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NOTES ON GLACIATION IN
CENTRAL YUKON TERRITORY

(Report, 1 figure and 7 plates)

H. S. Bostock



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CENTRAL YUKON TERRITORY**

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ABSTRACT

Two clearly defined series of glacial limit features, readily correlated and traced from place to place are inferred to mark the limits of the last glacial advance in central Yukon. These are the McConnell Moraine and an earlier advance, the Reid Moraine. In addition, older glacial drift, till, erratics and modified landforms have been found beyond the clearly marked limits and perhaps record two earlier glaciations. These earlier features are referred to as the Klaza Drift (the younger) and the Nansen Drift (the older).



PLATE I. View east over Kalzas Plateau showing Big Kalzas Lake and Kalzas Twin Peaks in front of it. The kame terrace of the McConnell Moraine winds around the plateau close to the level of timber-line. Note that the moraine laps around the slope of the Twin Peaks on the right and the solifluction features on the slope above the moraine in the foreground. 99473 (copied from USAAF trimetrogon photograph).

NOTES ON GLACIATION IN CENTRAL YUKON TERRITORY

INTRODUCTION

From the beginning of geological work in the Yukon Territory, though the emphasis was always on bedrock geology, information on Pleistocene glaciation has been gathered. An endeavour is made here to assemble the gist of the Pleistocene information on the central part of the territory from early reports and particularly from the writer's reports and notes up to 1960, enhancing them with some observations from airphotos. The dating and correlation from place to place are little better than speculations. The assembling of these scraps of information has yielded a picture that, while hazy, nevertheless reveals features of great interest in taking the next step forward in gathering Pleistocene data.

The paper has been discussed with O.L. Hughes who is currently studying the region to the north and the writer is much indebted to him for his ideas and assistance.

Glaciation was first recognized in the Yukon Territory in 1887 by G.M. Dawson (1889)¹. Multiple glaciation was first suggested by the writer (Bostock, 1934, p. 6A)² in the Carmacks area and the first evidence was noted in the Nansen Creek mining camp, where a till or boulder clay (above which a concentration of gold had developed in the placer creeks) was recognized as an "older boulder clay" and placed beyond the limits of the "last glaciation" (Bostock, 1936). Nineteen years earlier, in 1914, D.D. Cairnes (1915) had drawn attention to this boulder clay but made no suggestion of more than one glacial advance.

Two clearly defined series of glacial limit features, readily correlated and traced from place to place are inferred to mark the limits of the last and an earlier glacial advance. In addition older glacial drift, till, erratics, and modified glacial landforms have been found beyond the two clearly marked limits and perhaps record two earlier glaciations.

The youngest glacial limit is marked by fresh ice-marginal landforms and is typified by the moraine crossing the Stewart River valley a few miles below Mayo. This moraine was first recognized in 1900 by R.G. McConnell (1903) and is here named the McConnell Moraine. The informal terms McConnell glacial limit and McConnell advance are applied to correlative phenomena.

Down the Stewart River valley about 40 miles beyond the McConnell Moraine a well marked zone of ice-marginal landforms and

¹Dates and/or names in parenthesis refer to publications listed in the references.

²A figure depicting areas covered by at least two advances is shown on page 6A in the original edition of Bostock (1934). The text without this figure was reprinted in Memoir 284.

deposits forms a second and distinctly older glacial limit. Here a system of moraines, kame terraces and ice-marginal features is named the Reid Moraine in view of its striking development near Reid Lakes, which is taken as the type locality. The informal terms Reid glacial limit and Reid advance are applied to correlative phenomena.

Till, gravel, erratics, and other glacial phenomena beyond the Reid limit, lacking glacial topographic expression in places and with degraded glacial landforms in others are separated into two units: a younger, the Klaza Drift, characterized by modified glacial landforms in the valleys of the Klaza River and Lonely Creek; and an older, the Nansen Drift represented by deeply weathered deposits without glacial topographic features found in localities around Nansen Creek. As with the names above the term advance is used with Klaza and Nansen informally.

No ice-marginal moraines mark the limits of these old drifts, but an attempt is made to delineate on the map the positions believed to have been reached by the associated glacial advances even though in places the positions of these limits appear incongruous with likely ice gradients.

NOTES ON VARIOUS LOCALITIES

It is convenient to begin in the Nansen Creek neighbourhood in the southern part of the region known to the writer and to trace the various discoveries northward.

Klaza River and Nansen Creek area

The boulder clay or till referred to by Bostock (1936, p. 48) has been seen on tributaries of Nansen and Victoria Creeks. It is weathered and fragments of schist and granite lying in it are completely rotted and crumble to pieces when touched.

Similar till was seen in 1947 by the writer in gold placer workings at 4,000 feet elevation in the upper branches of Discovery Creek, a tributary of Nansen Creek a few miles west of Victoria Creek. Also, a section showing soil at the top, underlain by angular rubble and then by very coarse rotten gravel that lay on bedrock was seen above 4,600 feet on the head of Discovery Creek. This section of 20 feet and more is underlain by deeply weathered bedrock. The gravel is believed to belong to the glaciation that left the till. The concentration of gold on the surface of this till, the lack of any noticeable glacial topographical features, and extensive modification of the slopes by solifluction over the till and gravel suggest an early date for this glacial advance. The high elevations at which the till and gravel occur indicate that the glaciation probably spread beyond the locality where they have been found. The materials belonging to this glacial advance are herein named the Nansen Drift.

At its headwaters Klaza River follows a broad open valley. This valley bends southwest, south, and then by a large wind gap southeast where it becomes occupied by Lonely Creek. At the wind gap the river turns northwest into a narrow valley that becomes deeply entrenched in the plateau

as it is followed downstream. The topography and the drainage pattern of Klaza River and its tributaries downstream from the wind gap show a reversal of the drainage at a point about 5 miles east of the 138th meridian. The course downstream from the wind gap is at a steady gradient and the tributaries, though successively steepening as the river continues, have concordant gradients. This reversal of the Klaza River is believed to have been caused by ice blocking the wide valley of Lonely Creek.

In the Klaza River valley, to the northwest of the wind gap, at 3,600 feet elevation and lower, remnants of terrace, truncated spurs and a widened valley floor are present to within 4 miles of Magpie Creek indicating that a tongue of ice reached to this locality. The wind gap and the floor of Lonely Creek valley are choked with hummocks of drift¹ and pocked with ponds. The next creek valley parallel to Lonely Creek to the southwest also contains drift features and ponds and its creek has been beheaded and diverted to Schist Creek.

The relative freshness of the features in Klaza Valley above Magpie Creek and along Lonely Creek, including the hummocky drift topography in the wind gap, contrast with the steady gradients and generally older character of the Klaza Valley below Magpie Creek. These points suggest that the reversal of drainage was established well before the ice left its last traces in the upper part of Klaza Valley and deposited the drift in the wind gap. For this reason and also because the general levels there and those of the Nansen till seem to correspond, the reversal is attributed to the Nansen advance while the fresher features are referred to a later, Klaza advance and the materials associated with this advance are called the Klaza Drift. In Bostock (1934, p. 6A) the Nansen and Klaza advances (then unnamed) were linked together, but they are now regarded as two quite distinct advances.

A castellated outcrop of granitic rock stands on the west side of Nansen Creek valley below the level of the Nansen till and lower than the assumed limit of the Klaza advance.

In the bottom of the valley around the lakes between Nisling River and Rowlinson Creek at elevations up to about 3,500 feet the glacial features are fresher than those of Lonely Creek. They are believed to be younger than the Klaza advance and to represent an advance whose boundary has not been traced there with certainty. A large kame terrace² on the east end of Miller's Ridge at elevation 4,300 feet marks the limit of an advance very distinctly. Above it but not below on the ridge, castellated outcrops of lava stand conspicuously. These features too are thought to evidence a later advance than the Klaza and are correlated with the Reid Moraine.

¹The term "drift" is used throughout this report for surficial deposits of undetermined glacial origin, not proven till.

²The term "kame terrace" is used throughout this report for the large railway-like embankments extending along the hillsides and commonly showing grades in the order of 50 to 100 feet per mile. They appear to be largely gravel, but often contain large boulders. Above them there is generally a lack of the glacial features prominent below them.

Miller's Ridge to Pelly River

From Miller's Ridge northwestward to the mouth of Big Creek a limit of glaciation is evident on the ground in many places and also on the airphotos. Spillways cross from Crossing and Merrice Creeks to the Big Creek drainage. This boundary is part of the Reid glacial limit of the Stewart River valley.

In the Glenlyon area, east of the 136th meridian, R.B. Campbell (in press) has found a later and less extensive glacial limit than that of the Reid Moraine and has traced its extension into the Carmacks area by the study of airphotographs. Everywhere its features are fresh, sharply defined, and readily distinguishable as in the case of the McConnell Moraine of which it is believed to be a part.

A fresh grey till, believed to belong to this McConnell advance, was exposed with fresh gravel above and below it in a gravel pit on the east side of the road near Five Finger Rapid. A few miles away in the big cut-bank on Yukon River below the mouth of Tatchun River stands a pink till in cliffs between gravels (Dawson, 1889, p. 144B). In the pit the till was freshly exposed, but in the river bank the till has been subject to weathering. It remains a question whether they are the same till or whether the pink till is older than the grey till.

Northeast of the Yukon River, on the mountain at the head of McGregor Creek a conspicuous kame terrace shows in the airphotos. It extends for some miles on the northeast side, sloping down northwestward from 4,100 feet at its southeast end. Lower down on the same side of this mountain another kame terrace starts at about 3,100 feet and slopes down northwestward in about 6 miles to 2,600 feet. On the south slopes of the mountain at about 3,300 feet the airphotos also show features believed to mark a limit. While the higher kame terrace is believed to mark the limit of the Reid advance these lower features may be due to a local halt or readvance during its waning.

Six miles northwest of Minto an upper limit of glaciation was found on the ground a little below 3,000 feet and some miles northwest there is a suggestion of a limit on the same ridge in the airphotos at a lower elevation.

Farther north, near Pelly River, an upper limit was found at about 3,000 feet with castellated, wind polished outcrops above it. Below this, overlooking the south side of Pelly River, opposite Caribou Creek, a long sloping kame terrace with its upper end about 2,200 feet elevation stands out clearly in the airphotos. It is thought that two limits are represented in these localities, possibly that of the Klaza advance above and the Reid advance below.

Southwest of Yukon River

On the southwest side of the Yukon River below Minto, no distinct limit was traced for the Reid Moraine, although features that may mark this limit appear to extend to near Fort Selkirk. That this advance probably

did not go farther seems to be shown by castellated granite outcrops a little above 2,000 feet, 4 miles south of Fort Selkirk, and by deep weathering in the bedrock a mile or two west of the Fort (E.B. Owen, personal communication).

Still on the southwest but farther from Yukon River, gravel deposits, terraces, and a few erratics were found on the ground. Linked with features in the airphotos these indicate glaciation extending above 3,000 feet from south of the mouth of Dark Creek to Wolverine Creek and thence westward through the wind gap to Selkirk Creek and into Hayes Creek valley. The most westerly erratics noted are boulders of Selkirk Volcanics at elevations up to 3,300 feet near meridian $138^{\circ}45'$ on the north side of Wolverine Creek (Bostock, 1936, p. 10). These glacial features are all modified and suggest one or more early and extensive advances that are here tentatively linked with the Klaza and Nansen advances. The specific source of the volcanic boulders is not known and it is not safe to assume that they have come from the interglacial lava flows opposite Fort Selkirk, referred to below (Bostock, 1936, p. 45).

Southeast of Mt. Pitt, at the head of Dark Creek, old gravel deposits above 3,000 feet elevation and a large, solitary granite erratic on the Carmacks lavas at 3,500 feet are believed to represent the Nansen advance.

Terraces east of Prospector Mountain in Big Creek valley and drift extending through the pass to Hayes Creek at 3,500 feet may also be of early glacial origin.

Farther west below the mouth of Selkirk Creek, Hayes Creek has a broad valley floor with a high, wide terrace on the southwest side. The bedrock in the terrace is 100 feet or more above the valley floor and some 100 feet and more of drift and muck lies on top of the bedrock. Placer workings in Sonora Gulch cut in this terrace showed rusty gravels with gold concentrated at the base lying on a tight, silty, sandy stratum. Bedrock was not exposed. A few miles above Selkirk Creek the Hayes Creek valley is canyon-like. It is thought that these features suggest that an ice tongue extended down Selkirk Creek into this broad part of Hayes Creek valley during the Nansen advance.

North of Fort Selkirk

Across the Yukon River northwest of Fort Selkirk, the surface of the lava flows is mantled with undulating drift deposits pocked in places with hollows containing ponds and small lakes. These surface features are subdued and modified, and the airphotos show them extending up the valley of Black Creek and its tributaries. Glacial grooving and striae were found by digging on the surface of the lava at 1,900 feet overlooking Pelly River. These features must have been made by ice overriding the castellated outcrop south of Fort Selkirk, probably during the Klaza advance.

On the north bank of the Yukon River east of the 138th meridian a bank about 100 feet high of coarse gravel and large boulders has the appearance of glacial drift. Farther down the river below the mouth of Selwyn River an area of drift lies in the big bend on the north side of the Yukon. If

these features are of glacial origin they indicate that early glaciation probably of the Nansen advance reached down the Yukon valley as far as Selwyn River.

In addition, in 1959, E. B. Owen (personal communication) found a till lying under the lava flows 3 miles downstream from and opposite Fort Selkirk. Wood from this till has been dated at greater than 38,000 years B.P. (Walton et al., 1961). This till may belong to the Nansen advance or is perhaps still older.

Pelly River to Stewart River

A glacial limit thought to be of the Klaza advance can be traced on the north side of Pelly valley from west of Crosby Creek to near Grayling Creek, but beyond this its position is uncertain until lower Lake Creek valley is reached.

Fresher glacial features are discernible east of Willow Hills and extend into the gaps in the hills to upper Lake Creek valley as at Willow Lake. From south of Firestone Creek a conspicuous kame terrace or moraine winds unbroken for miles around the northeast end of the hills where it has a maximum elevation of 3,100 feet. It slopes downward to the west at about 100 feet per mile. A castellated outcrop occurs a few hundred feet up the slope above it and others stand higher on Willow Hills, but none were noted below it. The course of this moraine past Reid Lakes and thence northward to near the mouth of McQuesten River was recognized in the air-photos and pointed out by R. B. Campbell (personal communication). Behind this glacial limit, fresh surface features of light grey drift are characteristic. The limit so well shown by these features in this area is referred to as the Reid Moraine, as already mentioned.

Upper Lake Creek Westward to Stewart River

Two basins, that of upper Lake Creek, including the east slopes and spurs of White Mountains, and that of Grand Valley and Rosebud Creeks, referred to below as the Rosebud basin, contain masses of drift carrying foreign rocks. This material appears to record early Pleistocene glaciation.

The last advance in the upper Lake Creek basin reached through gaps in Willow Hills and up Grayling Creek valley. Ponds lie along the floor of Lake Creek valley in the wider sections below 2,500 feet, but castellated outcrops occur in the basin on hills at 3,100 feet. It is thought that the lower parts of Lake Creek basin were occupied by ice of the Klaza advance that came through the gaps in the Willow Hills, but the position of the limit is uncertain.

To the west of Lake Creek the drift, though not often seen in fresh exposures, is more generally brown on the surface in contrast to the grey drift of the Reid Moraine east of Willow Hills. On the east slopes of White Mountains drift and erratics, some of great size, are abundant up to 3,500 feet but none is present at 3,800 feet. A large ridge of drift at 3,300

feet diverts the heads of the creek from the north, southward into Coldspring Creek and may be part of the moraine of an early, post-Nansen halt or minor readvance, or possibly a part of the Klaza terminal moraine, but it has not been traced anywhere from this feature.

Rosebud basin is well protected by high ground on all sides, but particularly on the east and north from where the most direct thrusts of the ice came. On the east side the passes, including that south of Coldspring Mountain, are 2,900 to 3,150 feet in elevation and those on the north 2,700 to 3,000 feet. These passes exhibit glacial sculpturing, evidencing the passage of ice into the basin where terraces of drift as well as erratics indicate that it reached a level of at least 2,500 feet but no drift or erratics were noted much above this elevation. On the floor of Rosebud basin the surface material is commonly gravelly, but in places, notably on Silt Creek, areas of silt 50 feet or more thick occur. The terraces and erratics continue down Grand Valley Creek on the southwest side close to 2,500 feet elevation. The valleys of Rosebud and Grand Valley Creeks form the westward outlets of the basin and show little sign of glacial erosion except that the valley of Grand Valley Creek is distinctly U-shaped as far as the junction with Jane Creek. The pressure of ice spreading from Stewart River valley into the lower parts of the valleys of Rosebud Creek and its tributaries probably held back the movement down these creeks.

South of Rosebud basin, the passes to the Yukon River by the heads of Black Creek are lower than those north of the basin and are at 2,300 to 2,500 feet elevation. Drift and erratics, some of Selkirk basalt, lie in upper Jane Creek valley and suggest that the ice moved from the Yukon River valley to join that of Grand Valley Creek.

The lack of any sign of the passage of ice or meltwater over the road pass, elevation 2,700 feet, from Jane Creek to Walhalla Creek and of any evidence of glaciation in Walhalla and Scroggie Creeks indicates that the ice remained below the level of the pass and did not cross the ridge into Walhalla Creek. Furthermore, the presence of mammoth bones at the base of an undisturbed section of peat lying on gravel in a tributary of lower Scroggie Creek also seems to support the absence of glaciation in Walhalla and Scroggie Creeks.

Turning now to the lower part of Rosebud Creek, a drift terrace rises more than 500 feet above bedrock 6 miles up the valley. It is composed of foreign rocks in a silty matrix, the whole material resembling slumped till. The top of the terrace at 2,100 feet elevation slopes downward up the creek. On the hill joining it on the southeast, large and small boulders of chert breccias brought from either the Ogilvie Mountains or far up Pelly River were found on the west side at 2,600 feet (Bostock, 1964). Another exposure of till-like material occurs at 2,650 feet on the northeast side 2 miles farther up Rosebud Creek. All these features in the Rosebud basin are believed to belong to the Nansen Drift.

Lower Stewart River

West of the Reid Moraine, in the Stewart River valley, three exposures of till were found. One is on the old road near Belleview Point, one

is in a cut-bank on lower Lake Creek, and the third is at 2,300 feet elevation just east of the 138th meridian 3 miles south of Stewart River (Bostock, 1964). In these exposures the till is grey and fresh, except that on Lake Creek, diorite boulders in the till and in the grey gravels beneath it crumble on touch. The till in each locality is grey and has a silty to clay-like matrix and contains scattered stones commonly as long as 6 inches and occasional, striated boulders. On both sides of Stewart River close to the 138th meridian, but particularly on the north side, drift and erratics occur up to about 2,600 feet elevation, above which castellated outcrops start abruptly. This drift was not traced down the river valley and is believed to disappear in about 10 miles. It is regarded as belonging to the Klaza advance.

Farther down Stewart River, great masses of drift form terraces around the mouth of Rosebud Creek up to about 2,200 feet elevation. A few miles east on the north or opposite side of the river, east of Valley Creek, large areas are also covered by drift up to about the same level. There the surface of the drift is hummocky and undulating in places and the material appears to have blocked two creek courses along one of which a canyon 300 feet deep has been cut down to grade in bedrock.

The lowest pass across the ridge between the Stewart River and Australia Creek lies northeast of Wounded Moose Dome and is at 2,300 feet elevation. This pass is deeply cut transverse to the ridge with a relatively moderate gradient leading from it on the north side. The only other low places on the ridge are saddles that drop abruptly on each side with no sign of the passage of either ice or water across them. These saddles have elevations of 2,650 and 2,750 feet so that a maximum level close to 2,500 feet is indicated for any stream or ice flowing over the lowest pass. From the lowest pass a train of foreign gravels, including much chert, extends down Australia Creek into Indian River and down to its mouth in the Yukon River. The gravels form modified terraces 100 feet and more above the creek and river valley floors on the south sides. These features are believed to show that ice once filled Stewart River valley to about the level of 2,500 feet at the pass. A tongue of ice may have projected through the pass, but if it did it was less than 300 feet thick, and it is believed that the pass acted mainly as a meltwater spillway.

At Porcupine Creek the Stewart River valley floor is somewhat narrower than upstream but beyond this, an area of gently undulating drift that may be of glacial origin lies on the low rock terrace along the river between Black Hills and Maisy May Creeks. Farther downstream, on the north side of the river below Scroggie Creek and on the south side below Tenderfoot Creek, large areas of drift occur that may also be of glacial origin or may only be part of an outwash train. The features described here along the sides of Stewart River valley from near the pass to Australia Creek and Rosebud Creek downstream are linked with those of the Rosebud basin. They are regarded as evidencing a single early extensive glaciation to which the Nansen Drift belongs.

Tintina Trench

Northwest from Stewart River the Tintina Trench contains a great mass of brown gravelly material, referred to here as the brown drift.

This drift forms a huge fill, hundreds of feet deep on the floor and sides of the Trench up to about 2,500 feet, approximately from Stewart River to South Klondike River. Its surface slopes gently southeastward and is varied by a few hollows, some of which contain lakes. In it road and placer cuts have exposed parts of the stratigraphic section.

In a placer working on the bank of Clear Creek, opposite Barlow, White Channel Gravels, typical of the Klondike (McConnell, 1905, p. 29B; also Bostock, 1957, p. 82 and 1964) are exposed lying directly on bedrock and underneath brown gravels. The contact with the brown drift is sharp and horizontal. Early miners report that their shafts etc. revealed the White Channel Gravels under the brown drift in a considerable area around Barlow.

The brown drift contains foreign quartzites, cherts, and other rocks whose nearest source lies to the north in the Ogilvie Mountains. The bulk of the stones are rounded, some large ones are angular, many have faceted forms, but none seen are striated and many are wind-faceted. The few exposures show this material to be gravels, but the scattered boulders and general appearance of its surface, its undulations and lake-filled hollows suggest that it may be partly till. In a cut on the old Clear Creek road near Bellevue Point, the brown drift consists of well-washed, fine gravel and is overlain by the grey, silty till, referred to above and regarded as Klaza Drift. It is believed to be part of McConnell's Flat Creek beds (McConnell, 1905, p. 24B; Bostock, 1957, p. 78) and is correlated here with the Nansen Drift.

Great quantities of similar brown drift containing foreign rocks, notably including quartzite similar to that of Keno Hill, are spread over the hills from upper Partridge Creek northwestward, in Clear Creek, around its tributaries, Squaw Creek and Henry Gulch, and northwestward along the side of the Tintina Trench up to 3,500 feet elevation. The tributaries of Partridge Creek have entrenched their valleys through this drift and some tens of feet into the granite beneath it. While this drift is thought to be one with the brown drift and part of the Nansen Drift it may possibly be older.

Upper Stewart River

A few miles below Mayo the McConnell Moraine (McConnell, 1903), referred to above, lies on the broad valley floor of Stewart River. For a distance of several miles it is formed of a mass of fresh ice-marginal landforms including at its outer limit a sharply defined, narrow, drift ridge that stretches for 2 or 3 miles on the north side of the valley floor at an elevation of about 1,850 feet. A bed of fresh, grey till with silt and gravel above and gravel below it, none of which contain any weathered stones, extends for several miles in the banks where the river cuts through the moraine. Less than 17 miles below Mayo the till and moraine end and the river channel, instead of being confined to a narrow trough in banks of gravel, till, and silt as it is in the moraine, meanders across the full width of its valley with low gravel banks. This moraine has been followed as far south as Nogold Creek valley where the anomalous loop in the creek seems to be due to it. A similar moraine again shows in the MacMillan River valley and from there it is continuously traced in to the Carmacks area by

R.B. Campbell (in press) as already mentioned.

In the excavation for the Mayo River hydro dam an exposure of two tills was recorded by E.B. Owen (personal communication). In this exposure a brown weathered surface soil 2 to 4 feet thick rests on 4 to 8 feet of dark grey till with many dark chert pebbles. Below this lies 4 to 6 feet of dark grey gravelly till with many local schist pebbles and boulders lying on top of talus material. The top of the lower till is a brown weathered zone 1 1/2 to 2 feet deep. Presumably these two tills belong to the Reid and McConnell advances.

In progressing eastward the profiles of the ice surfaces of the major advances rise increasingly gently and converge in elevation so that the moraines of the McConnell advance are so close to those of the earlier advances as to make them virtually indistinguishable. However, two or three advances may be distinguished on Talbot Plateau. There the McConnell limit can be traced fairly continuously around the plateau. It is marked on the north slope by a large double kame ridge, similar to those on Fork and Klaza Plateaux. The moraine opposite Mayo is at about 2,900 feet elevation and extends to east of Two Buttes, where it is at 4,000 feet. Erratics and foreign gravels lie above it and there is a suggestion of a second moraine 300 to 400 feet higher at Two Buttes and 800 feet or more higher at the west end of the plateau. This second moraine is thought to belong to the Reid advance. Erratics occur still higher on the plateau, but above 4,700 feet elevation on the west butte none was noted. It is thought that the highest erratics are from the Klaza advance and that the limits of the three advances are close together at Two Buttes, but that the buttes stood as nunataks above them.

On Nogold Plateau again a number of drift features at different levels suggest that the mark of more than one limit occurs there above the McConnell limit. As yet these moraines are not correlated with major advances.

Dublin Gulch

A key area lies around and south of Dublin Gulch. There the highest indication of glaciation is gravel containing foreign rocks at 4,500 feet elevation on the plateau at the head of the gulch. Below this, in 1943, two trenches were made by the Geological Survey on the south side of Dublin Gulch below Bawn Boy Gulch (Bostock, H.S., 1959, p. 35, for map with names of this area) in a terrace at about 3,650 feet elevation. In them the brown soil at the top showed a concentration of fine gold and scheelite, but from a foot or more down the terrace is composed of glacial till to depths of at least 10 feet, with numerous foreign rocks, some faceted and striated and no gold or scheelite. One notable erratic, about 15 pounds weight, of purple volcanic breccia, well faceted and striated was found on the surface of the terrace. This rock is believed to have come from the Beaver River area (Cockfield, 1925). It is thought that to deposit this till the ice must have moved either over the plateau, 4,500 feet elevation, to the east or over the ridge, 4,200 feet elevation to the north. Lower in Dublin Gulch below Eagle Pup placer workings exposed material believed to be till in which all the granitic rocks, some 2 to 3 feet in diameter were completely rotted.

Trenches cut on the upper part of the hill, 3,500 feet elevation, west of Ann Pup, revealed deep weathering with a normal gradation from soil down into bedrock and no sign of glaciation. The lower slopes, however, are covered by drift. No evidence of glaciation was noted on upper Haggart Creek above Dublin Gulch, though the ice that laid the till up the gulch is thought to have been both there and on the hill.

In the placer workings of Dublin Gulch and Haggart Creek, and indeed all the neighbouring placer creeks, quantities of hematite pebbles and some stones as large as 2 feet long have been found. The nearest source for these foreign stones is to the northeast, beyond the Mackenzie drainage divide.

In Haggart Creek valley a large fan-like terrace lies on the east side at the mouth of Dublin Gulch and extends about half a mile below it. The terrace is of silty and gravelly drift and has in places a skin of gravel carrying a concentration of fine gold and scheelite on it. Farther downstream in the same valley a large undulating mass of silty drift with a few ponds on it lies on the west side of Haggart Creek above the mouth of Lynx Creek. As below Dublin Gulch, gravels lying on the surface of this drift in places carry a little gold and scheelite.

On the east side of Haggart Creek south of Platinum Pup a large well-faceted and striated quartzite erratic and other foreign rocks were found at 2,850 feet elevation. The valley of lower Haggart Creek and adjacent Lynx Creek, except near and below Secret Creek, show sloping modified terrace forms. In the lower part near Secret Creek and below it fresher forms are apparent and light grey till is exposed in the road cuts.

These phenomena are thought to show that a very early glacial advance covered the country at least as high as the top of the plateau at the head of Dublin Gulch, 4,600 feet elevation. It was followed later by a second early advance that flowed down Lynx Creek and lower Haggart Creek. This later advance protruded up Haggart Creek valley to near the mouth of Dublin Gulch and reached an elevation of about 2,850 feet near Platinum Pup. Later still an advance pushed up lower Haggart Creek from the McQuesten Valley to a short distance above Secret Creek.

The first of these advances is regarded as the Nansen advance. The second advance is also believed to be old and is correlated with the Klaza advance. The drift in Haggart Creek valley near Secret Creek is thought to belong to the Reid advance.

UNCORRELATED MORAINES

The airphotographs, particularly, and also some ground observations reveal features that may be local halts of readvances during retreat of major advances. The earliest of these noted is the mass of drift, already mentioned, north of Coldspring Creek, which may be a relic of some post-Nansen halt or possibly a part of the terminal moraine of the Klaza advance. Another occurrence is in the valley of Willow and Crooked Creeks, which contains a mass of morainal material. The valley drains both north and south from the summit of this mass between Pelly and Stewart Rivers.

This great pile must have formed between contemporaneous ice tongues opposed to each other pushing from the Pelly and Stewart Valleys. As yet the extension of the ice margins from the valley have not been traced, but there are features along Woodburn and North Crooked Creeks that may correspond to this moraine and these phenomena probably represent an important readvance after the maximum of the Reid advance.

In places in Mayo map-area sections of moraine have been found for limited distances below or east of the McConnell Moraine. Notable among these are some in the MacMillan Valley, around Plateau Mountain, Moose Lake, and thence north to the Hess and Stewart Valleys. These seem to delineate an important McConnell halt or minor late readvance.

ALPINE GLACIATION

Dawson Range

There is evidence of more than one advance of isolated alpine glaciers in the higher parts of the Dawson Range beyond the limit of general glaciation. A small lake lies in a freshly cut, steep-walled cirque on the north side of Apex Mountain and there is another small fresh cirque adjacent to this one on the west (Bostock, 1936, p. 12). Two very small fresh cirques also occur on Prospector Mountain. These features seem to be all there is of the last alpine glaciation, which was perhaps contemporaneous with the McConnell advance.

Around Apex Mountain, both on the ground and in the airphotos, evidence of extensive but somewhat modified alpine and valley glaciation is apparent. At the head of Selwyn River is a terminal moraine about 5 miles down from Apex Mountain (Bostock, 1944). It lies at an elevation of about 3,800 feet and is somewhat modified in form but not deeply weathered. Ponds and hummocky ground were noted in the heads of Big Creek in 1933 and the airphotos show that these are included in the areas covered by alpine and valley glaciers coming from Apex and Prospector Mountains and from the mountains south of Apex Mountain along the 138th meridian. Small alpine glaciers also appear to have been present on the north side of Mt. Cockfield. In all cases except the fresh cirques on Apex and Prospector Mountains these features show some modification. Perhaps they may be linked with the Reid advance.

Syenite Range

A small isolated glaciated area formed on the Syenite Range. In and around the range evidence of four glacial advances has been found. The first and most extensive, tentatively correlated with the Nansen advance, formed an ice-cap centred on the range and was bounded on the south by the valley of the Little South Klondike River. The clearest and most extensive evidence of this advance was seen at the head of the east fork at Gates Creek, above 3,000 feet elevation, and in the adjacent Glacier Creek drainage. There great, rotten boulders, mainly of the distinctive rocks of the Syenite Range, lie on slopes of brown till-like material.

The next younger period, referred to the Klaza advance, is represented by a chain of morainal ridges containing similar Syenite Range material on the northeast side of Glacier Creek. These ridges divert the head tributaries and the main stream of Glacier Creek from flowing on their normal courses through the gaps in the hills into the Little South Klondike River.

The third period, tentatively considered to be of the age of the Reid advance, is represented by moraines along the sides of the major creek valleys radiating from the Syenite Range. These moraines are composed of fresher, but still considerably weathered material from the range, including solid boulders. Their topographic forms are modified and on the west side of the range reach to the river valley, but end moraines in the valley are lacking.

In the cirques at the heads of the alpine valleys a few ponds are held in by small moraines, which may belong with the McConnell advance.

McArthur Range

In the McArthur Range the valleys heading in the mountain cirques show three periods of glaciation. The earliest extends right down the valleys leaving a great deal of local rock debris in the valleys and lateral moraines at about 4,500 feet elevation. No terminal moraines belonging to this period were noted on the southwest flank of the range where they discharged into the Tintina Trench. The glaciers either reached to the contemporary main ice or to below the level of that of subsequent advances. The few exceptions that show terminal moraines are present in the northwest part of the range where the heads of Nogold and Crooked Creeks were apparently sheltered from the ice of the main advances. These alpine glaciers are thought to be contemporaneous with the Reid advance.

The next period left small terminal moraines commonly impounding small lakes in the upper parts of the valleys, practically in the cirques. The third period is represented by small moraines at the heads of the cirques.

In addition there are in a few places small bodies of blue glacier ice showing under debris against the head walls of the highest cirques. In 1940 one of these with a cliff below it, on the east side of Grey Hunter Peak showed 20 or more dirt layers in its steep face that was judged to be 40 feet high. These may well be the last remnants of the cirque glaciers of the Little Glaciation.

The same triple pattern occurs in the cirques and alpine valleys of the Gustavus Range, but no ice was seen there.

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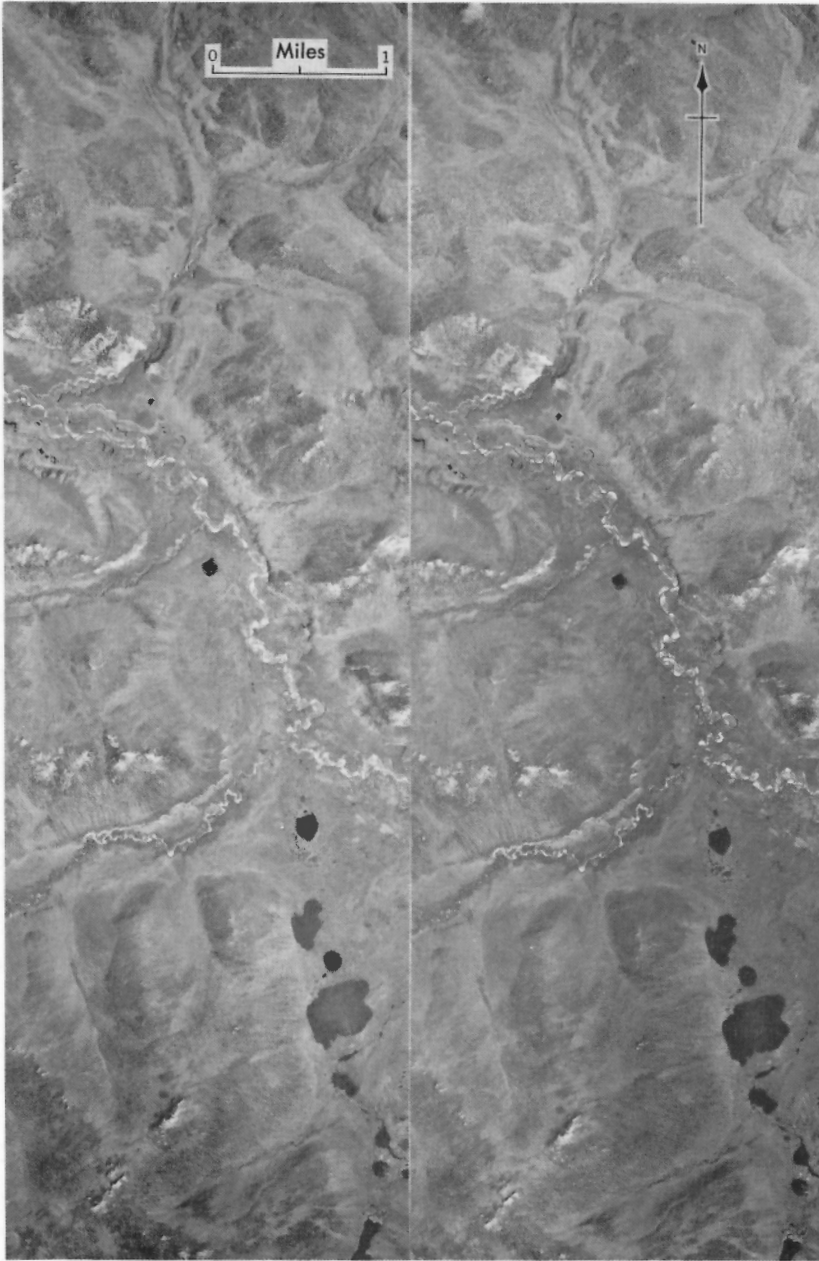


PLATE II. Stereoscope pair of vertical airphotographs showing sculpturing of the Klaza River valley, terraces, and ponds filling hollows in the windgap to Lonely Creek. (Parts of photographs A15770-32 and 33, National Airphoto Library)

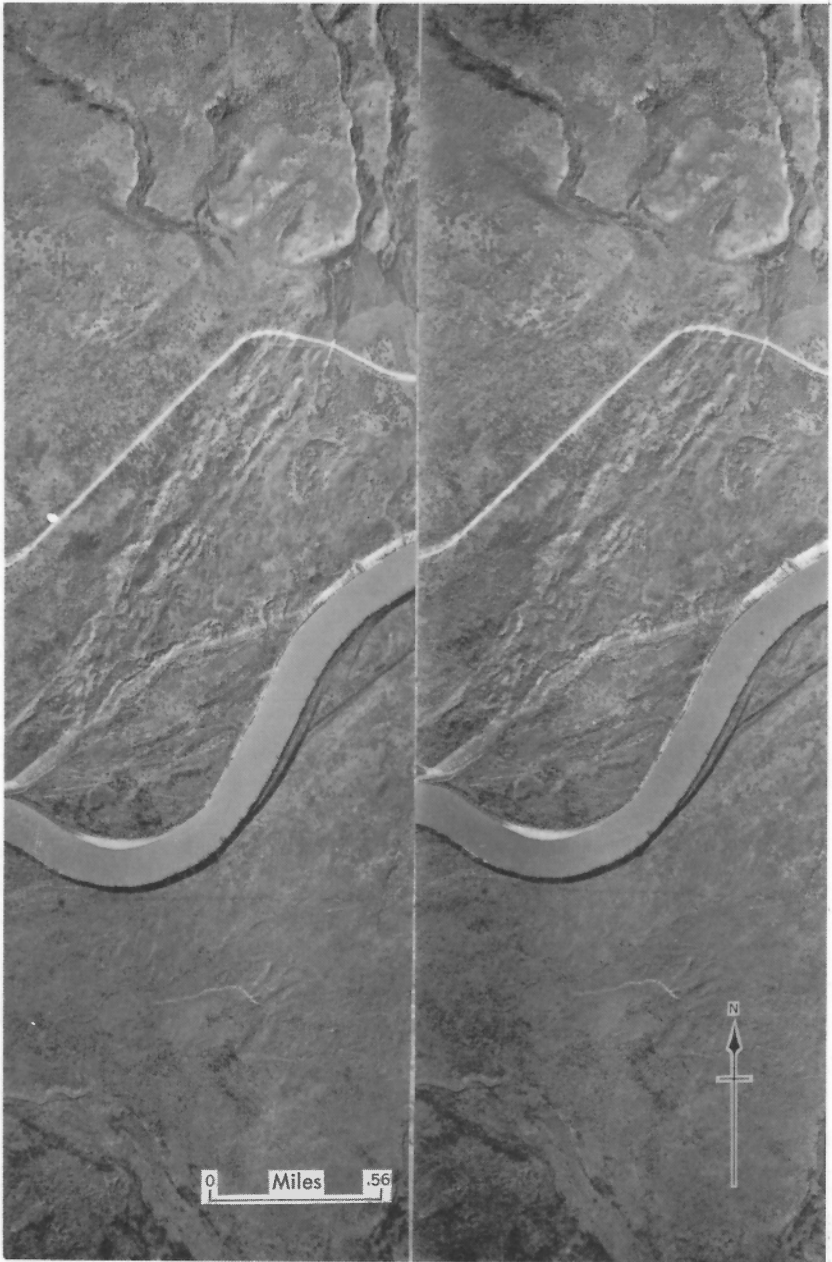


PLATE III. Stereoscopic pair of vertical airphotographs showing the west limit of the McConnell Moraine, where it intersects the north bank of Stewart River about 15 miles west of Mayo Landing. (Parts of photographs A17059-33 and 34, National Airphoto Library).



PLATE IV. Castellated outcrops above the Reid Moraine southeast of Ethel Lake gap, 15 miles southwest of Mayo Landing. 91309.



PLATE V. Castellated outcrop northeast of Fraser Falls, Stewart River. The top of a moraine believed to be either the McConnell or Reid Moraine forms the foreground. 84676.



PLATE VI. Castellated outcrops of granite on the uplands beyond any known glaciation, northwest of Apex Mountain in Dawson Range. 77120.



PLATE VII. View southeast looking at the large drift terrace in Rosebud Creek valley six miles upstream from Stewart River. Note the up-creek slope of the top of the terrace. Erratics of foreign chert conglomerates were found at 2,600 feet elevation on the hill southeast of the terrace just off the picture. 81580.