained; medium-bedded, interbedded with thin beds of dolomitic mudstone	5½	114½
3	Dolomite, dark grey to grey, fetid, coarse-grained; thin-bedded in lower 5 feet, medium- to thick-bedded above; very abundant black chert nodules; abundant *Amphipora* and stromatoporoid remains, some replaced by chert; many large calcite masses with strong sulphurous smell	54	109
2	Dolomite, dark grey to brownish grey, fetid, coarse-grained; very abundant black chert beds and nodules; regularly medium-bedded; some beds calcite flecked..	48	55
1	Dolomite, brownish grey, coarse-grained; thin- to medium-bedded, scattered chert; some *Amphipora*.....	7	7
	Total thickness of Cairn formation.....	330	
	SUB-DEVONIAN		
1	Dolomite, light grey, coarse-grained; thick-bedded..... Unit 1 forms core of anticline in gully; lowest beds exposed.	26	26
	Total exposed thickness of sub-Devonian.....	26	

Southesk and Cairn Rivers Forks (Section 3)

The upper part of the following section, comprising the Palliser and Alexo formations, and the granular limestone member of the Southesk formation, was measured on the southeast side of the mountain that rises immediately to the west of the junction between Cairn and Southesk Rivers. The Palliser formation is cliff forming and may be examined at the top of the talus slope that rises from the terrace above the left bank of Southesk River about 2 miles upstream from the forks.

The remainder of the section, comprising the lower part of the Southesk, and the Cairn formation, and some sub-Devonian beds was measured on the spur of Mount Dalhousie, immediately south of the Southesk and Cairn forks.

The exposure on both mountains is almost 100 per cent, and correlation between the two mountains is positive.

This section constitutes the type section of the Southesk and Cairn formations.

Unit No.		Thickness in Feet Unit	Thickness in Feet Total from base
	BANFF FORMATION (MISSISSIPPIAN)		
1	Shale and limestone; alternation of grey, fine-grained, calcareous, fissile shale and grey, very argillaceous, fine-grained, limestone; limestone, thin-bedded (½ inch to 1½ inches); shale (4 to 6 inches); very regular alternation		
	EXSHAW FORMATION		
3	Shale, black, fissile, fine-grained; alternation of harder, more compact beds (¼ inch to 1½ inches) and very thin paper shales (3 to 6 inches); yellow and brownish red staining on weathered surfaces.....	15½	17
2	Shale, grey, fine-grained, fissile; soft weathering; yellowish and brown stain.....	½	1½
	Unit 2 weathers back beneath unit 3 and is poorly exposed.		
1	Shale, black, fine-grained, hard; rusty weathering.....	1	1
	Total thickness of Exshaw formation.....	17	
	PALLISER FORMATION		
	Costigan Member		
61	Limestone, dark grey to black, very fine-grained, porcellanous; medium- to thick-bedded or massive; rubbly weathering; top of unit irregular with small depression filled with overlying unit rocks; fragmentary brachiopods: *Camarotoechia* sp., *Cyrtospirifer* sp.	33	2,206
60	Limestone, dark grey to black, dolomitic, medium- to fine-grained; thick-bedded to massive; *Cyrtospirifer* sp. fragments	75	2,173
59	Limestone, dark grey to black, dolomitic, fine-grained; thick-bedded; some calcarenaceous beds.....	27½	2,098
58	Covered interval	24	2,070½
57	Limestone, grey to brownish grey, dolomitic, slightly silty, medium-grained; medium-bedded, laminated bands on surface	24	2,046½
	Thickness of Costigan member.....	183½	
	Morro Member		
56	Limestone, dark brownish grey, dolomitic, fine-grained; medium- to thick-bedded becoming massive downwards; calcarenaceous at some horizons; sporadic beds of dolomite (2 feet thick); scattered gastropods and fragmentary brachiopods	112	2,022½
	Unit 56 is exposed as a series of bare rock ledges, the bedding plane surfaces showing prominent dolomitic tracery.		
55	Limestone, dark brownish grey, dolomitic, fine-grained; thick-bedded becoming massive downwards; some calcarenaceous beds	43	1,910½
54	Limestone, dark brownish grey, dolomitic, fine-grained; thin-bedded; rubbly soft weathering.....	5	1,867½
53	Limestone, dark grey to brownish grey, dolomitic, medium- to fine-grained; thick-bedded and massive; calcarenaceous pellety structure variously developed; dolomitic tracery more or less well developed throughout..	293	1,862½

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	PALLISER FORMATION—*Cont.*		
52	Limestone, dark brownish grey to black, dolomitic, fine-grained; thin to medium, irregular bedding; vertical fracture; rubbly weathered surfaces; some pellety or calcarenaceous bands; dolomitic tracery on weathered surface covers about 60 per cent of total surface.....	94	1,569½
51	Limestone, dark brownish grey, dolomitic, fine-grained, and dolomite, brown, medium-grained; thick-bedded to massive; suggestion of pellety structure; dolomitic tracery on weathered surfaces.....	112	1,475½
50	Limestone, dark brownish grey, granular, pellety?; massive; pale grey weathering.....	32	1,363½
49	Limestone, brownish grey, slightly dolomitic, fine-grained; massive; abundant calcite flecks that weather out on surface; a few calcite-filled vugs.....	66½	1,331½
	Thickness of Morro member.....	757½	
	Total thickness of Palliser formation.....	941	
	ALEXO FORMATION		
	Upper Member		
48	Dolomite, dark grey to black, slightly silty, fine-grained; bedding vague, irregular, rubbly.....	6	1,265
47	Limestone, dark grey to black, dolomitic, slightly argillaceous and silty; vaguely medium- and thick-bedded; irregular vertical fracture; faintly banded at some horizons	18	1,259
46	Dolomite, grey, very silty, medium-grained; thin-bedded; alternating with highly laminated and slumped siltstones	32½	1,241
	Thickness of upper member.....	56½	
	Lower Member		
	The junction between units 46 and 45 is very sharp both in lithology and topographic expression. Unit 45 marks the top of a small cliff below the more soft weathering upper Alexo.		
45	Limestone, grey, granular; medium- to thick-bedded; alternating with thin laminated and (?) silty beds (up to 3 feet thick); five alternations downwards, limestone at top, laminated beds at bottom; limestones pellety and calcarenaceous, with some beds composed entirely of dendritic stromatoporoids, including species of *Amphipora* and *Stachyodes*.....	59	1,208½
44	Limestone, grey, fine-grained; interbedded with and grading laterally into dolomite, grey, medium-grained; medium-bedded; laminated	20	1,149½
43	Dolomite, black, medium-grained; thick-bedded; vuggy and rubbly weathering	4½	1,129½
42	Limestone, grey, granular, silty, vaguely laminated; in 2-foot beds; alternating with limestone, dolomitic, silty, finely laminated, with flaggy weathering.....	7	1,125
41	Dolomite, greenish grey, strongly silty, fine-grained; thin- and medium-bedded; strongly laminated; weathers a pale yellowish brown.....	18	1,118
40	Dolomite, grey, flecked with brown, silty, slightly argillaceous, fine-grained; faintly laminated; residue of light grey flocculant mass and quartzitic silt.....	2	1,100

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION—*Cont.*		
39	Dolomite, black, slightly silty, fine-grained; laminated; thin- and medium-bedded	6	1,098
38	Covered interval, probably similar to unit 39	6	1,092
	Thickness of lower member	122½	
	Total thickness of Alexo formation	179	
	SOUTHESK FORMATION		
	Granular Limestone Member		
37	Limestone, light brownish grey, granular; thick-bedded with some thin rubbly beds towards the top; rounded grains of aphanitic limestone in calcite cement. Unit 37 is soft-weathering and is followed by cliff-forming units below.	32	1,086
36	Limestone, light brownish grey, fine-grained; thin rubbly beds; upper part of unit covered, probably similar	6	1,054
35	Limestone, light brownish grey, granular, flecked with clear and red-stained calcite; massive- to thick-bedded; composed of vaguely shaped granules of aphanitic limestone up to 0·1 mm. in diameter in clear calcite cement; abundant calcite-filled spheres; slightly dolomitic about 70 feet down in unit, with scattered rhombs of dolomite up to 2 mm. wide; *Amphipora* occur throughout, but not abundant; some traces of algae; rare shell fragments	95	1,048
34	Dolomite, light grey, flecked with white, pink, and green, slightly argillaceous, medium- and coarse-grained; thick-bedded at base becoming massive upwards; a few large vugs; pale flocculent residue	44	953
33	Dolomite, grey to light brownish grey, medium-grained, calcareous; vaguely thick-bedded; undolomitized in patches; limestone, light brownish grey, composed of round aphanitic grains about 0·1 mm. in diameter in a clear calcite cement; small spheres abundant, up to 0·1 mm. in diameter; clear calcite flecks throughout; scattered *Amphipora* and small stromatoporoids	25	909
	Thickness of granular limestone member	202	
	The remainder of the section was measured on the mountain immediately south of the junction of Southesk and Cairn Rivers.		
	Coral Bed Member		
32	Dolomite, dark brownish grey, slightly argillaceous, medium-grained; massive- to vaguely thick-bedded, thin- and medium-bedded on weathering; scattered calcite-filled vugs; abundant *Amphipora* and ? *Stachyodes* concentrated in bands; white coral remains throughout: species of *Aulopora, Coenites, Thamnopora,* disphyllids, and cup corals	45	884
	Thickness of coral bed member	45	
	Grey Dolomite Member		
31	Dolomite, grey to light grey, coarse-grained, structureless, dense; massive near top, becoming thick-bedded with a few medium beds; scattered small gypsum crystals; a few rare silty layers	75	839

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	SOUTHESK FORMATION—*Cont.*		
30	Dolomite, brownish grey to grey, argillaceous, medium-grained, soft, very vuggy; vaguely thick-bedded, weathers thin; cavities lined with white calcite; unit broadly lenticular in form along hillside	23	764
29	Dolomite, grey, coarse-grained; massive, becoming softer and thinner-bedded downwards	32	741
	Units 29 and 30 tend to weather back more than the more massive dolomites.		
28	Dolomite, light brownish grey, slightly argillaceous, coarse-grained; thick-bedded to massive	32	709
	Unit 28 forms top of another cliff.		
27	Dolomite, black, slightly argillaceous; thin- to medium-bedding; traces of small gypsum crystals; corals common, *Thamnophyllum* sp. and other disphyllids, some brachiopod traces; weathers back, commonly scree covered	13	677
26	Dolomite, dark grey, to grey and brownish grey, coarse-grained; thick-bedded to massive; some laminations	58	664
25	Limestone, grey to reddish grey, dolomitic, fine- to coarse-grained, fragmental; small amounts of plagioclase feldspar; largely composed of stromatoporoids, *Thamnopora, Atrypa* and other brachiopods, and other organisms; thin- and medium-bedded	9	606
	Unit 25 weathers back.		
24	Dolomite, grey, coarse-grained; thick-bedded	17	597
23	Limestone, grey, dolomitic, fine- and medium-grained, fragmental; medium- and thick-bedded; abundant organic traces, some beds entirely composed of ramose *Amphiphora* and encrusting stromatoporoids; other beds of medium-grained granular limestone in clear crystalline matrix; residue of small amounts of gypsum.	22	580
	Thickness of grey dolomite member	281	
	Total thickness of Southesk formation	528	
	CAIRN FORMATION		
	Organic Dolomite Member		
22	Dolomite, dark grey to black, medium-grained; medium-bedded; very abundant *Amphipora*	37	558
21	Dolomite, dark brownish grey, medium-grained; largely composed of stromatoporoids and tabulate corals that weather out a lighter grey; massive	12	521
20	Dolomite, dark brown, fetid, medium-grained; medium-bedded	7½	509
	The succeeding units become increasingly soft and easily weathered; steepness of mountain side decreases.		
19	Dolomite similar to units 20 and 21, regular alternations, 3 cycles, reefoid to bedded dolomite	30	501½
18	Dolomite, dark grey to dark brown, argillaceous, fetid, medium-grained; bedding irregular; sporadic calcite-filled vugs; scattered *Amphipora*	33	471½

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	CAIRN FORMATION—*Cont.*		
17	Dolomite, dark brown, slightly argillaceous, medium-grained; medium-bedded, irregular to rubbly; an 18-inch soft-weathering bed of black dolomite at base, more strongly argillaceous; disphyllid corals common in upper part of unit, gastropods scattered throughout.	16	438½
16	Dolomite, dark grey, argillaceous, slightly silty, fine- to medium-grained; medium-bedded; dark brown flocculent residue and small amounts of quartzitic silt; stromatoporoids form a large proportion of rock; cavities within them contain round grains up to 0·4 mm. diameter of brown dolomite; *Amphipora* in bands and scattered throughout.....	22½	422½
15	Dolomite, dark grey, slightly argillaceous, fine- to medium-grained; bedding vague, reefoid; dark grey flocculent residue; stromatoporoids very abundant throughout and large fragments of species of *Amphipora, Thamnopora, Spongophyllum,* and other corals at some horizons....	57	400
	Unit 15 forms a prominent bluff on hillside.		
14	Dolomite, dark brownish grey, medium-grained; medium- to thick-bedded; scattered *Amphipora* in bands, interbedded with rock rich in spherical stromatoporoids....	15	343
13	Dolomite, dark brownish grey, argillaceous, medium- to coarse-grained; medium-bedded; *Amphipora* and some stromatoporoids throughout	42	328
12	Dolomite, dark grey, argillaceous, fetid, medium-grained; thin- to medium-bedded; faintly banded at some horizons; *Amphipora* prominent and scattered corals..	27½	286
11	Dolomite, dark grey, fine-grained; medium-bedded.....	3½	258½
10	Dolomite, dark grey, argillaceous, slightly pyritic, medium-grained; thin- to medium-bedded; stylolitic; thin *Amphipora* band near top.....	5½	255
9	Dolomite, dark brownish grey, slightly argillaceous, medium-grained; medium- to thick-bedded; *Amphipora* abundant in bands.....	80	249½
8	Dolomite, dark grey, fine-grained, argillaceous; medium- to thick-bedded, irregular; bluish grey to greyish brown weathering; stylolitic; a few small gastropods..	34	169½
7	Dolomite, dark brownish grey to black, strongly argillaceous, fine-grained; vaguely thin- and medium-bedded; brown flocculent residue with scattered pyrite; soft weathering	9½	135½
6	Dolomite, dark grey, fetid, medium-grained; massive to vaguely bedded; rubbly weathering; scattered *Amphipora* and stromatoporoids.....	25	126
	Thickness of organic dolomite member.....	457	
	Cherty Dolomite Member		
5	Dolomite, dark grey, cherty, medium-grained; thick-bedded, irregular; chert as scattered nodules becoming more abundant downwards and forming bands up to 3 inches in thickness; scattered stromatoporoids.....	65	101
4	Dolomite, light brownish grey, silty, slightly calcareous; thin- to medium-bedded, weathered surfaces irregularly banded	2½	36

Unit No.		Thickness in Feet Unit	Thickness in Feet Total from base
	CAIRN FORMATION—*Cont.*		
3	Dolomite, dark grey, fine- to medium-grained; thin-bedded, irregular, rubbly; thin cherty stringers; abundant *Amphipora*	3½	33½
2	Dolomite, dark grey, fine- to medium-grained; medium- to thick-bedded; abundant *Amphipora*	11	30
1	Dolomite, dark to light grey, slightly silty, fine-grained; medium-bedded	19	19
	Thickness of cherty dolomite member	101	
	Total thickness of Cairn formation	558	
	SUB-DEVONIAN		
3	Dolomite, light grey, silty, medium- to coarse-grained; thick-bedded to massive	88	253
2	Dolomite, light grey, fine-grained; thin- to medium-bedded, flaggy, finely banded; weathering light yellowish grey	5	165
1	Dolomite, brownish grey, slightly silty to very silty; thick-bedded to massive; light to dark grey weathering.	160	160
	Total thickness of sub-Devonian measured	253	
	Unit 1 forms a prominent cliff at the top of the first talus slope above tree line. Other massive ledges of dolomite occur among the trees on the lower slopes.		

Bighorn Range, Wapiabi Creek, Northwest Side (Section 6)

The section described below was measured at the first major exposure immediately northwest of Wapiabi Creek, in the Bighorn Range. The upper units are well exposed in the first gully northwest of Wapiabi and the remainder on the hillside to the north. The lower part of the Mount Hawk formation is largely covered, but talus and detritus from burrows as well as scattered outcrops give good indication of the type of lithology. The upper beds of the Cairn formation are exposed a short distance above the left bank of Wapiabi Creek. The Palliser formation was not measured.

Unit No.		Thickness in Feet Unit	Thickness in Feet Total from base
	PALLISER FORMATION		
27	Limestone, grey, fine-grained; medium-bedded to massive.		
	ALEXO FORMATION		
	Upper Member		
26	Dolomite, brownish grey, silty, calcareous, medium-grained; medium-bedded, laminated; some contortion and minor brecciation	26	1,229
25	Limestone, grey, fine-grained; single bed	3	1,203
24	Dolomite, brown, strongly silty; medium-bedded; becomes calcareous towards base of unit	16	1,200
23	Siltstone, grey, dolomitic; finely laminated and contorted	10	1,184
22	Shale, pale olive-green, dolomitic; partly covered	4	1,174
21	Limestone, grey, argillaceous, fine-grained; thin-bedded; mottled with small fragments of green shale, prominent on weathered surfaces	4	1,170

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION—*Cont.*		
20	Dolomite, brown to brownish grey, silty, fine-grained; thin-bedded; laminated	5	1,166
	Thickness of upper member	68	
	Lower Member		
	Unit 19 is cliff forming below the softer weathering units above.		
19	Dolomite, grey to light grey, silty, slightly argillaceous, fine- and medium-grained; thick-bedded to massive; with thinner beds and laminations of fine-grained, dolomitic sandstone	63	1,161
18	Sandstone, brownish grey, dolomitic, argillaceous and silty, fine-grained; thin- and medium-bedded becoming thick-bedded downwards; subangular quartz grains in a silty matrix; some beds of silty dolomite; weathers into fissile flagstones	50	1,098
	Below unit 18 the beds are softer weathering and less prominent.		
17	Dolomite, dark grey, argillaceous, medium-grained; medium beds alternating with thin flaggy laminated beds; becomes increasingly fissile downwards	35	1,048
16	Mudstone, black, dolomitic, silty; thin, fissile bedded; shaly, light yellowish grey weathering	35	1,013
15	Mudstone, similar to unit 16 but medium-bedded	16	978
	Thickness of lower member	199	
	Total thickness of Alexo formation	267	
	MOUNT HAWK FORMATION		
	Argillaceous Limestone and Dolomite Member		
14	Siltstone, dark grey, dolomitic, argillaceous, sandy, fine-grained, medium-bedded; moulds of *Atrypa* sp., *Cyrtospirifer* cf. *whitneyi* (Hall)	20	962
13	Dolomite, grey to dark grey, argillaceous towards base, fine- and medium-grained; irregularly thin- and medium-bedded; discontinuous thin black chert beds; small cavities on weathered surfaces	44	942
	The remainder of the section was measured on the hillside a few hundred yards north of the gully.		
12	Limestone, dark grey, dolomitic, variably argillaceous, medium-grained; thin-bedded, laminated; scattered chert nodules; flaggy weathering	57	898
11	Limestone, dark grey, dolomitic, medium-grained; medium-bedded; chert nodules; increasingly dolomitic downwards	35	841
10	Dolomite, grey, calcareous, medium-grained; thick-bedded; abundant chert as irregular patches, nodules, and bands some replacing vague organic remains, including crinoid stems; fresh surfaces laminated	17	806
	Unit 10 is the last major outcrop on the hillside on the north side of the gully down to unit 7 below.		
9	Covered interval; detritus of fine-grained, argillaceous dolomite fragments; estimated	c. 70	789
	Thickness of argillaceous limestone and dolomite member	243	

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	MOUNT HAWK FORMATION—*Cont.*		
	Grey Calcareous Mudstone Member		
8	Covered interval; abundant detritus of greenish grey, calcareous mudstone, with rare outcrops; estimated....	c. 80	719
	Thickness of grey calcareous mudstone member..	80	
	Total thickness of Mount Hawk formation.....	323	
	SOUTHESK FORMATION		
7	Dolomite, light grey, slightly argillaceous, porous, coarse-grained; partly covered; no bedding visible; vuggy on weathered surfaces; lower part of unit increasingly covered	118	639
6	Dolomite, grey, light grey, and light reddish grey, slightly calcareous, porous, medium- and coarse-grained; upper part vaguely thick-bedded to massive, lower 200 feet massive; traces of clay in some beds; variably vuggy with large irregular cavities on weathered surfaces; some irregular lamellar layers and traces of *Amphipora* (?) at some horizons.....	407	521
5	Dolomite, grey to light grey, medium-grained; medium-bedded	4	114
	Total thickness of Southesk formation.....	529	
	PERDRIX FORMATION		
4	Dolomite, dark grey to black, argillaceous, pyritic, medium-grained; medium-bedded (2 inches to 1 foot); black shale partings that increase in thickness downwards; upper dolomite beds full of white rods *(Amphipora?)*, *Thamnopora* and other corals, and crinoid fragments..	25	110
	Unit 4 becomes considerably more shaly southwards towards the bank of Wapiabi Creek, where its base is not exposed. Northwards along the hillside the upper part of the unit interfingers with lighter grey, coarse-grained dolomite, but the relations of the lower part of the unit with beds along strike are obscure.		
	Total thickness of Perdrix formation.....	25	
	CAIRN FORMATION		
3	Dolomite, grey to dark grey, medium-grained; regular medium-bedded	40	85
2	Dolomite, grey, medium-grained; massive.....	20	45
1	Dolomite, brownish grey, medium-grained; medium-bedded; upper 10 feet with very abundant black chert..	25	25
	Total exposed thickness of Cairn formation.....	85	

Bighorn Range, Wapiabi Creek, Southeast Side (Section 7)

This section was measured along the ridge running northwards from the crest of the range about 1 mile from Wapiabi Creek. It begins at the base of the Palliser formation and continues down into the sub-Devonian.

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	PALLISER FORMATION		
62	Limestone, dark grey to black, dolomitic, fine-grained, granular; massive; dolomitic tracery on weathered surfaces.		
	ALEXO FORMATION		
	Upper Member		
61	Limestone, dark grey, dolomitic, slightly silty, medium-grained; thin- to medium-bedded; irregular fracture, blocky weathering; finely laminated on weathered surfaces, becoming more silty and with lamination more pronounced downward	38½	1,593
60	Dolomite, medium grey, silty, slightly calcareous, medium-grained; irregularly thin- to medium-bedded; weathering light grey with pronounced lamination, commonly with minor folds and flexures	10	1,554½
59	Limestone, light brownish grey, dolomitic, very silty, medium-grained; medium- to thin-bedded, irregular and platy; soft weathering	8	1,544½
58	Dolomite, light brownish grey, silty, medium-grained; medium-bedded; light grey weathering	3	1,536½
57	Dolomite, dark grey, slightly calcareous, silty, medium- to coarse-grained; laminated; irregularly medium-bedded; dark grey weathering	7	1,533½
56	Dolomite, light brownish grey, silty, calcareous, medium-grained; irregularly thin- to medium-bedded, platy; soft weathering	9	1,526½
55	Sandstone, pale yellowish brown, dolomitic, medium-grained; irregularly thin- to medium-bedded; weathering yellowish brown	12	1,517½
54	Dolomite, light yellowish grey, very silty and sandy, medium-grained; irregularly medium-bedded	6	1,505½
53	Sandstone, pale yellowish brown, calcareous, medium-grained; thin, irregular, platy bedding; soft weathering.	2	1,499½
52	Dolomite, light brownish grey, silty, medium-grained; thin- to medium-bedded; weathering dark grey with silty laminations very pronounced on weathered surface; crossbedding and minor slump structures	7	1,497½
51	Sandstone, yellowish brown, dolomitic, medium-grained; irregularly thin- to medium-bedded	8	1,490½
50	Dolomite, light brownish grey, silty and sandy, slightly calcareous, medium-grained; medium-bedded; light buff grey weathering	6	1,482½
49	Covered interval, grass and talus. Fragments of yellowish grey shale and thin-bedded sandstone	14½	1,476½
48	Dolomite, medium grey, sandy, slightly argillaceous, medium- to fine-grained; irregularly thin- to medium-bedded, inclined to be flaggy; brownish grey weathering; laminated with minor structures	17	1,462
	For 5 or 6 feet above the top of unit 47 below, the beds of unit 48 are bent into slight flexures in conformity with the rolling surface of the top of unit 47.		
	Thickness of upper member	148	

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION—*Cont.*		
	Lower Member		
47	Dolomite, light grey, coarse-grained; massive; irregular vertical fractures	7	1,445
46	Dolomite, light grey, slightly silty, fine-grained; irregularly thin- to medium-bedded, laminated	5	1,438
45	Dolomite, grey, argillaceous, fine-grained; a single bed of variable thickness	c. 3	1,433
44	Dolomite, medium grey, coarse-grained; massive	3	1,430
	The base of unit 44 forms a prominent ledge above the softer weathering unit 43 below.		
43	Dolomite, medium grey, slightly argillaceous and silty, medium-grained; irregularly medium-bedded to massive, fine silty lamination at some horizons; becoming darker in colour and slightly coarser grained downwards; base irregular and undulating	47	1,427
42	Dolomite, dark grey, silty, argillaceous, medium-grained; irregularly medium-bedded to massive; weathering dark to brownish grey; *Amphipora* abundant at some horizons; laminated sporadically	49	1,380
41	Sandstone, brownish grey, dolomitic, argillaceous, fine-grained; thin-bedded, shaly; yellowish brown weathering	1½	1,331
40	Sandstone, dark grey, dolomitic, argillaceous, fine-grained; thin- to medium-bedding, flaggy, laminated; angular to subrounded quartz sand grains; fucoid markings on bedding planes; commonly pinkish stained; weathering pale greyish brown	17	1,329½
39	Shale, medium grey, dolomitic, medium- to fine-grained; thin-bedded; weathering pale greenish yellow; becomes finer grained and more greenish in colour downwards	4	1,312½
38	Dolomite, dark grey, silty, medium-grained; thin- to medium-bedded, flaggy; brownish yellow weathering	3	1,308½
37	Mudstone, dark grey, dolomitic; bedding vague, rubbly; vuggy; brownish yellow weathering	2	1,305½
36	Dolomite, dark grey, silty and argillaceous, medium-grained, medium-bedded, with shaly interbands (2 to 3 inches); brownish grey banded weathering	15½	1,303½
35	Dolomite, dark grey, very silty, medium-grained; well bedded, thin to medium, flaggy; dark greyish brown weathering; alternating with more massive beds (9 to 18 inches) of dolomite, dark grey, silty, medium-grained; with irregular and wavy bands, containing detrital fragments showing faintly on weathered surfaces; fish remains	15	1,288
34	Shale, dark grey, dolomitic, medium-grained; brownish grey weathering; some bedding planes with scattered fucoid markings; alternating with dolomitic mudstone, dark grey, fine-grained, thin-bedded, flaggy; forming bands in shale succession	45	1,273
	Unit 34 grades down into unit 33 by increase in proportion of flaggy, dolomitic siltstone.		
33	Siltstone, dark grey to black, dolomitic, sandy and argillaceous; vaguely bedded; flaggy light yellowish grey weathering; abundant *Warrenella* n.sp. in bands	23	1,228

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION—*Cont.*		
32	Dolomite, dark grey, silty, medium-grained; medium-bedded; thin and rubbly on weathered surfaces; bands with small, white weathering, organic fragments; lower 5 to 6 feet more silty with wavy laminations.....	9	1,205
	Thickness of lower member.....	249	
	Total thickness of Alexo formation.....	397	
	MOUNT HAWK FORMATION		
	Argillaceous Limestone and Dolomite Member		
31	Dolomite, medium grey, argillaceous, medium- to coarse-grained; irregularly thin- to medium-bedded; grey weathering; discontinuous chert bands (¼ to ½ inch) and nodules; a few irregular patches of calcite near top; unit becomes finer grained and darker coloured downward, amount of chert increases; top of unit irregular	40	1,196
30	Shale, dark grey to black, strongly calcareous; alternating with limestone, black, slightly argillaceous, fine-grained; thin- and medium-bedded; dominantly shaly at top with limestone bands becoming increasingly prominent downwards; 14 feet from top, silty stringers and lenses prominent; 26 feet from top, mainly limestone with thin silty bands at intervals of 1 inch to 3 inches; lowest 15 to 20 feet more silty and shaly....	65	1,156
29	Dolomite, dark grey, argillaceous, silty, medium-grained; irregularly thin- to medium-bedded; chert in irregular nodules	6	1,091
28	Limestone, dark grey, argillaceous, silty, dolomitic, medium- to fine-grained; irregularly thin-bedded, rubbly.....	72	1,085
27	Dolomite, dark brownish grey, argillaceous, silty and sandy, medium-grained; thin-bedded, flaggy; chert nodules; laminated on weathered surfaces; some bands of dolomitic sandstone	14	1,013
26	Dolomite, greyish brown, silty, medium-grained; irregularly thin- to medium-bedded; laminated on weathered surfaces; irregular lenticular cavities, in bands; chert in bands and nodules becoming more prominent 30 feet from top	76	999
25	Limestone, dark grey to black, very strongly argillaceous, dolomitic, fine-grained; irregularly thin-bedded; sporadic silty bands; soft shaly weathering.....	9	923
	Thickness of argillaceous limestone and dolomite member	282	
	Grey Calcareous Mudstone Member		
24	Covered interval	9	914
23	Mudstone, grey, calcareous, fine-grained; irregularly thin-bedded; alternating with limestone, dark grey, argillaceous, fine-grained, in bands (¾ to 1 inch) at 3- to 6-inch intervals; both mudstone and limestone weather to light yellowish grey with a greenish tinge.....	20	905
22	Limestone, dark grey, slightly silty, medium-grained, dense, containing large numbers of crinoid fragments, corals, and reddish brown nodules.....	½	885
	Unit 22 forms a resistant ledge between the softer units above and below.		

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	MOUNT HAWK FORMATION—*Cont.*		
21	Mudstone and limestone, similar to unit 23 but limestone in less regular bands; more rubbly weathering.....	56	884½
20	Limestone, dark bluish grey, medium- to coarse-grained, dense, with abundant echinoderm fragments; scattered authigenic quartz crystals.....	1	828½
19	Mudstone and limestone, similar to unit 21 with more resistant dense fragmental limestone bands (3 to 10 inches thick) at 89, 170, and 215 feet from top of unit; towards the base the limestone-mudstone association becomes more obscure, being replaced by dark grey calcareous mudstone with irregular rounded fracture...	226	827½
18	Mudstone, grey to greenish grey, calcareous, fine-grained; irregularly thin-bedded; weathering to thin brittle fragments, greenish grey colour.....	229	561½
17	Limestone, grey and brown, strongly phosphatic, coarse-grained, fragmental, with abundant bone and coral fragments, strongly pyritic with numerous rounded pyritized organic fragments; a remanié bed; *Thamnopora* sp., *Hexagonaria minuta* Stumm, *Pachyphyllum* cf. *woodmani* (White), Arthrodire, and other fish remains	2	332½
16	Limestone, dark brownish grey, very coarse-grained, fragmental, pyritic; largely composed of crinoid plates with abundant rounded pyritized organic fragments; some interstitial anhydrite; abundant poorly preserved fossils: *Thamnopora* sp., *Phillipsastraea* sp., *Schizophoria* sp., *Nervostrophia* sp., *Productella* 2 spp., *Nudirostra insculpta* McLaren, *Warrenella nevadensis* (Walcott) (=*W. eclecta* Crickmay), *Atrypa* spp., *Leptodesma* sp., fish fragments	8	330½
	Thickness of grey calcareous mudstone member...	591½	
	Total thickness of Mount Hawk formation.....	873½	
	PERDRIX FORMATION		
15	Shale, black, dolomitic; thin-bedded.....	5	322½
14	Dolomite, black, argillaceous, medium-grained; thin-bedded.	4	317½
13	Shale, similar to unit 15.....	19	313½
12	Dolomite, similar to unit 14.....	4	294½
11	Shale, similar to unit 15, with thin bands of limestone....	22	290½
	Total thickness of Perdrix formation.....	54	

Units 11 to 17 were measured along the right bank of Wapiabi Creek at water level, and in a small stream that flows into the creek at this point. The contact between units 17 and 18 is sharp and is found in a weathered-back gully all the way up the mountain on the southeast side of Wapiabi Creek. The following units of Cairn formation, were observed on the mountainside, along the ridge and down the face of the easternmost ridge on the range on the east side of Wapiabi Creek. The upper beds of the Cairn formation interfinger with several feet of the Perdrix shales higher up the hillside away from the river.

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	CAIRN FORMATION		
	Organic Dolomite Member		
10	Dolomite, brownish grey, coarse-grained; irregularly medium-bedded; reddish brown weathering; uneven top surface; several bedding planes uneven and red stained.....	7½	268½
	The top of unit 9 below forms the lip of a waterfall in a gully on the hillside.		
9	Dolomite, light brownish grey, coarse-grained, cavernous, porous, slightly fetid odour; irregularly thick-bedded to massive; weathering light grey with irregular, vuggy surface; remains of crinoids, stromatoporoids, and corals	70	261
8	Covered interval; vegetation.....	10	191
7	Dolomite, dark grey, medium- to fine-grained, dense; irregularly medium-bedded; brownish grey weathering; scattered stromatoporoids and solitary corals.....	16	181
6	Dolomite, grey, coarse-grained; massive; vuggy.....	50	165
	Thickness of organic dolomite member.....	153½	
	The top of unit 5 forms the top of the main ridge. The remainder of the section was measured down the scarp face to the east.		
	Cherty Dolomite Member		
5	Dolomite, brownish grey, medium-grained; vaguely medium- to thick-bedded; very rich in white chert (up to 20 per cent of rock) as bands, nodules, and replacing stromatoporoids; abundant *Amphipora* and stromatoporoids, and other organic remains.....	66	115
4	Dolomite, dark brownish grey, medium-grained; medium-bedded; abundant *Amphipora* beds of varying thickness	18	49
3	Covered interval	10	31
2	Dolomite, dark grey, coarse-grained; thick-bedded; some beds with abundant small cavities on weathered surface, otherwise structureless	16	21
1	Dolomite, dark grey to grey, slightly calcareous, medium-grained, laminated; thin-bedded.....	5	5
	Thickness of cherty dolomite member.....	115	
	Total thickness of Cairn formation.....	268½	
	SUB-DEVONIAN		
9	Dolomite, light greenish grey, fine-grained; yellow weathering; one bed.....	2	202½
8	Covered interval	26	200½
7	Dolomite, light grey, fine-grained to porcellanous, faintly laminated; thick-bedded; vertical fracture; weathers pale buff-brown	9	174½
6	Sandstone, quartzose, coarse-grained, with flecks of greenish dolomitic shale	½	165½
5	Dolomite, grey to light grey, alternating medium- and fine-grained; massive to thick-bedded; finely laminated light grey beds alternating with coarser grey dolomites.....	108	165
4	Dolomite, grey, medium-grained, strongly silty; laminated, medium-bedded	20	57
3	Dolomite flagstones, brownish grey; thin-bedded, rusty weathering pyritic surface at top.....	7	37

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	SUB-DEVONIAN—*Cont.*		
2	Conglomerate, edgewise, fine-grained, dolomite pebbles in similar matrix; yellow buff weathering; one bed.....	5	30
1	Dolomite, varicoloured, grey, green, and red banding, medium-grained, dense; medium-bedded; weathers a prominent pale rust-red colour; finely banded; near top becomes more shaly and weathers into thin flags with shaly dolomite in between.....	25	25
	Total thickness of sub-Devonian measured.....	202½	

Medicine Lake (Section 18)

The following section is composite; the strata of the Palliser formation were observed and measured along the western flank of Proposal Mountain, the peak that rises to the east of the southeast end of Medicine Lake. The remainder was studied across the ridge that lies between Medicine and Beaver Lakes. The Alexo formation on Proposal Mountain shows anomalous thickness owing to the duplication of part of the sequence by a fold that develops into a thrust along strike to the southeast. The Devonian below the Alexo on this mountain is closely similar in thickness and lithology to the development on 'Beaver Ridge' as described here, some 2½ miles along the strike to the northwest.

The Palliser formation is not usefully divided into two members on Proposal Mountain, although its upper beds become thinner bedded and carry a fauna typical of the Costigan member. The Alexo formation is divided into three members, which, as they appear to be only of local significance, are designated by letters of the alphabet. Member C probably corresponds approximately to the upper member elsewhere and members A and B may correspond to the lower Alexo of other sections.

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	BANFF FORMATION (MISSISSIPPIAN)		
3	Limestone, dark grey, argillaceous; thin-bedded; fucoidal markings common; continuing upwards.....		
2	Mudstone, grey to greenish grey, calcareous, fine-grained; thin-bedded; coalified plant remains, 30 feet above base; *Lingula* sp., fish scales?.....	50	51
1	Sandstone, grey, calcareous, coarse-grained and conglomeratic; weathers reddish brown; contains angular to rounded quartz grains, bone fragments, plant remains (driftwood?), rounded chert fragments, and phosphatic nodules; variable thickness; fills fissures and pockets in the underlying Palliser.....	1	1
	Thickness of Banff formation measured.....	51	
	PALLISER FORMATION		
	The Mississippian-Devonian contact is well exposed in the northernmost gully on the west side of Proposal Mountain. The top of the Palliser formation is irregular and is overlain unconformably in detail by the basal Banff, although there is no difference in regional dip and strike.		

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	PALLISER FORMATION—*Cont.*		
60	Limestone, black to dark grey, bituminous, coarsely crystalline; fragmentary, semi-silicified fauna: *Nudirostra utahensis ventricosa* (Haynes), *Cyrtospirifer* large sp., *Strophopleura* sp.	3	2,327
59	Limestone, grey, fine-grained; thick-bedded; rubbly weathering; fossils scarce: *Camarotoechia nordeggi* Kindle, *Cyrtospirifer* sp.	25	2,324
58	Limestone, grey, dolomitic, fine- to medium-grained; thin- to medium-bedded; well-marked dolomitic tracery; fossils rare: *Cyrtospirifer* spp.	158	2,299
57	Limestone, similar to unit 58, but thin, rubbly bedding...	97	2,141
56	Limestone, similar to unit 58; medium-bedded.....	73	2,044
55	Limestone, dark grey to brownish grey, dolomitic, medium-grained; massive, becoming thick-bedded near top; prominent dolomitic tracery; fossiliferous in top 10 feet: *Schuchertella* sp., small *Cyrtospirifer* sp.	250	1,971
54	Limestone, dark grey to brownish grey, dolomitic, fine-grained; faintly bituminous, some granular bands; massive and thick-bedded; weathers pale grey; irregular dolomitic tracery; sporadic fossils: *Camarotoechia* sp., *Athyris* sp.	256	1,721
53	Limestone, dark grey, medium-grained, with silty and argillaceous stringers; thin, rubbly bedding.....	6	1,465
52	Limestone, dark brownish grey, medium-grained; massive; some thin black chert bands; fragmentary fossils: *Athyris* sp. and gastropods.....	33	1,459
51	Limestone, grey, silty; fine-grained, thin-bedded; nodular rubbly weathering; brachiopod fragments.....	8	1,426
50	Limestone, dark brownish grey, granular; thick-bedded; fossil traces	27	1,418
	Total thickness of Palliser formation.....	936	
	The contact with the Alexo formation is well displayed on the west side of Proposal Mountain, but the remainder of this section was measured on 'Beaver Ridge'.		
	ALEXO FORMATION		
	Member C		
	The lowest beds of the Palliser are exposed on the southwest side of 'Beaver Ridge', and the uppermost beds of the Alexo form the steep dip-slope of the ridge itself. The ridge may be climbed on this side by any of the numerous gullies.		
49	Limestone, grey, sandy and silty; thick-bedded; thin rubbly weathering	25	1,391
48	Sandstone, brown, strongly calcareous, formed of small rounded quartz grains; thin-bedded; weathers yellowish brown; fucoid markings on bedding planes; at 20 feet from base, a 3-inch grey limestone bed with *Camarotoechia* and *Athyris* spp.	23	1,366
47	Sandstone, quartzose, calcareous, and limestone, sandy and silty, both yellowish brown to light grey; thin flaggy bedding; bedding planes covered with coarse fucoid markings up to 12 inches long, all aligned approximately north-south	68	1,343
	Thickness of member C.....	116	

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION—*Cont.*		
	Member B		
46	Limestone, medium grey, fine- to medium-grained; regular medium bedding (18 inches to 2 feet), breaking up into thinner rubbly beds on weathering; richly fossiliferous, mainly small forms: *Aulopora* sp., *Camarotoechia* sp., *Pugnoides* sp., *Cyrtospirifer* sp., *Athyris* sp., gastropods, and nautiloids; some larger forms: *Schuchertella* sp., *Camarotoechia banffensis* Warren subsp. nov., productellids	34	1,275
	The following unit forms a prominent feature along most of the ridge crest.		
45	Sandstone, grey, strongly calcareous, grading upwards into very sandy limestone; thin-bedded; rubbly buff weathering; fucoid markings on bedding planes; a few fossils near top of unit: *Aulopora* sp., small *Cyrtospirifer* sp., *Athyris* sp., and large nautiloids	20	1,241
	Measured down the scarp slope of the ridge, the following units are all prominent on the hillside.		
44	Sandstone, pale brownish grey, very calcareous; thick-bedded; a few nodules of grey sandy limestone; fucoid markings common	11	1,221
43	Limestone, grey, very sandy and silty; thin-bedded; laminated silty stringers enclose small limestone nodules; silt content decreases downwards	7½	1,210
42	Limestone, grey, silty, fine-grained; thin-bedded (1 inch to 3 inches); weathers brownish yellow; fossiliferous throughout: *Aulopora* sp., *Schuchertella* sp., *Chonetes* sp., *Leioproductus* sp. and other productellids. *Camarotoechia banffensis* subsp. nov., *Pugnoides* sp., *Cyrtospirifer* cf. *portae* Merriam, small *Athyris* sp. (abundant), *Leptodesma* sp. and other pelecypods, *"Bellerophon"* sp., cf. *Bactrites* sp., *Camarotoechia* spp. are particularly abundant between 25 and 35 feet above the base: the *"Camarotoechia* zone"	46	1,202½
	The base of unit 42 forms a prominent feature along the hillside.		
41	Limestone, similar to unit 42; bedding planes ripple-marked; fossiliferous: *Aulopora* sp., *Schuchertella* sp., *Pugnoides?* sp., *Cyrtospirifer* sp., *Athyris* sp., gastropods, nautiloids, well-preserved carapaces of *Echinocaris* sp.	32	1,156½
40	Limestone, dark grey, very fine-grained; rythmically interbedded with yellow calcareous silty stringers; fragmentary fossils: *Pugnoides* sp., *Cyrtospirifer* sp., straight nautiloids	20	1,124½
39	Limestone, grey, rubbly; a single bed; abundantly fossiliferous, mainly *Schuchertella* sp. with rare *Pugnoides* sp., and *Cyrtospirifer* sp.; shells all red-stained	1½	1,104½
	Thickness of member B	172	
	Member A		
38	Limestone, grey, argillaceous, silty; nodular bedded; interbedded with thin, fissile, silty layers (2- to 3-inch alternations); few fossils: *Aulopora* sp., *Cyrtospirifer* sp.	15	1,103

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION—*Cont.*		
37	Limestone, similar to unit 38 but more massive; richly fossiliferous especially near middle: *Orbiculoidea* sp., *Nudirostra gibbosa walcotti* (Merriam), *Pugnoides* sp., *Cyrtospirifer* cf. *portae* Merriam, *Leptodesma* sp.; "the *Nudirostra* zone".	35	1,088
36	Limestone, similar to unit 38 but more thinly bedded; scattered fossils: *Nudirostra gibbosa walcotti* (Merriam), small *Pugnoides* sp., *Cyrtospirifer* sp., *Athyris* sp.	20	1,053
35	Limestone, light to dark grey, slightly argillaceous; bedding obscure; curved fracture surface: weathers yellowish brown; sparingly fossiliferous similar to unit 36	48	1,033
34	Limestone, dark grey, strongly argillaceous, silty; vaguely thick-bedded; fossiliferous: *Lingula* sp., *Chonetes* sp., *Nudirostra gibbosa walcotti* (Merriam), *Cyrtospirifer* sp., *Leptodesma* sp.	40	985
33	Limestone, similar to unit 34; irregular bedding; fossiliferous: *Chonetes* sp., *Nudirostra* sp., small *Cyrtospirifer* sp., pelecypods, "*Conularia*" sp.	35	945
32	Limestone, similar to unit 34; irregular, thin- to medium-bedded, fissile; fossiliferous: abundant "*Styliolina*", rare *Nudirostra* and pelecypods	15	910
31	Limestone, black to dark grey, argillaceous, slightly silty, very fine-grained; thin-bedded, fissile, becoming thicker bedded upwards; conchoidal fracture; grades down into unit 30; sparingly fossiliferous throughout: "*Styliolina*" sp., *Nudirostra gibbosa walcotti* (Merriam)	25	895
30	Limestone, black to dark grey, strongly argillaceous; very thin shaly bedding, fissile, becoming a little thicker upwards; residue pale brownish grey	80	870
	Thickness of member A	313	
	Total thickness of Alexo formation	601	
	MOUNT HAWK FORMATION		
29	Sandstone, grey, dolomitic, silty, slightly calcareous; thin-bedded, laminated; yellowish brown weathering; *Tentaculites* and rare conodonts	9	790
28	Limestone, dark grey, silty and argillaceous; very thin-bedded, fissile; yellow weathering	10½	781
27	Sandstone, quartzose, dark grey to black, calcareous, argillaceous, fine-grained, laminated, with silty stringers; medium-bedded at base, increasingly thin and fissile upwards; weathers light brownish yellow	7½	770½
26	Sandstone, similar to unit 27; medium-bedded with two prominent bands of pyritic nodules and one thin argillaceous band	3½	763
25	Sandstone, similar to unit 27; thin-bedded and fissile; at base a 2-inch bed of irregular, nodular, argillaceous and phosphatic limestone pebbles in a sand and siltstone matrix	2½	759½
24	Limestone, dark grey, argillaceous and silty; medium-bedded, alternating with thin, fissile, calcareous and argillaceous siltstones	10	757
23	Limestone, black to dark grey, argillaceous; medium-bedded at base; becoming increasingly fissile and argillaceous upwards	5½	747

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	MOUNT HAWK FORMATION—*Cont.*		
22	Limestone, similar to unit 23; medium-bedded at base, becoming increasingly fissile upwards.....	19	741½
21	Limestone, black to dark grey, argillaceous; 3-inch beds alternating with 2 inches of fissile, platy, limestone; becomes increasingly argillaceous in the top 15 feet; rare pelecypods indet., and flattened tapering rod-like bodies (up to 3 inches long).....	155	722½
20	Limestone, black, argillaceous, nodular, alternating in bands (2 to 6 inches) with fissile, calcareous shale; grades upwards from lower unit and into higher.....	30	567½
	Total thickness of Mount Hawk formation.....	252½	
	PERDRIX FORMATION		
19	Shale, grey to black, calcareous, fissile; grades upwards from unit 18.....	60	537½
18	Shale, black, pyritic, fissile; mainly non-calcareous, but calcareous bands increase upwards; a few thin beds of nodular argillaceous limestone; *"Styliolina"*, fairly common in bands.....	290	477½
	Total thickness of Perdrix formation.....	350	
	The remainder of the section was measured in the gully that runs down from the open hillside above and cuts the lower, wooded slopes of 'Beaver Ridge', immediately above the south end of Beaver Lake.		
	FLUME FORMATION		
	Upper Member		
17	Limestone, black, argillaceous, fetid; thin-bedded with shale partings; richly fossiliferous: *Productella* sp., *Nudirostra athabascensis* (Kindle), *Ambothyris* sp., *Eleutherokomma jasperensis* (Warren), *Athyris* sp., *Buchiola* sp., *Leiopteria* sp., and other pelecypods, *Bactrites* sp.	6½	187½
16	Limestone, dark grey, argillaceous, fine- to medium-grained, poorly medium-bedded, rubbly; richly fossiliferous: *Nudirostra athabascensis* (Kindle), *Atrypa* sp., *Eleutherokomma jasperensis* (Warren).....	30	181
15	Limestone, grey, argillaceous, rubbly, fine-grained, transitional from underlying dolomite; abundant *Eleutherokomma jasperensis* (Warren).....	1	151
	Thickness of upper member.....	37½	
	Lower Member		
14	Dolomite, dark grey to brown, argillaceous, bituminous odour, medium- to coarse-grained; medium- to thick-bedded	24	150
13	Dolomite, black to dark brown, medium-grained; very thin-bedded and laminated at base, becoming thicker bedded higher up; chert abundant in bands; scattered stromatoporoids throughout and *Amphipora* band (4 inches) at top.....	17	126
12	Dolomite, black, coarse-grained; weathers chocolate-brown; medium-bedded; black chert bands at several horizons	8½	109

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	FLUME FORMATION—*Cont.*		
11	Dolomite, light to medium grey, medium- to coarse-grained; medium-bedded; scattered silicified *Allanaria* cf. *allani* (Warren) and *Athyris* sp.	18	100½
10	Dolomite, grey, medium- to coarse-grained; medium-bedded; vuggy; scattered chert nodules, some after stromatoporoids; irregular erosion surface at base and thin (6-inch) silty dolomite bed at top	10	82½
9	Dolomite, black, fetid, coarse-grained; thin-bedded	1½	72½
8	Dolomite, grey and brown, fine- to medium-grained; thick-bedded; sporadic thin silty bands and thin *Amphipora* horizons; basal bed strongly bituminous; rare stromatoporoids and silicified *Athyris* sp.	23	71
7	Dolomite, silty, laminated; thin-bedded	1	48
6	Dolomite, grey and brown, medium-grained; massive; 18-inch *Amphipora* bed at top	4½	47
5	Dolomite, dark grey, medium-grained; medium-bedded; scattered large rounded quartz grains throughout; erosion surface at base	9½	42½
4	Dolomite, dark grey to brown, bituminous odour; thin- to medium-bedded; several 1-inch silty beds	13½	33
3	Dolomite, black, argillaceous; thin, shaly bedding	1½	19½
2	Dolomite, dark grey, argillaceous, medium-grained; medium-bedded; black chert band in middle of unit; erosion surface with channelling at base; large *Eleutherokomma*? sp. in top 10 inches	10	18
1	Dolomite, dark grey, coarse-grained; massive; scattered large rounded quartz grains; grades downwards into coarse dolomitic quartzose sandstone, with some lenses of pure sandstone at bottom; very variable in thickness, thinning to 4 feet in less than 20 feet along strike, overlies erosion surface, bored and channelled and filled with sand grains; richly fossiliferous with beekitized broken shells: *zaphrentid* corals, *Allanaria* cf. *allani* (Warren), *Athyris* sp.	8	8
	Thickness of lower member	150	
	Total thickness of Flume formation	187½	
	SUB-DEVONIAN		
	Ordovician and Underlying Beds of Uncertain Age		
9	Dolomite, dark grey, argillaceous and calcareous; some silty bands; conglomeratic, with pebbles of similar rock; worm trails on bedding planes	4½	914
8	Shale, dark grey, slightly calcareous	½	909½
7	Dolomite, grey, argillaceous, fine-grained; medium-bedded; upper part of each bed conglomeratic with flat disk-shaped pebbles of dolomite in a similar matrix. Some thin beds of green, calcareous shale	36	909
6	Limestone, grey, fine-grained; medium-bedded; interbedded with green, calcareous shale	22	873
5	Limestone and dolomite as above, interbedded with thin beds of shale; trilobite fragments including *Bellefontia* cf. *nonius* (Walcott)	85	851
4	Conglomerate, intraformational, flattened dolomitic pebbles in more calcareous mudstone matrix; unbedded	22	766

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	SUB-DEVONIAN—*Cont.*		
3	Limestone and shale, regularly interbedded in 6-inch to 1-foot alternations	53	744
2	Shale, green, calcareous; a few thin beds of limestone throughout	141	691
1	Dolomites and limestones; well-bedded; with sporadic conglomerate beds becoming fewer downwards; much evidence of currents: ripple-marks, fine current bedding, and small-scale slump structures; continuing down to last outcrop in gully	550	550
	Total exposed thickness of sub-Devonian	914	

Headwaters of Job Creek (Section 23)

About 3 miles upstream (southwest) from where it is joined by the trail from Coral Creek, Job Creek cuts through a Devonian range. This range is prominent on both sides of the valley near the headwaters of the creek. The following section was begun high up on the hillside on the northwest side.

The Palliser was not measured, and the upper Alexo formation was partly inaccessible. Most of the Cairn formation was measured at the top of the talus slope above the valley. The base of this formation is not present, the section ending against a dislocation under which highly contorted sub-Devonian dolomites are exposed. There are, however, 88 feet of the basal member of the Cairn present and there is presumably little missing.

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION		
	Upper Member		
	Above unit 43 a small thickness of soft, brown weathering beds could be seen below the typical massive grey limestones of the Palliser formation. These softer beds doubtless also belong to the Alexo formation.		
43	Limestone, light grey, fine-grained; massive	15	1,462
42	Dolomite, light grey, silty, medium-grained; thin-bedded, strongly laminated; prominent slump structures, and siltstone bands	35	1,447
41	Dolomite, light grey, very silty, medium-grained; thin- and medium-bedded, laminated; some siltstone bands	5	1,412
	Thickness of accessible part of upper member	55	
	Lower Member		
40	Dolomite, brownish grey, coarse-grained, vuggy; massive, thick-bedded at top; estimated	30	1,407
39	Dolomite, grey, silty, medium-grained; thin- and medium-bedded, laminated; some thin siltstone bands	6	1,377
38	Dolomite, light grey, medium- and coarse-grained; vaguely medium-bedded to massive; abundant vugs	49	1,371

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	ALEXO FORMATION—*Cont.*		
37	Dolomite, similar to unit 39; abundant signs of small-scale slumping	9	1,322
36	Dolomite, grey and dark brownish grey, medium-grained; medium-bedded	16	1,313
35	Dolomite, brownish grey, silty; thin- to medium-bedded, laminated	11	1,297
34	Dolomite, yellowish brown, silty and argillaceous, medium-grained; thin- and medium-bedded; becoming increasingly argillaceous downwards	10	1,286
33	Partly covered; mudstone, yellowish grey, dolomitic, silty; weathers pale yellow	5	1,276
	Thickness of lower member	136	
	Total accessible thickness of Alexo formation	191	
	SOUTHESK FORMATION		
	Upper Grey Dolomite Member		
32	Dolomite, light grey, coarse-grained; massive, cliff forming; weathered surface mottled with large white dolomite crystals	44	1,271
31	Dolomite, dark brownish grey to greyish brown, fine- and medium-grained; massive with vague structure lines; large cavities on weathered surface; a few small coral colonies	32	1,227
30	Dolomite, light grey, coarse-grained; massive; cavernous; fractured with abundant calcite veins; irregular junction with units above and below, broadly lenticular in form	20	1,195
	Thickness of upper grey dolomite member	96	
	Coral Bed Member		
29	Dolomite, dark brownish grey, petroliferous smell, fine- and medium-grained; vaguely bedded to massive; filled with white tabulate and rugose coral remains; vuggy, cavernous on weathered surface; soft weathering	61	1,175
28	Dolomite, similar to unit 29, but medium-bedded and feature forming; abundant coral remains, including *Thamnopora* sp., *Hexagonaria* sp.	18	1,114
	Unit 28 forms top of small cliff on hillside.		
27	Dolomite, light greyish brown, argillaceous, fine- and medium-grained; thin-bedded; scattered coral detritus and occasional *Atrypa*	16	1,096
26	Dolomite, greyish brown to light brownish grey, argillaceous and highly cherty; thin- and medium-bedded; black chert in nodular bands making up 30 per cent of rock	32	1,080
25	Dolomite, dark brownish grey, fine-grained; thick-bedded	12	1,048
	Thickness of coral bed member	139	
	Grey Mudstone and Limestone Member		
24	Covered interval	22	1,036
23	Limestone, dark grey, argillaceous, fine-grained; abundant fossil debris; rubbly and nodular	4	1,014

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	SOUTHESK FORMATION—*Cont.*		
22	Limestone, dark grey, fragmental in fine-grained matrix; in medium beds interbedded with rubbly, nodular limestone and greenish grey, calcareous mudstone that increases downwards; richly fossiliferous with *Atrypa* greatly predominating: *Thamnopora* sp., *Synaptophyllum* cf. *stramineum* (Billings), *S.* cf. *arundinaceum* (Billings) of Smith 1945, *Metriophyllum* sp., cup corals, fennestellid fragments, *Douvillinaria* sp., *Nervostrophia* sp., *Schuchertella* cf. *prava* (Hall), *Devonoproductus walcotti* (Fenton and Fenton), *Pugnoides* sp., *Atrypa* spp., *Cyrtospirifer* cf. *whitneyi* (Hall), *Indospirifer* n.sp. cf. *I. orestes* (Hall and Whitfield), *Tenticospirifer* sp., *Cranaena* sp., crinoid columnals.....	41	1,010
21	Limestone, similar to unit 22, but less mudstone and more resistant; lower few feet partly covered; fossiliferous: *Synaptophyllum* cf. *arundinaceum* (Billings) of Smith 1945, trepostome *bryozoa, Atrypa* sp.	44	969
20	Limestone, grey, argillaceous, fine-grained; thin rubbly bedding with mudstone partings; bedding planes with large fucoidal marks of hard, grey, nodular limestone; becomes more shaly downwards and grades into next unit; fossiliferous, largely corals and *Atrypa* spp.	15	925
	Thickness of grey mudstone and limestone member.	126	
	Lower Grey Dolomite Member		
19	Dolomite, dark grey, argillaceous, fine-grained; thin fissile bedding; almost shaly on weathering; a few medium beds near base.....	22	910
18	Dolomite, grey and brownish grey, medium-grained; medium-bedded; fragmental	11	888
17	Dolomite, dark brown, slightly argillaceous, strong petroliferous smell, porous, medium-grained; massive, medium-bedded on weathering; abundant calcite-filled vugs and veinlets; a few traces of small corals (*?Syringopora*)..	111	877
16	Dolomite, dark brownish grey, argillaceous, fine-grained; thin- and medium-bedded; some flagstone bands....	15	766
15	Dolomite, dark brown to brownish grey, porous, medium-grained; massive; bands of flattened calcite-filled vugs give appearance of bedding; some large cavities on weathered surface; numerous calcite veinlets.....	31	751
14	Covered interval; flaggy brown dolomites, similar to unit 15 in talus.....	25	720
13	Dolomite, similar to unit 15, but increasingly vuggy, and with signs of abundant stromatoporoids and some corals	31	695
12	Dolomite, light grey, strong petroliferous smell, coarse-grained; massive; at 76 feet down in unit a 10-foot band of dark brown, vuggy, stromatoporoidal dolomite and a similar 7-foot band at 134 feet below top of unit; the whole unit is broadly lenticular along hillside to the northwest and the darker bands are also lenticular...	155	664
	Unit 12 is sheared and contorted; the thickness is only approximate.		
	Thickness of lower grey dolomite member.....	401	
	Total thickness of Southesk formation.....	762	

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	CAIRN FORMATION		
	Organic Dolomite Member		
11	Dolomite, dark brownish grey, strong petroliferous smell, medium-grained; massive, with a few bedding planes; vuggy, with vugs arranged and elongated parallel with bedding; strongly organic, rock filled with lighter grey traces of *Amphipora,* stromatoporoids, and corals, some beds largely composed of *Amphipora;* one lens of light grey dolomite, 4 feet thick, 50 feet down in unit.....	97	509
10	Dolomite, similar to unit 11, but medium- and thick-bedded with some beds of featureless grey dolomite and some laminated beds.....	19	412
9	Dolomite, similar to unit 11; massive and vuggy.....	28	393
8	Dolomite, dark grey, medium-grained; thick-bedded, laminated; *Amphipora* and other organic traces.....	20	365
7	Dolomite, dark brownish grey, strongly fetid, medium-grained; thick beds alternating with medium beds of lighter grey coarse-grained dolomite; abundant *Amphipora* and coral traces.....	49	345
6	Dolomite, dark brownish grey, fetid and sulphurous smell, medium- to coarse-grained; thick-bedded; sporadically vuggy; abundant vague organic traces.....	31	296
5	Dolomite, similar to unit 6; irregularly medium-bedded; abundant *Amphipora*	32	265
4	Dolomite, similar to unit 6; massive to vaguely bedded; abundant vugs and stromatoporoids; alternating with medium-bedded dolomite with *Amphipora*.....	46	233
3	Dolomite, dark grey and dark brownish grey, medium-grained; thick-bedded to massive; abundant vugs, some calcite filled, paralleling bedding; very abundant *Amphipora* and stromatoporoids in lighter grey dolomite	99	187
	Thickness of organic dolomite member.....	421	
	Cherty Dolomite and Limestone Member		
2	Dolomite, similar to unit 3; medium- and thick-bedded; abundant black and grey chert as nodules and bands..	44	88
1	Limestone, dark grey to grey, fine-grained; alternating thick beds with thin-bedded, laminated limestone.....	44	44
	Thickness of cherty dolomite and limestone member present	88	
	Total thickness of Cairn formation present.....	509	
	The beds immediately above and below the dislocation under the Cairn formation are contorted and fractured. The beds below, presumably of sub-Devonian age, consist of massive, faintly laminated limestones of various shades of grey, green, and red.		

Job Creek, Eastern Fault Block (Section 24)

The following section was studied and measured on the range immediately to the east of the trail leading down into Job Creek from Coral Creek and Job Creek Pass. It is approached up the stream that joins Job Creek from the southeast about 1 mile downstream from the foot of

the pass. The Palliser forms a cliff, for the most part unclimbable, and the section was begun at the base of this formation and measured down the ridge that overlooks Job Creek Valley from the southeast. It is easily accessible and the exposures are good.

Unit No.		Thickness in Feet *Unit*	*Total from base*
	PALLISER FORMATION		
43	Limestone, dark grey, fine- and medium-grained, thick-bedded to massive.		
	ALEXO FORMATION		
	Upper Member		
42	Dolomite, dark grey, fine-grained; medium-bedded.....	5	1,391
41	Limestone, dark grey, dolomitic, fine-grained; thick-bedded; vaguely laminated.....	7½	1,386
40	Dolomite, grey, silty, fine- and medium-grained; thin- and medium-bedded, silty laminations and stringers with small-scale slump structures; a few thin siltstone bands; silt, quartzose, rounded grains; weathers into flagstones	24	1,378½
	Thickness of upper member.....	36½	
	Lower Member		
39	Limestone, grey to brownish grey, fine-grained, variably granular; medium- and thick-bedded.....	26	1,354½
38	Dolomite, brownish grey, coarse-grained; medium-bedded; some laminated bands.....	11	1,328½
37	Limestone, grey, dolomitic, coarse-grained; thick-bedded; abundant small 'rosettes' of dolomite crystals that weather out on surface.....	23	1,317½
36	Dolomite, grey, coarse-grained; thick-bedded; alternating with thinner beds of medium-grained, laminated dolomite; thicker beds with stromatoporoid and coral traces	17	1,294½
35	Dolomite, variably grey to dark brownish grey; medium-bedded, laminated; coral and stromatoporoid traces at some horizons	15	1,277½
34	Dolomite, light greenish grey, very fine-grained; vague medium bedding, laminated; soft flaggy weathering....	8½	1,262½
33	Mudstone, black, dolomitic; interbedded with black fissile shale	5	1,254
	Thickness of lower member.....	105½	
	Total thickness of Alexo formation.....	142	
	MOUNT HAWK FORMATION		
	Grey Dolomite Member		
32	Limestone, variably grey and reddish grey, dolomitic, fine-grained with abundant calcite flecks; massive, becoming thick-bedded at base; vague structure lines paralleling bedding on weathered surfaces; dolomite content increases downwards	50	1,249
31	Dolomite, grey and light grey, very coarse-grained; thick- and medium-bedded with sporadic massive development along strike; abundant calcite-filled vugs and flecks	17	1,199
	Thickness of grey dolomite member.....	67	

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	MOUNT HAWK FORMATION—*Cont.*		
	Coral Bed Member		
30	Dolomite, dark brownish grey, medium-grained; massive, becoming thin-bedded on weathering; abundant calcite-filled vugs, flecks, and veins; weathers dark chocolate-brown; scattered tabulate corals in lower part, and a few large gastropod moulds	12	1,182
29	Dolomite, brownish grey, slightly fetid odour, coarse-grained; massive	31	1,170
28	Dolomite, dark brownish grey, slightly argillaceous, medium-grained; filled with white compound corals in great profusion; massive; slight carbonaceous residue with rare detrital quartz grains; *Aulopora* sp., *Thamnopora* sp., *Synaptophyllum* sp., and other disphyllids	22	1,139
	Thickness of coral bed member	65	
	Argillaceous Limestone Member		
27	Partly covered. Limestone, grey, strongly argillaceous, fine-grained; alternating with black, calcareous shale; limestone bands richly fossiliferous, some beds being largely composed of corals: *Cladopora* sp., *Syringopora* sp., *Thamnopora* sp., *Trachypora* sp., *Pachyphyllum* ex gr. *nevadensis* (Stumm), *Synaptophyllum* cf. *arundinaceum* (Billings), *Atrypa* sp., *Cyrtospirifer* sp. (with high area), *Tenticospirifer* cf. *cyrtiniformis* (Hall and Whitfield), fennestellid bryozoans	24	1,117
26	Limestone, dark grey, strongly dolomitic, argillaceous; rubbly, thin- and medium-bedded; weathers as nodular masses in shaly calcareous matrix; pyrite abundant in bands as small aggregates and scattered cubes; residue of brownish grey flocculent clay; richly fossiliferous: *Striatopora* sp., *Synaptophyllum* sp., *Gypidula* large sp., *stropheodontid, Devonoproductus* ex gr. *walcotti* (Fenton and Fenton), *Atrypa* sp., *Cyrtospirifer* sp. (with high area), *Indospirifer* n.sp. cf. *I. orestes* (Hall and Whitfield), *Tenticospirifer* cf. *cyrtiniformis* (Hall and Whitfield), bryozoans (identified by T. E. Bolton): *Eridotrypella* sp., *Leptotrypella* sp., fish fragments	24	1,093
25	Limestone, grey, very argillaceous, dolomitic, cherty; massive, becoming thin-bedded on weathering; chert in nodular bands, very abundant; remanié deposit at base; residue black, granular, slightly pyritic; fossiliferous near top: trepostome bryozoa, *Atrypa* cf. *devoniana* Webster	26	1,069
	Thickness of argillaceous limestone member	74	
	Grey Calcareous Mudstone and Limestone Member		
24	Mudstone, grey to greenish grey, calcareous; thin-bedded and fissile; with thin (½-inch) bands of argillaceous limestone every few inches; residue of light grey translucent granules; becomes more nodular near top and richly fossiliferous: small cup corals, *Nervostrotrophia* sp., *Devonoproductus* ex gr. *walcotti* (Fenton and Fenton), *Atrypa* cf. *devoniana* Webster, *Cyrtospirifer* sp., *Indospirifer* n.sp. cf. *I. orestes* (Hall and Whitfield), *Cranaena* sp.	77	1,043

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	MOUNT HAWK FORMATION—*Cont.*		
23	Mudstone, grey, calcareous; weathers greenish grey and shaly	75	966
22	Mudstone, grey, calcareous, with thin nodular argillaceous limestone bands; weathers yellowish brown and thin-bedded	120	891
21	Limestone, dark grey, strongly argillaceous; medium beds alternating with dark grey, fissile, calcareous mudstone; scattered pyrite crystals; weathers light yellowish grey; abundant *Nudirostra albertensis* (Warren)	28	771
20	Limestone, grey, silty, slightly argillaceous, fine-grained; medium-bedded; interbedded with calcareous shale; abundant quartzitic silt grains and scattered pyrite; *Nudirostra albertensis* (Warren) abundant at base	70	743
	Thickness of grey calcareous mudstone and limestone member	370	
	Total thickness of Mount Hawk formation	576	
	PERDRIX FORMATION		
19	Limestone, black, argillaceous; in well-marked beds (up to 18 inches) with more fissile limestone beds between, and some calcareous shale; becomes less shaly upwards and more flaggy and fissile	156	673
18	Limestone, black, argillaceous, dolomitic, fine-grained; alternating with shale, black, calcareous; limestone in beds up to 2 feet thick, shale up to 6 inches	30	517
17	Limestone and shale, similar to unit 18 but thinner bedded; shale more in evidence	25	487
16	Limestone and shale, similar to unit 18; a few scattered fossils: *Macgeea* sp., small productellid, *Nudirostra insculpta* McLaren, *Atrypa* sp.	35	462
15	Limestone, black, argillaceous, fine-grained; single bed	4	427
14	Limestone, black, argillaceous, dolomitic, fine-grained; alternating with shale, black, calcareous; medium-bedded (4 to 8 inches); limestone fragments emit a marked metallic ring when struck	57	423
13	Covered interval, talus similar to unit 12	25	366
12	Limestone, dark grey to black, strongly argillaceous, dolomitic, fine-grained; in thin and medium flaggy beds; interbedded with black calcareous mudstone and shale in about equal proportions; scattered pyrite crystals and small nodules common; some bedded chert between 20 and 30 feet above base; at 40 feet above base: small productellid, squashed *Nudirostra insculpta* McLaren, *Tentaculites* sp. Unit 12 is feature forming; there is a sharp break between units 11 and 12.	80	341
11	Limestone, black, argillaceous, fine-grained; medium-bedded, with thin calcareous mudstone bands between bedding planes; scattered pyrite as crystals and replacing small fossils; at 4 feet above base; small productellid, abundant *Nudirostra athabascensis* (Kindle), *Eleutherokomma* cf. *jasperensis* (Warren); at 40 feet above base; *?Schuchertella* sp., abundant *Nudirostra insculpta* McLaren, *Tentaculites* sp., small pelecypods cf. *Ontaria* sp.; near top of unit bedding planes with numerous small fucoid or coprolite markings and some worm trails	56	261
	Total thickness of Perdrix formation	468	

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	FLUME FORMATION		
	Upper Member		
	The following three units are more resistant than those above and form more prominent features, but not cliffs.		
10	Limestone, dark brownish grey, very fine-grained; thick-bedded; finely colour banded (½ to 1½ mm.); insoluble residue consists of a mass of very fine, anastomosing filaments; scattered small crystals of fluorite	9	205
9	Limestone, black, slightly argillaceous, fine-grained; thin-bedded; interbedded with black, calcareous shale; small amounts of fluorite grains; small productellid, *Nudirostra athabascensis* (Kindle), *Eleutherokomma* spp. cf. *E. jasperensis* (Warren), and *E. leducensis* Crickmay	4½	196
8	Limestone, dark grey, slightly argillaceous and dolomitic, fine-grained; rubbly medium bedding; soft weathering; small numbers of silt grade fluorite crystals; zaphrentid coral, abundant *Stropheodonta* spp., *Atrypa* sp., *Allanaria minutilla* Crickmay	22½	191½
	Thickness of upper member	36	
	Lower Member		
	The following units are resistant and cliff forming.		
7	Limestone, black, argillaceous, cherty, fine-grained; medium- and thick-bedded; disseminated chert replacing some fossils; traces of fine-grained, authigenic quartz; scattered stromatoporoids and brachiopod fragments	24	169
6	Limestone, black, dolomitic, slightly argillaceous, medium-grained, fragmental, cherty; laminated, thin- and medium-bedded low in unit, becoming thick-bedded to massive upwards; bulk of rock composed of stromatoporoids; abundant medium-grained, white dolomite rhombs and traces of fine-grained, authigenic quartz; scattered brachiopods: *Atrypa multicostellata* Kottlowski, *Eleutherokomma jasperensis* (Warren), *Athyris* sp.	100	145
5	Dolomite, dark grey, calcareous, medium-grained; medium-bedded; chert in bands and nodules and replacing fossils; *Amphipora* sp. and stromatoporoids common; grades into overlying unit	8	45
4	Dolomite, light grey, strongly calcareous, fine-grained; single bed; irregularly laminated on weathered surfaces	1½	37
3	Dolomite, dark grey, strong fetid smell, coarse-grained, porous; thick-bedded, with some medium beds of lighter grey, finer grained dolomite in lower 10 feet; some calcite-filled vugs (½ inch to 2 inches diameter); abundant *Amphipora* sp. in well-marked beds	23½	35½
2	Breccia, of dolomite, angular pebbles (½ inch to 4 inches diameter) in similar matrix; fragments typical of units above and below	1	12

Unit No.		Thickness in Feet: Unit	Thickness in Feet: Total from base
	FLUME FORMATION—*Cont.*		
1	Dolomite, dark grey, coarse-grained; in 1- to 2-foot beds; interbedded with dolomite, light grey, fine- and medium-grained, laminated; in 9- to 18-inch beds.....	11	11
	Thickness of lower member.....	169	
	Total thickness of Flume formation.....	205	
	SUB-DEVONIAN (PROBABLY ORDOVICIAN)		
7	Covered interval	27	429
6	Thick-bedded limestones and dolomites, mainly very coarse-grained, with shaly partings.....	67	402
5	Thin- and medium-bedded dolomites and limestones with thin shaly partings; grey, green, and dark red.....	28	335
4	Limestone, light grey, dolomitic; forming a small bioherm-like mass interfingering along strike with thin-bedded laminated limestones and shales; probably tectonic thickening; considerably broken by stylolites at all angles to the bedding, giving the rock the appearance of a breccia; a few fragments of orthoid brachiopods..	40	307
3	Series of medium- and thick-bedded dolomites, edgewise and penecontemporaneous conglomerates, with some limy and greenish grey dolomitic shales.....	97	267
2	Covered, probably increase in proportion of shales; estimated thickness	c. 70	170
1	Limestone, grey, dolomitic, argillaceous; thick-bedded (4-foot beds); penecontemporaneous and edgewise conglomerates common; interbedded with thinner, greenish grey, dolomitic shales; fucoid markings common on weathered surfaces; estimated thickness ..	c. 100	100
	Total thickness of sub-Devonian measured.....	429	