CANADA
DEPARTMENT OF MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Second Edition

GEOLOGICAL RECONNAISSANCE ALONG THE CANOL ROAD FROM TESLIN RIVER TO MACMILLAN PASS, YUKON

(REPORT AND MAP)

BY

E. D. KINDLE

OTTAWA

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C O N T E N T S

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INTRODUCTION

Summary and Acknowledgments

This report describes the geology seen along the Yukon sector of the Canol Road during the 1944 and 1945 field seasons. It comprises information published in the first edition of this report, augmented by data secured during the 1945 field season.

The Canol pipeline road connects with the Alaska Highway at Johnsons Crossing, 80 miles southeast of Whitehorse at the north end of Teslin Lake in southern Yukon, and extends in a northeasterly direction for 513 miles by road to Camp Canol opposite Norman Wells on Mackenzie River. (The road runs from latitude 60°30', longitude 133°20' to latitude 65°15', longitude 127°00'.) Macmillan Pass, 283 miles by road northeast along the Canol Road from Johnsons Crossing marks the boundary between Yukon and Northwest Territories. The road passes through a little known country, inhabited only by Indians and a few whites interested in the fur trade. It was completed late in 1944 as a military project, but the termination of the war resulted in its abandonment by the United States authorities in the spring of 1945. Some prospecting was done along the road during the 1944 field season, but the road was closed to traffic in 1945, and there is still much virgin territory along its course to be examined for mineral occurrences.

Field work was largely confined to a belt 20 miles wide along the Canol Road. Geological information indicated on the accompanying map at farther distances from the road is based mainly on a study of air photographs of the district. The belt explored is underlain mainly by Palaeozoic and older sedimentary rocks intruded by several granitic stocks with which mineralization is associated. A hurried trip in September 1944 along the northeasterly part of the road, across the Mackenzie Mountains to Camp Canol, revealed only sedimentary rocks, chiefly Palaeozoic sandstones, shales, and limestones, for 200 miles southwesterly from Mackenzie River. A mineral deposit containing grey copper and chalcopyrite was reported to have been found that summer by one of the road crew near the junction of Egouchie and Godland Rivers.

Field work was hampered during the 1945 season by spring flood damage to roads and bridges. The bridge across Pelly River, built in December 1944, was taken out as a result of a sudden onslaught of ice from an ice jam on Ross River. Only four washouts requiring repair work were encountered between Johnsons Crossing and Pelly River, whereas forty such washouts were noted between Pelly River and Tsichu River, (mile 220C). Except for the locally damaged parts, the road was found to be generally hard, dry, and smooth. Work in 1945 did not proceed beyond mile 295, northeast of Johnsons Crossing.

The writer is indebted to the E.W. Elliott Construction Company for their many courtesies extended throughout the 1944 season. The road foreman, Mr. David Robinson, and the camp superintendent, Mr. Sandeen, were especially helpful. Assistance provided by Major McKee and Colonel Cunningham and other United States Army officials was very much appreciated. The Special Commissioner for Defence Projects in Northwest Canada assisted greatly by arranging with the United States Army authorities at Whitehorse for permission to travel along the road during the 1945 season. Thanks are due to Major Compton of the United States Army at Whitehorse for the use of army pontoons to ferry the party's truck across Pelly River. Messrs. R.M. Thompson, R.D. Hutchinson, and L.S. Fraser assisted with the field work in 1944, and Messrs. J.E. Proctor and A.J. Troop in 1945.

Mileage along the Yukon sector of the Canol Road was indicated in 1944 by posts 5 feet high on which was recorded the number of miles northeast of Johnsons Crossing. Early in 1945 the Canol operators renumbered all posts in the Yukon sector to designate the mileage as from Camp Canol on Mackenzie River. As the original system of numbering is more useful to prospectors working from the south end of the road, it is used in this report.

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Military Project

Canol Road is an outgrowth of the $133,000,000 Canol Project, a military enterprise undertaken by the United States War Department. The decision to build a pipeline from Norman Wells to Whitehorse, with a refinery at the Whitehorse terminal, was made in 1942, and the project was completed in 1944 with construction of the Canol Road to service the pumping stations along the pipeline route across Pelly and Mackenzie Mountains. At the close of the year there were sixty-four producing oil wells[1] in the

[1] Stewart, J.S.: Geol. Surv. Canada; personal communication.

Norman Wells field and the pipeline was capable of carrying up to 4,000 barrels of oil a day to the Whitehorse refinery. The Norman Wells oil field produced 1,229,310 barrels of oil during 1944, and 353,100 barrels during 1945. Altogether, to the end of December 1945, some 2,050,525 barrels of oil were produced from this field since the first productive well was drilled at Norman Wells by the Imperial Oil Company in 1920.

The Canol Project was abandoned early in 1945, due to the success of operations in the Pacific War Theatre. Oil can now be brought by boat and rail to Whitehorse at less cost than by way of the 4-inch pipeline from Mackenzie River, so that the pipeline may not be used again. However, the economic picture could be changed by the discovery of larger oil fields along or near Mackenzie Valley.

Both the Alaska Highway and Canol Road were under the control of the United States Army throughout the war. Since July 1945 permission to travel over the Alaska Highway could be secured from the Royal Canadian Mounted Police at Fort St. John and Whitehorse.

Access

The Alaska Highway connects Dawson Creek, British Columbia, with Whitehorse, Yukon, and with Fairbanks, Alaska. Train service is maintained between Dawson Creek and Edmonton (495 miles) by the Northern Alberta Railway, and there is also a motor road between these points. Both Canadian and American steamships maintain freight and passenger service to Skagway, Alaska, and the railway of the White Pass and Yukon Route maintains rail service between Skagway and Whitehorse (110 miles). Johnsons Crossing at the junction of the Canol Road and Alaska Highway is 80 miles by road southeast of Whitehorse and about 975 miles by road northwest from Dawson Creek. Camp Canol, northern terminal of the Canol Road, is served by a long established steamship service. Both Northern Transportation Company and Mackenzie River Transport operate steamship service between the railhead at Waterways on Athabaska River and points along Mackenzie River as far north as Aklavik. A portage of 16 miles around rapids at Fort Smith is the only break in the flow of freight over this route. Aeroplane transportation is available at both Whitehorse and Norman Wells.

Provisions and supplies of all kinds are available at Whitehorse and there are no ration regulations. Two small trading posts, engaged chiefly in trade with the natives, are situated on the Canol Road route.

One of these is at the mouth of Ross River; the other is at the southwest end of Sheldon Lake at its outlet. Before the building of the road supplies were brought up the Pelly to the Ross River post by small steamers and river launches, whereas the Sheldon Lake post was supplied by hydroplane. Small boats with outboard motors may be taken easily up Pelly River as far as Pelly Banks by making a portage half a mile long at Hoole Canyon, 23 miles above Ross River.

Natural Resources

The valley bottoms between Johnsons Crossing and Macmillan Pass are generally well forested. The upper limit for trees on the mountain slopes is about 4,500 feet above sea-level (and some trees on favoured slopes persist to an elevation of 4,700 feet). Trees up to 12 inches in diameter are common in the lower valleys, and some exceed 18 inches. According to Mr. Porsild[1], who investigated the plant life along the Canol Road for the National Museum, the native trees include the lodge-pole pine, black spruce, white spruce, alpine fir (balsam), western paper birch, Alaska paper birch, balsam poplar, and trembling aspen. Stunted willow and alder are generally present in swampy land. In Pelly River Valley and for some miles north along the valley of Ross River the timber has been ravaged by forest fires. In low ground in the vicinity of Sheldon Mountain and in many places along the South Branch of Macmillan River there is a boulder clay sub-soil that thaws for short periods each year beneath the moss capping. Spruce that grow there are stunted, seldom exceeding 30 feet in height or 4 inches in diameter. On higher ground, about Sheldon Mountain, spruce trees up to 60 feet high and 14 inches in diameter were seen. Near the headwaters of the South Fork of Macmillan River the trees become smaller and scattered, and none grows at Macmillan Pass and for some 25 miles or more along the road northeast of the Pass.

Blueberries and two varieties of cranberries of good quality are abundant, and some raspberries and red and black currants are to be found.

Dr. Rand[2] studied the wild life along the Canol Road during the 1944 season for the National Museum, and his report lists the following mammals as resident in the district: black bear, grizzly bear, Alaska pine marten, Richardson weasel, western mink, wolverine, Yukon otter, Alaska red fox, northwest coyote, timber wolf, Canada lynx, beaver, muskrat, porcupine, snowshoe rabbit, Alaska moose, Osborn caribou, Dall sheep (grey phase), Yukon woodchuck, hoary marmot, ground squirrel, Yukon chipmunk, red squirrel, flying squirrel, pika (rock rabbit), jumping mouse, wood mouse, wood rat, bog lemming, brown lemming, common cinereous shrew, dusky shrew, water shrew, mountain water shrew, phenacomys vole, Dawson red-backed vole, Macfarlane tundra vole, long-tailed vole, and meadow vole.

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1 Porsild, A.E.: Flora of Southeast Yukon, Adjacent to the Canol Road; Nat. Mus., Canada, Bull. (in preparation).

2 Rand, A.L.: Mammal Investigations on the Canol Road; Nat. Mus., Canada, Bull. 99 (1945).

Grayling are found in almost all of the streams in the district, and pike abound in many of the lakes. Lake trout were caught in Quiet Lake, Lapie Lakes, and in Bassett or Dragon Lake (mile 205). Whitefish are found in many of the larger streams and lakes. Salmon ascend Pelly and Ross Rivers to reach their spawning grounds. Ptarmigan and grouse are quite abundant and ducks were seen on many of the lakes. A brood of sixteen geese was seen on the South Branch of Macmillan River near mile 238.

The abundance of wild life is responsible for the Yukon being widely known to big game hunters. Fur-bearing animals and plentiful fish give scattered Indian bands ready means of subsistence.

Canol Road crosses or runs close to numerous swift-flowing streams that could be harnessed to develop electric power should it ever be required in mining operations. The narrow, rock-walled canyon on Lapie River near mile 131 is suggested as a possible site for a small power plant; a larger flow of water is available at Prevost Canyon on Ross River near mile 204. Hoole Canyon on Pelly River might also be suited for electrical power development.

History of Exploration

Early exploration in the Yukon was by officers of the Hudson's Bay Company in the interests of the fur trade. Pelly River was discovered in 1843 by Robert Campbell, who ascended Liard and Frances Rivers to Frances Lake, then followed Finlayson Creek to Finlayson Lake and crossed over to the Pelly, which he named after Sir John Henry Pelly, a Governor of the company. Campbell explored the Pelly during the next few years and in 1848 established Fort Selkirk as a trading post at the confluence of Pelly and Lewes River. In 1850 he descended the Yukon to Fort Yukon, ascended Porcupine River, crossed the mountain portage, and returned to Fort Simpson by way of the Mackenzie. Lapie and Kitza Rivers and Hoole Canyon are named after Campbell's Indian voyageurs. He named Ross River after Chief Factor Donald Ross, and Lewes River after Chief Factor J.L. Lewes. Following the pillaging of the Selkirk post in 1852 by a band of Coast Indians, the Pelly and Frances River country was neglected for 35 years. In 1887, G.M. Dawson reached the Upper Liard by way of Stikine and Dease Rivers, followed Campbell's route by way of Frances River to Pelly Banks on the Pelly, and descended the river to its mouth. He returned by way of Lewes River, Lake Laberge, Marsh Lake, and Lake Bennett. Mr. Warburton Pike crossed from Liard River to Pelly Lakes during the winter of 1893, and in the spring descended the Pelly and Yukon to Bering Sea.

Teslin district was first reported on by F. Schwatka, C.W. Hayes, and M. Russell, who entered the region by way of Taku River in 1891. Arthur Saint Cyr prepared topographic maps showing Teslin Lake and Teslin River in 1897, and in the following year mapped Big Salmon River, Quiet Lake, and Nisutlin River. R.G. McConnell carried out geological exploration of these winter routes in 1898.

The discovery of the rich Klondike placer gold fields in 1896 brought a rush of miners to the Yukon during the years 1897-98. Many attempted to reach the Klondike from the valley of the Mackenzie. Some came by way of the Liard and Pelly, others by the northerly route, via Bell and Porcupine Rivers to the Yukon. Keele (1910)[1] reports that one

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[1] Dates, in brackets, refer to reports listed in bibliography.

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party followed Gravel and Twitya Rivers to the divide, then went down Hess and Stewart Rivers to the Yukon. During the season of 1902, R.G. McConnell and Joseph Keele made an exploration of Macmillan River and a part of its main branches. They ascended the South Fork as far as Riddell River, which lies about 40 miles below where the Canol Road now gives access to the river. Upper Pelly River was first visited by Joseph Keele in 1907. He ascended Ross River in the autumn, crossed through Christie Pass during the winter of 1908 to the headwaters of Gravel River, and descended the latter stream to Mackenzie River. There are no records of the Mackenzie Mountains in this region being visited again by white men until 1942 when United States Army engineers and construction crews carried the pipeline across the mountains from Norman Wells by way of Macmillan Pass.

The only exploratory work carried out by the Geological Survey in recent years along what is now the route of the Canol Road is that done by E.J. Lees and by J.R. Johnston in 1935. Lees (1936) mapped the Teslin-Quiet Lake Area and Johnston (1936) mapped a strip about 15 miles wide along Pelly River between Macmillan River and Hoole Canyon. The northwest corner of the Teslin-Quiet Lake map overlaps the southeast corner of the Laberge sheet, mapped by E.J. Lees and H.S. Bostock (1938).

According to Keele (1910) placer miners have successfully worked the bars in Pelly River and many of its tributaries from time to time since as early as 1882. He states that prior to 1910 at least three miners prospected Ross River for placer gold deposits, but found none. The old reports do not mention any search for lode deposits in this region by these early placer miners. Lees (1936) states that placer deposits were discovered about 1905 on Iron Creek, a tributary of Sidney Creek, and at the time of his visit in 1935 were still being worked on a small scale. These workings are about 10 miles west of the 30 mile post on the Canol Road. A little placer gold was also taken from Brown Creek, a tributary of Sandy Lake, north of Quiet Lake, prior to 1935.

Prospecting was not encouraged along the Canol Road during 1944, as the road was under construction throughout the season. However, the Consolidated Mining and Smelting Company maintained a party in the field, and two private prospectors, Clyde Wann and P.E. McNee of Whitehorse, did some work. As yet only a preliminary examination of the rock exposures near the road has been made. The season's discoveries include a silver-lead vein (accidentally) exposed by a bulldozer during construction of the road at mile 120. During the course of mapping a number of barite veins were found on the mountain side, 1½ miles west of the road at mile 118, and, late in the season, P.E. McNee reported finding more barite veins there, about half a mile east of the road. A specimen of bedded carbonate rock from the mountain at mile 130 was found upon analysis to consist of 82.88 per cent barium carbonate (witherite) and 11.94 per cent silica. An assay of a hand specimen of mineralized quartz from Sheldon Mountain (mile 222) disclosed 0.02 ounce a ton in gold and 0.06 per cent tin. These discoveries, all made alongside the road, are evidence that the region traversed is well worth prospecting.

TOPOGRAPHY AND GLACIATION

The southern half of the Canol Road runs in a southwesterly direction across the Yukon plateau. Northeast from about mile 260 the road enters the Mackenzie Mountains and follows a winding course across seven mountain divides before descending to Mackenzie River Valley. Macmillan Pass, at mile 283, marks the divide between streams flowing into Mackenzie River and those draining into the Yukon. The Yukon plateau, as seen along the road, is an extensive stretch of elevated land, broken by large groups of mountains that generally rise from 3,000 to 4,000 feet above the valleys. A belt of particularly rugged mountains lying between Pelly River and Quiet Lake is named Pelly Mountains. Several peaks near the road in this range stand more than 7,000 feet above sea-level.

At Teslin River (mile 0) the elevation is 2,250 feet. To the northeast the road rises gradually, and at 11 miles passes over a divide at elevation 4,040 feet to enter the wide valley of Nisutlin River. Mountain peaks a few miles northwest and southeast of this pass rise to elevations exceeding 6,000 feet. Bedrock in Nisutlin River Valley is almost everywhere mantled by a thick cover of boulder clay, so that no rocks are exposed along the road until Quiet Lake is reached. This lake forms the headwaters of Big Salmon River, which flows northwesterly to the Yukon. It is a deep, clear-water lake, 18 miles long and at most places from 1 to 2 miles wide. The road follows along the water's edge for several miles at the northeast end of the lake. The country between the south end of Quiet Lake and Nisutlin River is comparatively low, but northeast of the lake the road crosses a 3,200-foot divide at mile 65.5, then descends a 2-mile grade to Rose River Valley. The bridge over Rose River is about 2,500 feet above sea-level. Bedrock on the mountain top (elevation, 4,600 feet) on the east side of Quiet Lake is rounded and polished by glacial ice, and rounded granite boulders lie upon greenstone and schists. The slopes are mantled with boulder clay, and the pass at mile 65.5 is underlain by a thick mass of glacial till. Four mountain peaks on the west side of Quiet Lake range from 6,066 to 6,642 feet high. These mountains show a rounded, glaciated aspect below an elevation of 5,000 feet.

The road follows Rose River Valley from mile 68 to mile 103, the latter being on the divide at elevation 3,600 feet between Rose Lake, at the head of Rose River, and Lapie Lakes, at the head of Lapie River, which drains northerly to Pelly River. Rose River Valley is floored with a thick deposit of glacial till, but in many places the river has cut into and reworked the till to form extensive beds of sand and gravel. Some of these gravel beds outcrop along the road near mile 70, and also at mile 88 where a large tributary stream joins Rose River from the west. Abandoned glacial cirques that bottom in U-shaped valleys at an elevation of 4,800 feet were seen on the north side of 6,000-foot peaks, 3 miles west and southwest of mile 82. These and a high, strongly glaciated, U-shaped valley that drains north and west to Rose River from 4 miles east of mile 78 are evidence of ice accumulation there during the glacial period. Other cirques, also free of ice, were noted on the northwest sides of high granite peaks west from miles 95 to 98. The entire granite belt between miles 83 and 100 is characterized by the presence of very high, knife-edge mountain ridges.

The valley occupied by Lapie River is narrow and U-shaped, with mountains close to the road. The valley sides are covered by a thick mantle of boulder clay to elevations of about 4,000 feet, and the river has cut deeply into these deposits, particularly on the northwest side, leaving very steep valley walls. Alpine glaciers were active at one time on the north slope of the mountain west of mile 115, but the mountain peaks nearer the Pelly, between miles 117 and 130, are in a drier belt and appear to have escaped glaciation. Lapie Lakes and Rose Lake are giant kettle-holes that were occupied by large masses of stagnant ice during the late stages of valley glaciation. These lakes are roughly 3,500 feet above sea-level. An esker that formed along the west side of Rose Lake and upper Lapie Lake rises to 125 feet above the water. Sand, gravel and boulder terraces several hundred feet wide occur in a number of places along the valley sides near Rose Lake and Lapie Lakes, and rise about 250 feet above the level of the lakes. They are believed to have been formed by running water when the valley was filled to an equal or higher level with melting ice and glacial debris, with melting most pronounced along the flanks of the disintegrating ice mass. A few other terraces, noted farther down the valley as far as mile 121, are located at the mouths of tributary streams and represent an accumulation due to damming by ice or till deposits in the main valley.

Throughout most of its length Pelly River occupies a trench-like depression that trends north 55 degrees west for several hundred miles. This valley trench was first recognized by McConnell (1903, p. 24) who states that the valley is occupied in different parts of its course by a part of the Pelly, a branch of Kalzas River, Crooked Creek, a part of Stewart River, Clear Creek, Flat Creek, and the lower part of the North Fork of Klondike River. The valley is 8 miles wide where traversed by the Canol Road. Mile 132, at Lapie River bridge (elevation, 2,500 feet), is near the southwest wall of the trench, and mile 141, at Pelly River (elevation, 2,200 feet), is near the northeast side of the trench. A short distance west of mile 132 Pelly Mountains rise precipitously to elevations exceeding 5,000 feet, and elsewhere along this continuous mountain front the peaks rise to over 5,500 feet. On the northeast side of the trench the mountains also rise sharply, but in the vicinity of Ross River are comparatively low, with rounded tops somewhat below timberline. The trench is apparently the result of profound faulting and prolonged differential erosion. One of the northwesterly trending faults seen on the mountain at elevation 4,500 feet, north of mile 132, is marked by quartz-biotite schists in contact with black shales and sandstone beds of Palaeozoic age. The schistose rocks of the trench are on the uplifted side of the fault belt, but have undergone greatest erosion due to their softer character. The greater part of the trench was eroded by Pelly River during Cretaceous time, and Paleocene sediments were deposited later at a number of places in the valley bottom.

During the glacial period the trench was filled by ice that moved northwesterly down grade. The low mountains to the northeast were ice covered at that time, as proved by the occurrence of glacial striae crossing the top of the ridges north of mile 146. Striae and deep grooves seen there at an elevation of 3,500 feet strike north 50 degrees west. Glacial ice brought much debris into the trench and filled the lower hollows and ravines in the low mountainous sectors to the northeast, whereas the tops of these mountain ridges were rounded and scraped bare of most of their soil. Terraces of gravel that occur at various places along the sides of Pelly Valley probably formed in streams flowing along the border of the melting glacial ice during stages in its recession, and ponding of some of the streams resulted in deposition of silt beds in many places along the valley walls.

The country adjoining the road between Pelly River (mile 141) and Sheldon Lake (mile 220) is much like some rugged areas of the Canadian Shield, with rock-ribbed, glaciated hills rising from a few hundred to 1,000 feet above a valley bottom that is heavily mantled with glacial deposits. The road rises gradually for 25 miles and crosses the Anvil Mountains granite batholith, mileage 161 to 171, at an average elevation of about 3,300 feet. The road circles the south side of Orchay Lake at the head of Orchay River, which empties into Pelly River 20 miles below the mouth of Ross River. Orchay Lake is about 3,200 feet above sea-level. At mile 171 the granite contact with the sedimentary rocks is marked by a steep grade that descends 400 feet to the soil-covered floor of Ross River Valley. Much of the valley bottom along the road between miles 171 and 200 is low and swampy with considerable areas of muskeg. Forest growth is poor over such areas except along the streams where drainage has been good. Along the stream half a mile north of mile 175 there are birch trees 12 inches in diameter and spruce up to 14 inches in diameter that range from 75 to 100 feet in height (elevation, 2,850 feet). One mile farther north, at elevation 3,650 feet, spruce were seen that measured 14 inches in diameter 6 feet above the ground, and were as much as 75 feet tall.

From mile 202 to 205 the road follows a northerly course along the top of a broad esker that stands as much as 100 feet above the underlying drift. The esker swings west into Dragon Lake at mile 205, and as the lake drains westerly by way of Riddell River to the South Branch of

Macmillan River, it is thought that the glacial stream that formed the esker beneath the melting ice field also drained that way. Dragon Lake is a deep, spring-fed, clear-water lake, formed of a network of kettle-holes nestled among small eskers and bounded by sand and gravel deposits. Sheldon and Lewis Lakes are in great contrast, as their water is milky and they occupy shallow depressions in a wide valley carpeted by thick deposits of boulder clay. The barometer reading was 2,900 feet at Dragon Lake and 3,000 feet at Sheldon Lake.

Sheldon Mountain is the first big mountain near the road on the route northeast from Pelly River. A granite core and baked sedimentary rocks have given the mountain extra hardness to withstand erosion, so that under prolonged differential erosion it now towers over 4,000 feet above the lake. Mount Riddell, some 6 miles farther west, is only a few hundred feet lower. Two cirques seen on the north side of Sheldon Mountain are now free of ice. On the north and northeastern slope of Sheldon Mountain perched boulders of large size were observed to elevations of 4,600 feet, and glacial striae seen below this elevation and at many places in the valley below have a common strike of about 10 degrees north of west.

Ten miles northeast of Sheldon Mountain, at mile 229.5, the road crosses the glaciated divide (elevation, 3950 feet) between Ross River Valley and the valley of the South Branch of Macmillan River. The road follows close to the south side of the latter river from mileage 232 to 252, then crosses and follows the north side to mile 268. Low mountains outcrop southeast of the road between miles 228 and 250, but they rise scarcely to timber-line, whereas many of the mountains on the north side of the Macmillan in this area appear to exceed elevations of 5,000 feet.

An unusually high and rugged group of mountains that rise a few miles southeast of the road, between mileages 250 and 265, are named Itsi Mountains. They owe their greater resistance to weathering to the granite stocks that form their cores. The highest peak of Itsi Mountains is judged to be more than 7,500 feet above sea-level. Large masses of glacial ice occur in cirques along the north sides of these mountains. A broad, rolling valley strewn with large boulders and deposits of boulder clay extends north 4 to 6 miles from Itsi Mountains to Macmillan River and runs an additional 5 or 6 miles north of the river between mileage 251 and 261. This was evidently a great gathering ground for ice during the Pleistocene epoch, and the ice moved down the valley of the South Branch of Macmillan River. Glacial striae on the rounded mountain top at elevation 4,600 feet, north of mile 251, trend south 25 degrees west. A thickness of more than 100 feet of boulder clay is exposed along the river at the bridge at mile 252. Much of the valley floor is between 3,300 and 3,600 feet above sea-level, and due to the prevalence of permanent frost in this latitude the forest growth is poor. The spruce are generally less than 50 feet high and 6 inches in diameter.

From mile 265 to 283 (Macmillan Pass) the road is confined to a narrow, steep-walled valley with mountain peaks on both sides reaching from about 5,000 to 6,000 feet above sea-level. Three of the higher mountains seen close by or within a few miles of the road, towards the southeast, are comprised largely of granite. The barometer showed an elevation of 3,600 feet at mile 268, and 4,500 feet at Macmillan Pass. Northeast of the pass the road runs for 10 miles along the south side of Tsichu River through high open country with mountains lying back a mile or more to the north and south. The road crosses Tsichu River at mile 292, then climbs slowly for a number of miles in crossing a high, barren plateau that lies between Tsichu and Intga Rivers. According to the barometer the road rises to an elevation of 5,700 feet in passing over this plateau.

The region northeast of mile 290 is not included on the accompanying map, and the following is only a brief outline of its principal topographic features as seen from the road to Camp Canol.

Northeast of mile 310 the road follows up the valley of Intga River for about 15 miles, crosses through Caribou Pass, at an elevation of 5,250 feet, and then descends by way of Bullcook Creek to Sekwi (or Egouchie) River. It follows the Sekwi northeasterly for 20 miles or more, then swings north and passes over a low divide (about 3,900 feet high) at Godland Lakes. The road follows Godland River for 25 miles, then swings northwest and circles a prominent mountain ridge on the divide between Godland and Twitya Rivers. The valley of Twitya River is followed for about 10 miles, and the river is bridged a mile west of the mouth of Deca Creek. About 3 miles northwest of the junction of Twitya and Keele Rivers the road swings north up the valley of Trout Creek to Devils Pass at an elevation of 5,100 feet, and descends by way of Bolstead Creek to Carcajou River. It follows the north side of Carcajou River for some 8 miles, but leaves this valley at Andy Creek and climbs to 6,200 feet (barometric reading) in crossing the highest pass on the route, known as the Plains of Abraham. From this flat-topped mountain the road follows down McDermott Creek towards Little Keele River. It lies south of Little Keele River for 18 miles, following a route well back on the mountainside and rising in one place to an elevation of 4,800 feet (mile 63C, that is at 63 miles from Canol). The road turns north to cross Little Keele River (elevation, 2,600 feet) at mile 50C, then climbs what is known as Kroup Hill to the pass (mile 44C) at an elevation of 3,800 feet. It enters Dodo canyon at mile 40C, runs northerly for 16 miles along the east side of Dodo Creek, and, half a mile from the mouth of the latter, swings northeasterly to cross Carcajou River (mile 24C). The 24-mile stretch between Carcajou and Mackenzie Rivers is relatively low and flat, but, nevertheless, stands several hundred feet above the Mackenzie.

Pumping stations are located along the Canol Road at the following mileages on the route northeast from Johnsons Crossing: 78, 127, 177, 235, 307 (same as 214 out of Camp Canol), 174 Canol, 111 Canol, 76 Canol, and 36 Canol. They are more closely spaced out of Canol due to the lift over the Mackenzie Mountains.

GENERAL GEOLOGY

Introduction

Rocks of the Yukon group, consisting principally of mica schists, micaceous quartzites, slates, marble, greywacke, greenstone, and andesite, and intrusive stocks and small batholithic masses of granite and granodiorite, are the dominant rocks found along the Canol Road for 170 miles of Teslin Lake. This sector includes a 16-mile wide belt of sedimentary rocks, chiefly limestone, dolomite, shale, sandstone, and slate beds of Palaeozoic age, which cross the road between miles 112 and 131. All formations strike northwesterly, and all of the major folds and faults also trend in that direction. The sector northeast of the Anvil Mountains batholith, from mile 172 to Macmillan Pass at mile 283, is underlain largely by sedimentary rocks of early Palaeozoic age. These rocks are also folded into northwesterly trending structures, and are intruded by a number of granodiorite stocks, the largest of which forms the core of Itsi Mountains. The early Palaeozoic strata include, in ascending order, prominent members of grit, quartzite, green and red slates, greywacke, hornfels, chert, sandstone, and shale. These are overlain by conglomerate and slate and northeast of Macmillan Pass by strata of Late Palaeozoic age. Little is known as yet of the latter strata, but they are less disturbed commencing 30 miles northeast of the pass, and include some thick limestone formations that should yield fossils.

Table of Formations

Age	Group	Lithology	Approximate thickness Feet
Pleistocene and Recent		Boulder clay, sand, silt, gravel Volcanic ash	0 to 200 0.3
		Unconformity	
Tertiary		Conglomerate	100
		Unconformity	
Palaeocene		Shale, sandstone, conglomerate, coal	800
		Unconformity	
Cretaceous or later		Granite, granodiorite, diorite	
Jurassic or later		Peridotite, serpentine	
Jurassic	Laberge	Argillite, tuff, andesite, basalt	5,000 +
		Unconformity	
Late Palaeozoic		Limestone, dolomite, argillite, quartzite, slate, sandstone, shale	5,600
		Conglomerate, shale, slate, limestone, hornfels, greywacke	3,000
Upper Ordovician ?		Chert, shale, sandstone, slate, quartzite, hornfels, limestone	4,000
Lower Ordovician ?		Red and green slate, argillite, limestone, greywacke, hornfels	3,500
Cambrian ?		Quartzite, grit, conglomerate, arkose, slate, mica schist	4,000
		Unconformity	

Precambrian and (?) later	Yukon	Quartz mica schist, chlorite schist, graphite schist, greywacke, argillite, quartzite, slate, crystalline limestone, andesite, greenstone, rhyolite, conglomerate, gneiss	11,000

Yukon Group

The Yukon group consists of an assemblage of altered rocks, including quartz-mica schist, chlorite schist, graphite schist, biotite gneiss, greywacke, argillite, quartzite, slate, crystalline limestone, greenstone, schistose conglomerate, and rhyolite. None of these rocks were found to contain fossils, and they are believed to be of Precambrian age, but Palaeozoic rocks may also have been mapped with the Yukon group in those places where metamorphism and apparent lack of fossils have prevented their separation from the older rocks. The name Yukon group has been applied widely to such rocks in the Yukon since its introduction by Cairnes[1] in 1914 as a useful field name under which "may be included

[1] Cairnes, D.C.: Yukon-Alaska International Boundary Between Porcupine and Yukon Rivers; Geol. Surv., Canada, Mem. 67, pp. 38-44 (1914).

all the older metamorphic, probably Precambrian, schistose and gneissoid rocks that are encountered regardless of their origin which is often difficult or impossible to determine".

Rocks of the Yukon group outcrop near or within a few miles of the Canol Road from mile 10 to mile 83, from mile 100 to mile 112, and between mile posts 131 and 148. There are, in addition, small roof pendants of these rocks in the granitic areas, such as the band shown crossing the road at mile 93.

A band of white crystalline limestone that trends northwesterly across the Canol Road at mile 82 forms one of the most easily identified units of the Yukon group. In the mountains a few miles west of the road the limestone is possibly 1,500 feet thick, but east of the road the same band is more nearly 2,500 feet thick. In the latter locality the band includes numerous, intercalated beds of schist, slate, and argillite. The limestone is underlain by about 2,000 feet of quartz-mica schist, quartzite, slate, greywacke, and hornfels, with some narrow intercalated beds of crystalline limestone. These strata flank the Rose River granodiorite batholith. The beds strike northwesterly parallel to the contact and dip southwest, for the most part steeply adjacent to the intrusion. The limestone band is overlain to the south by an assemblage of altered sedimentary rocks that is thought to be more than 3,000 feet thick. The strata include greywacke, black slates, argillite, quartz-mica schists, calcareous schists, and quartzite. Farther southwest these strata are overlain by rocks of the highest division of the group, consisting of andesite, chlorite schist, altered tuff, micaceous quartzite, and greenstone. These rocks occupy a belt 3 or 4 miles wide that trends northwesterly from the mountain ridge on the east side of Quiet Lake. According to Lees (1936) the greenstone belt also outcrops farther south on the mountains north and south of Sidney Creek.

In summary, the Yukon group of the Quiet Lake area may be subdivided roughly from top to bottom into five divisions, as follows:

Division	Description	Probable average thickness
		Feet
5	Andesite, greenstone, chlorite and mica schist, quartzite, tuff	3,000
4	Greywacke, slate, quartzite, limestone, quartz-sericite schists	3,000
3	Limestone, minor mica schist, quartzite, and slate	2,000
2	Greywacke, hornfels, quartzite, slate, quartz-mica schists, limestone	2,000
1	Basement rocks, not exposed (probably gneiss, schist, etc.)	1,000 ?
	Total thickness (subject to revision)	11,000

Yukon group rocks that comprise a large part of Big Salmon Mountains, 30 miles northwest of Quiet Lake (See Laberge sheet; Geol. Surv., Canada, Map 372A) are believed to be a continuation of the rocks described above. They have been divided there by Bostock and Lees (1938) into five members that correspond very closely with the five-fold division listed, the principal difference being that the divisions were each judged to be a little thicker in Big Salmon Mountains.

On the north side of the Rose River batholith, the Yukon group rocks strike northwesterly parallel to the intrusive contact and dip from 10 to 45 degrees northeast. A 400-foot section of intercalated beds of crystalline limestone, quartzite, and quartz-sericite schists, which outcrops on the mountain west of mile 102, evidently represents the intermediate limestone division. About 1,500 feet of the underlying beds (No. 2 division) is also exposed here, and north of the limestone there is a great thickness of quartz-sericite schists, slates, and quartzites, which is part of the No. 4 division of the group. There appear to be over 5,000 feet of these rocks in this sector. For the most part the strata dip northeasterly at low angles, but the monoclinal dip is interrupted by several minor anticlinal folds near the road. The contact between Yukon group rocks and overlying Lower Palaeozoic slates, schists, and quartzites has been provisionally marked on the accompanying map as crossing the Canol Road near mile 112, but it cannot be accurately located until the Lower Palaeozoic strata are mapped in detail.

In Pelly River Valley the structural relationships of the Yukon group rocks are complicated by profound faulting, and abundant drift hinders investigation. In general, the strata strike northwesterly parallel with the strike of the Pelly Valley trench, and they dip from 10 to 90 degrees, in part to the northeast and in part to the southwest. A high ridge of white crystalline limestone that outcrops 2 miles west of mile 138 may represent the limestone division (No. 3) of the Yukon group, and the andesite and greenstone hills 3 miles north of the mouth of Ross River are thought to be part of the uppermost division. Quartz-sericite and graphitic schists that contain intercalated beds of greenstone schist and andesite north of the Ross River post may belong to this group. A band of conglomerate schist 300 feet thick and interbedded with the sericite schists is exposed about a mile northwest of the pipeline bridge across the Pelly. Its pebbles are largely of quartz, greywacke, and quartz-sericite and graphite schist, and these are flattened and sheared in a matrix of mica schist. Calcareous schist is faulted against Paleocene conglomerate a mile west of mile 140. An andesite outcrop on the north side of Slough Lake (mile 139.3) is sheared in a direction of north 15 to 25 degrees west, and this suggests that the fault west of mile 140 may swing southeasterly through Slough Lake. The fact that quartz-sericite schists on high ground south of mile 138 dip 10 to 30 degrees southwesterly and, in lower ground north of mile 138, dip 85 degrees northeasterly suggests the presence of either an anticlinal axis or a northwesterly trending fault at or near mile 138.

Biotite schists of the Yukon group are in faulted contact with Palaeozoic shales and sandstones on the mountain north of mile 131. This is a vertical fault striking northwest, with biotite schists on the northeast dipping 60 degrees southwesterly and shales and sandstones on the southwest dipping 40 degrees northeasterly towards the fault. Biotite schist on the mountain crest (elevation, 4,500 feet) on the northeast side of the fault is raised more than 2,000 feet with relation to the Palaeozoic shales that lie southwest of the fault. With such profound vertical offset, the fault is certain to persist for a great distance along the southwest side of the Pelly trench.

A few hundred feet west of the mouth of Tenas Creek there are small exposures of a chert conglomerate that is like chert conglomerates seen in the Palaeozoic area to the northeast. There are large masses of Yukon group andesite and a little rhyolite on hi... ground to the southwest, and it is suspected that the two rock form..ons are separated along another of the northwesterly trending faults.

Early Palaeozoic Sedimentary Rocks

North of Pelly River

The mountains along the Canol Road between miles 173 and 290 are built of sedimentary rocks that are considered to be of early Palaeozoic age. They consist of quartzite, arkose, shale, slate, limestone, sandstone, and greywacke beds that are unlike any strata seen along the road south of Pelly River. In the mountains east of Macmillan Pass they are overlain by younger Palaeozoic limestones and shales. No useful fossil horizons were found last season, though some of the chert beds were seen to contain fragmentary remains of no aid for age determination. On ascending Ross River in 1908, Keele (1910, p. 38) found some graptolites in black indurated shale interbedded with cherty argillites and cherts, about 7 miles below John Lake. Three forms identified from the collection dated the beds containing them as of Upper Ordovician age.

The oldest formation is comprised of quartzite, arkose, grit, quartzite, and pebble quartzite, with occasional beds of grey slate that are partly converted to mica schists. The quartzites are brittle rocks, and numerous small fractures that have formed in them are now filled with quartz stringers and veins. The formation contains at least one thin limestone band. These rocks are exposed in the mountains west of mile 200, about Prevost canyon on Ross River, and north of Dragon Lake. They are gently folded and are cut by a number of faults. The folds trend northwesterly, and the limbs dip 35 to 7[illegible] degrees to the northeast and southwest. This basal quartzite formation is also exposed in gently sloping ground on the north side of Sheldon Mountain. In the vicinity of a small lake half a mile or more southwest of mile 226, the quartzite is faulted against younger chert beds that lie to the northeast. Scattered outcrops of the quartzite were seen between the lake and a point 4,400 feet high on the north slope of the mountain. This amounts to a horizontal distance of about three-quarters mile across the strata, which strike west to northwest and dip 50 to 85 degrees south. The formation is evidently about 4,000 feet thick. The problem as to whether these are Cambrian beds or represent late Precambrian sedimentation must remain unsettled until more detailed work is done in this region.

The quartzite formation is succeeded, at elevation 4,400 feet on the north slope of Sheldon Mountain, by red, purple, and green slates, argillite, limestone, and hornfels. These rocks are in contact, at an elevation of 6,050 feet, with the porphyritic granodiorite stock that forms the core of the mountain. The formation is characterized by the red and green slates. The section as exposed on the north slope of Sheldon Mountain has a thickness of about 3,500 feet. It is in contact on the east side of the mountain with cherts of the overlying sedimentary division.

The chert division forms the south slope of Sheldon Mountain and outcrops east and west of the Canol Road as far south as mile 214. It is exposed also along the Canol Road and in the nearby mountains between miles 226 and 252. The low mountain ridges east and west of mile 215 (4 miles south of Sheldon Mountain) are comprised almost wholly of chert beds. Here are grey, white, green, brown, red, and black chert beds with a total thickness exceeding 2,000 feet. In the lower part of the formation, as seen on the south slope of Sheldon Mountain, the stratified cherts are interbedded with considerable slate and baked argillites. In the rock exposures near the road, between miles 230 and 240, abundant shale and sandstone beds are intercalated with dark chert. Some of the shale is highly carbonaceous. These rocks are all rather closely folded along axes that strike northwesterly, and some faults observed on air photographs of this sector also strike in that direction. The chert formation near mile 237 coincides along its strike to the southeast with black indurated shales, cherty argillites, and cherts along Ross River, from which Keele (1910) made his collection of Upper Ordovician fossils. The chert beds appear to become progressively thinner towards the northeast, with shales, slates, sandstones, and quartzite taking their place. The formation may have a total thickness of about 4,000 feet.

Massive beds of chert conglomerate that outcrop along the north side of the Canol Road for 8 or 9 miles southwesterly from Macmillan Pass overlie the chert division described above. The conglomerate is formed largely of rounded pebbles of chert, quartzite, black slate and quartz. Most of the pebbles are an inch or less in diameter, with the largest about 2 inches across. In most places the conglomerate is impregnated with a little pyrite that has oxidized on exposed surfaces, thereby imparting a rust colour to the rock, and on the south side of the road, 7 miles southwest of Macmillan Pass, it has resulted in the formation of small, impure limonite deposits that range from a few inches to 2 feet in depth. Limonite also occurs associated with similar conglomerate on the mountain side 6 miles north of mile 242. The conglomerate formation near the pass has a number of intercalated black slate and thin-bedded quartzite and sandstone beds that together form a stratigraphic sequence ranging from 1,500 to 2,000 feet in thickness. In a section at the head of a valley 3 miles south of the pass the uppermost conglomerate bed is 100 feet thick. It is overlain by a thick succession of black to brown shales and slates, with some greywacke beds, and, commencing 100 feet above the conglomerate, by 400 feet of light grey weathering slate that is black on freshly broken surfaces. About 700 feet higher in the section there is a second band of the light grey weathering slate, 75 feet thick. The 400-foot band is a good horizon marker because of its continuity and distinctive colour. It is well exposed along the south slopes of the mountains on the north side of the valley of the South Branch of Macmillan River for 10 miles southwesterly from Macmillan Pass. Its convolutions indicate intense folding in several places. Northwest of mile 273 it dips southwesterly below some 2,000 feet of black and brown slate and shale and associated greywacke and sandstones. The latter are predominant over shale and slate at the summits of the mountains west and northwest of mile 268. The dark shales are intruded by a stock of granodiorite east of mile 268, and are converted to hornfels near the contact. They are characteristically rusty weathering near the intrusive stocks.

No fossils were seen in either conglomerate or shale and slate formations, but as the conglomerate is formed largely of pebbles of white, grey, and black chert common to the Upper Ordovician chert beds of the Sheldon Mountain district, it is presumed that the strata must be of Silurian age or younger. They are believed to underlie limestone formations (not yet examined) northeast of Macmillan Pass.

Palaeozoic Sedimentary Rocks

South of Pelly River

Sedimentary rocks of Palaeozoic age form the mountains on both sides of the Canol Road for about 20 miles, from near mile 112 to mile 131. They are principally dark slates, greywacke, black shales, argillite, sandstones, tuffaceous sandstones, cherts, and quartzite. In many places the slates are schistose and the quartzites are micaceous, so that it is difficult to draw a line between the Yukon group schists and the altered Palaeozoic slates. Their line of contact is placed tentatively near mile 112.

On the mountain north of mile 115 micaceous quartzites and slates are conformably overlain by a dolomite and limestone formation containing intercalated sandstone, quartzite, and shale beds. Both formations strike northwesterly and dip 35 degrees to the northeast. The greater alteration of the lower formation is due in part to its proximity to a granodiorite stock that outcrops a mile to the west. Numerous dykes of granite and diorite that intrude the strata in this vicinity have added to the metamorphism. A band of hard, grey, fossiliferous limestone 150 feet thick lies an estimated 1,875 feet above the basal sandstone member of the dolomite and limestone formation. A small collection of fossils was obtained from this band 400 feet below the peak of the mountain, at an elevation of 6,150 feet, a mile north of mile 116. According to Alice E. Wilson of the Geological Survey, the collection includes the following:

Cup coral - structure obliterated
Colony coral - structure obliterated
Syringoporoid coral - structure obliterated
Brachiopod fragments - showing dental plates

Miss Wilson states that these coral types and the brachiopod fragments belong to an Upper Palaeozoic horizon, but that lack of structure makes a closer correlation impossible. This statement is also applied by Miss Wilson to a coral taken from a dolomite outcrop on the roadside at mile 119 and described as follows:

Coral - Colony type - Diphyphyllum or fine Lithostrotion - structure obliterated.

A rough estimate of thicknesses of the principal units of the Upper Palaeozoic succession as displayed northwest of the Canol Road between miles 116 and 118 is given as follows:

Top of Section	Approximate Thickness Feet
Slate, black; strong fault parallel to bedding....	100
Limestone, grey, and dolomite, buff; minor sandstone (barite veins)	3,500
Limestone, grey, hard, fossiliferous (Upper Palaeozoic)	150
Sandstone, brown, thin-bedded	125
Shale, brown, lower part changing to black	100
Dolomite, buff, sandy texture	300
Sandstone, hard; pure quartz sand	100
Dolomite, buff, white on fresh surface	500
Shale, calcareous	100
Limestone, dark grey, becoming lighter towards top (a few fossil fragments seen in upper part)..	450
Sandstone, sandy limestone, dolomite	200
(Rests upon Lower Palaeozoic micaceous quartzite and slate)	
Total thickness	5,625

A limestone and dolomite succession similar to that listed above comprises the upper part of a very high rugged mountain that lies south of mile 120. The formation forms a syncline that strikes southeasterly. Three miles south of the road it is about 2 miles wide, and it appears to widen farther towards the southeast. The lowest dolomite bed on the northeast shoulder of the mountain is underlain successively by about 100 feet of black slate, 25 feet of grey chert, 100 feet of purple slate, 100 feet of light green, fine-grained quartzite, 150 feet of black shales, with some dark chert beds, and 300 feet of greywacke and coarse-bedded tuffs with 2 feet of limestone near the base of the exposed beds. This succession overlies at least 1,500 feet of dark shales, slates, greywacke, sandstone, and quartzite beds that are exposed in the mountains to the east. For example, the mountain 3 miles south of mile 127 is formed predominantly of slates and shales to an elevation of 5,250 feet, but the mountain top is capped by the overlying dolomite and limestone formation. As the latter formation contains fossils of Upper Palaeozoic age the underlying slates, shales, and quartzites are probably of Lower Palaeozoic age.

Laberge Group

The rocks shown on the accompanying map as Laberge group, near the outlet of Teslin Lake, were mapped by Lees (1936). He states that the series as developed on the east side of Teslin Valley is an assemblage of interbedded argillites and grey, crystal tuffs, which, with accompanying andesite, is at least 5,000 feet thick and may exceed 9,000 feet. The argillites are dark brown to black and in many places banded, and the tuffs are dense rocks that range from a fraction of an inch to hundreds of feet in thickness. Lees describes the pyritized volcanic rocks that form a small outcrop on the east shore of Teslin Lake, $1\frac{1}{2}$ miles from the outlet, as probably dacites, and andesites and argillites are interbedded northeast of this. He states that 2 miles east of the outlet of the lake the rock is greyish black with numerous green pyroxene phenocrysts and some carbonate, and may be a basalt.

The name Laberge series was first used by Cairnes[1] in

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[1] Cairnes, D.D.: Lewes and Nordenskiold Rivers Coal District; Geol. Surv., Canada, Mem. 5 (1910).

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describing widespread sandstone, argillite, and conglomerate beds of Lower Jurassic age that occur in the Lake Laberge area. Bostock and Lees (1938) and Lees (1936) have recently traced these rocks 20 miles easterly from Lake Laberge to Teslin River and southeasterly for 50 miles down Teslin River Valley to Teslin Lake.

Peridotite and Serpentine

Small stocks of peridotite and serpentine intrude rocks of the Yukon group on the east side of Rose River Valley. One of these stocks, half a mile in diameter, occurs on the north side of a small lake a mile east of mile 78. It is a dense, fine-grained, green to black rock comprised of varying proportions of anthophyllite, olivine, and serpentine (antigorite). Close to small fractures and faults that traverse the stock, the peridotite is completely altered to serpentine. Another stock of peridotite and serpentine outcrops as a prominent hill half a mile farther north, or about a mile east of mile 79. It is finely crystalline and of a dull greyish green colour. Some granite occurs between the two ultrabasic stocks, but its contacts with the stocks were not observed. A third stock, composed largely of dark peridotite with some serpentine, was seen on the divide 3 miles southeast of the small lake or about 4 miles east of mile 75. Granite dykes cut the ultrabasic rocks in this vicinity.

A peridotite stock 2 miles wide intrudes andesite in the mountains on the west side of Rose River Valley due west of Camp 78. This body strikes westerly towards the outlet of Big Salmon Lake. It is altered in many places to dense, light green serpentine. Dark, fine-grained peridotite is associated with a small body of coarsely crystalline grey gabbro on the mountain top 2 miles northwest of the camp.

Dark, greenish black, fine-grained serpentine and dark peridotite outcrop for 800 feet along the south bank of Pelly River at the bend 2 miles west of the road crossing. Quartz-sericite schists that dip 30 degrees southwest form the hanging-wall of the sill-like body at its westerly exposure.

Peridotite and serpentine also outcrop along a small stream-cut ravine 2 miles north of the mouth of Ross River and a mile west of mile 144. The mass is 200 to 300 feet wide, and trends northwesterly parallel with the strike of sericitic schists that are intruded. Here the peridotite ranges from dark and finely crystalline to a greyish green, coarsely crystalline rock, and along small faults that cross the dyke-like body, large masses of the peridotite are converted to finely crystalline, dark green serpentine.

All that is known of the age of these ultrabasic rocks is that they intrude the Yukon group and are themselves cut by granite dykes, and, as they are sheared and fractured, they have evidently undergone some deformation since their emplacement. Bostock (1938) in reporting on very similar bodies found in Big Salmon Mountains assumed them to be an early phase of the granite intrusion. As the granites are assigned to Cretaceous or later time, the ultrabasic rocks may be considered, tentatively, as of Jurassic or later age.

Granite, Granodiorite, and Diorite

A granite intrusion known as the Quiet Lake batholith is exposed for 10 miles along the west side of Quiet Lake. The batholith extends 35 miles in a northwesterly direction from the lake to Mount Black at the headwaters of South Big Salmon River (See Geol. Surv., Canada, Maps 372A and 350A) and is about 20 miles wide. Granite is also present in the mountains on both sides of the Canol Road between 5 and 10 miles north of Johnsons Crossing. This stock is known to extend 20 miles north, almost to Sidney Creek. There are medium-grained, coarsely crystalline and coarsely porphyritic phases of the granite, and a gneissic texture is developed in many places adjacent to the borders of the larger, Quiet Lake batholith. The average mineral composition of the granite is approximately: 25 per cent quartz, 33 per cent microcline, 15 per cent orthoclase, 18 per cent plagioclase (oligoclase), and 8 per cent biotite. Muscovite and a little apatite are present in some places. The occurrence of placer gold on Iron and Brown Creeks suggests the presence of gold-bearing veins about the flanks of the Quiet Lake batholith.

A granodiorite batholith that trends northwesterly across the Canol Road between miles 83 and 100 will be referred to in this report as the Rose River batholith, as Rose River Valley cuts diagonally across it. The Rose River batholith may extend as much as 40 miles northwest from the Canol Road if it connects with the granite bodies of Rangifer and D'Abbadie Mountains, shown on the east border of the Laberge Sheet (Geol. Surv., Canada, Map 372A). It may also extend southeasterly to connect with granitic bodies mapped by C.S. Lord (1944) along the Alaska Highway. Where examined near the Canol Road, the Rose River batholith is a coarsely crystalline, grey intrusion marked by an abundance of fine, black, biotite flakes and by prominent phenocrysts of oligoclase feldspar, many of which are more than an inch long. The rock generally contains some orthoclase and about 20 per cent quartz. Gneissic structure is developed in varying degrees across the batholith, and is particularly evident near the northeastern contact. Grey, medium-grained granodiorite lacking porphyritic habit is present in some places and appears to intrude a body of microcline granite that outcrops east of mile 93. The latter is a coarsely crystalline, pink to buff rock composed of about 60 per cent microcline and 35 per cent glassy quartz, with a little oligoclase and only 1 or 2 per cent of biotite. Small, glassy, quartz stringers seen in the roof pendant of schist, gneiss, and crystalline limestone east of mile 93 may have been derived from the stock of microcline granite.

On the mountain west of mile 82, and west of Rose River, a quartz-albite dyke about 1,200 feet wide intrudes crystalline limestone and laminated slates. This rock is grey to white and finely crystalline. It is sheared in places and is impregnated with as much as 5 per cent pyrite, the oxidation of which has imparted a rusty coloration to weathered rock surfaces. The dyke is probably closely related in age to the main body of the Rose River batholith. Float of brecciated quartz and altered rock containing a little galena, jamesonite, pyrite, and arsenopyrite was reported by R.M. Thompson to be abundant locally on the mountain slope at an elevation of 5,650 feet, $1\frac{1}{2}$ miles east of mile 99. Specimens examined by the writer were strongly suggestive of brecciated and mineralized quartz-albite dyke rock. With these evidences of mineralization so close to the road on both north and south flanks of the Rose River batholith, the advisability of prospecting along the flanks is self evident.

Granitic rocks that outcrop along the Canol Road between miles 161 and 172 are part of the Anvil Mountains batholith. This intrusive body extends in a northwesterly direction for 80 miles from Ross River to Tay Mountain on the northeast side of Pelly River. It is over 15 miles wide a short distance north of the road. Much of the intrusion exposed near the road is granodiorite, composed of about 20 per cent quartz, with 5 to 10 per cent microcline, about 10 per cent biotite, and from 55 to 65 per cent andesine felspar. In some places the rock contains up to 10 per cent hornblende in addition to biotite. Granite porphyry outcrops north of mile 159 and between miles 161 and 162 along the roadside. It consists of prominent phenocrysts of quartz, andesine feldspar, and biotite held in a finely crystalline groundmass of similar minerals. Many of the quartz phenocrysts are perfectly shaped crystals, the most common crystal form being double six-sided pyramids up to one-quarter inch in diameter. Some are intergrown through penetration twinning. Quartz-feldspar porphyry dykes seen intruding the shales and along the northeast side of the Anvil Mountains batholith may be of closely related age.

The granitic stock that forms the core of Sheldon Mountain has an average diameter of a mile. It is a grey, coarsely crystalline, porphyritic granodiorite, composed largely of oligoclase feldspar and quartz with minor biotite, uralite, and orthoclase. Much of the oligoclase feldspar is present as prominent grey phenocrysts 1 inch or more long. Quartz veins that occur within this stock, or in offshoots from it, contain arsenopyrite, and assays indicate the presence of gold and a small amount of tin.

Little is yet known of the Itsi Mountains granodiorite stock. Seen mostly from a distance, it appears to range from 3 to 6 miles in width, and is probably about 10 miles long. Where examined at its northwestern extremity, the intrusive rock is a coarsely crystalline, grey granodiorite that has baked, and, in some places impregnated with pyrrhotite, the surrounding argillites.

A granodiorite stock 2 miles in diameter outcrops close to the road at mile 268, and the southern end of another granodiorite body some 8 miles long and 4 miles wide lies 5 miles farther west. The latter is hidden from the road by an intervening mountain of greywacke and shales. The stock near the road is a grey, coarsely crystalline, porphyritic granodiorite. It has indurated the intruded slates and impregnated them near the contact with pyrrhotite, which has oxidized and stained the slates a rusty hue. Three additional granite stocks lie north of Macmillan Pass, north of Tsichu River. The largest of these is about 4 miles from the road camp at mile 292. It is 5 miles long and 3 miles wide, elongated in a northerly direction. Only sedimentary rocks occur farther northeast along the road.

Another stock of grey granodiorite, 4 to 6 miles across, cuts shales, greywacke, and conglomerate beds, east of mile 266. The north contact of this stock, 7 miles east of the road, dips 45 degrees north. Viewed through field glasses the overlying sedimentary beds were seen to be cut by a number of light-coloured sills and dykes.

Air photographs of the valley of Ross River show rugged topography, typical of areas underlain by granitic stocks, both south of Wilson Lake and east of Christie Pass. Mount Wilson, 12 miles south of Christie Pass, was reported by Keele (1910) to be formed of granite. So far as known these stocks have never been visited and represent virgin prospecting ground.

Diorite stocks as much as 1,000 feet in diameter were seen cutting Yukon group schists and slates in the mountains on both sides of the Canol Road between miles 104 and 110, and small diorite and lamprophyre dykes cut both Yukon group and late Palaeozoic rocks in numerous places between Quiet Lake and Pelly River. Where diorite stocks are present they commonly form the peaks of the mountains, due to their relative resistance to erosion. Most of the diorite bodies are considerably altered, the plagioclase and ferromagnesian minerals having been largely changed to chlorite, carbonate, and epidote. Many of the quartz veins that occur near the larger diorite stocks contain an abundance of rusty carbonate.

On the divide, at an elevation of 6,100 feet, 3 miles east of mile 109, there is a highly schistose sill of albite diorite 100 feet wide. The sill is a light rust-flecked grey on freshly broken surfaces, and displays a strong development of carbonate and sericite. It resembles a schistose tuff.

The age of the granitic stocks and batholiths adjacent to the Canol Road is not known definitely. Altered diorite dykes intrude limestones and shales of late Palaeozoic age on the mountain west of mile 118, and the diorite stocks that cut Yukon group slates and schists a few miles to the south are probably of the same age as these dykes. Both are comparable to diorite bodies that are known to intrude Laberge volcanic rocks in the area adjacent to the head of Teslin Lake. As the Laberge volcanic rocks overlie the upturned and eroded Tantalus conglomerate in the Seminoff Hills area, and as the fossils of the conglomerate formation are of either late Jurassic or Lower Cretaceous age, the volcanic rocks are not older than late Jurassic and are possibly younger (Lees, 1936). It follows that the diorite bodies near Teslin Lake are of late Jurassic or later age.

On the mountain ridge south of Evelyn Creek, west from mile 22, Lees (1936) found that biotite granite becomes finer in grain as a body of quartz diorite is approached, and held that the relative freshness of the granite as compared with the quartz diorite was also evidence of the younger age of the granite.

The writer was unable to find either diorite or granitic pebbles in Paleocene conglomerate beds in Pelly River Valley near the Canol Road, and their apparent absence supports the hypothesis of a Tertiary age for the intrusions. But the granites could have been intruded in late Cretaceous time without being exposed by erosion until Tertiary time. There is an abundance of granite and diorite pebbles and boulders in the partly consolidated beds of Tertiary conglomerate alongside the Canol Road east of mile 104.

Paleocene Sedimentary Rocks

Sandstone, shale, grit, and conglomerate beds are exposed in bluffs up to 100 feet high along Lapie River between 2 and 4 miles north of the bridge that crosses Lapie River at mile 132. The beds are gently folded, but in a few places dips approach 45 degrees. The contact of these beds with older rocks farther downstream was not observed. About 3 miles downstream there are a few seams of coal a few inches thick enclosed in shales that contain well-preserved fossil leaves. Fossils collected here by the writer were identified by W.A. Bell of the Geological Survey as follows:

Conifers

Taxodites dubius (Sternberg)

Angiosperms

Viburnum antiquum (Newberry)
Viburnum elongatum Ward
Juglans acuminata A.L. Brown

Bell states that this florule indicates a Paleocene age.

Conglomerate and coarse sandstone beds that outcrop 2 miles southwest of the pipeline bridge across Pelly River are thought to be of the same age. The conglomerate in both places is composed of pebbles of quartz, chert, sandstone, slate, and greywacke, with an occasional small fragment of coal and some kaolin-like material. About a mile west of mile 140 the conglomerate is faulted against sericitized, graphitic limestone, the fault being marked by a narrow, deep ravine. The conglomerate and sandstone beds strike northeasterly and dip from 10 to 45 degrees to the southeast. Exposures along the north side of a mile-long lake that lies half a mile west of the fault, exhibit a thickness exceeding 500 feet. The apparent absence of granite and diorite pebbles in these rocks raises the question as to whether the intrusions are of post-Paleocene age, or whether they had been intruded earlier but had not been unroofed by erosive agencies in Paleocene time.

Late Tertiary Conglomerate

Poorly cemented beds of flat-lying conglomerate outcrop in bluffs up to 100 feet high along a stream that flows westerly to the south end of middle Lapie Lake. There are continuous exposures of the conglomerate for half a mile in an easterly direction along the creek from the road crossing at mile 103.5. The beds rest unconformably upon folded, grey and black, quartz-sericite schists, and are overlain by unconsolidated post-glacial river gravels. The pebbles and boulders of the conglomerate formation are poorly cemented by calcium carbonate, and consist of quartz, crystalline limestone, schist, slate, granite, and diorite. The formation is considered to be a remnant of the Tertiary gravels that elsewhere along the valley bottom have been removed by valley glaciers. The contact of these gravels with the Yukon schists, half a mile east of the road, would be a favorable place to test for the possible occurrence of placer gold.

Pleistocene and Recent

All of the valleys traversed by the Canol Road southwest of Macmillan Pass are carpeted by deposits of boulder clay left by great valley glaciers of the last glacial epoch. Rivers and streams have reworked the boulder clay along their courses and have formed gravel, sand, and silt deposits from it. Some of these, and several of the eskers, kettle-holes, and glaciofluvial terraces seen near the road have already been described under the chapter dealing with physical features. A comparatively recent deposit of white volcanic ash ranging from 2 to 4 inches thick mantles much of the area. It is widespread in comparatively flat areas in the valley bottoms but was not seen on the mountain slopes, as it was washed and blown from the high ground by rain and wind. S.R. Capps[1] has estimated that the volcanic ash layer adjacent to White River,

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[1] Capps, S.R.: Glaciation in Alaska; U.S. Geol. Surv., Prof. Paper 170-A.

Alaska, is probably 1,400 years old. The ash deposits seen along the Canol Road are probably of the same age as those at White River.

ECONOMIC GEOLOGY

Placer Deposits

Keele (1910) states that fine gold is found in the gravels of Pelly River all the way from the Yukon to Campbell Creek, but no coarse gold has been found on bedrock in paying quantities. Placer miners reached the Pelly as early as 1882, and for some years subsequently they made as much as $10 to $20 a day each in their operations on the lower part of the river. For the last few years prior to Keele's visit, work was confined to the streams entering the Pelly from the south from and including Lapie River to Hoole River. Some of the best prospects were found on some of the small tributaries of Hoole River. On the upper Pelly the bars that produced best began about a mile below Hoole canyon and extended upstream for about 16 miles. The surface gravels to about a foot in depth yielded approximately 2½ cents to the pan, and 1½ cents at 2 feet below the surface. Three men who rocked on the bars above Hoole canyon made about $2.50 a day each, but according to Mr. Henderson who tested the bars for Keele it should be possible with the best appliances to make from $5 to $6 a day (figures based on gold at $20 an ounce).

Most of the productive creeks in southern Yukon are incised in rocks of the Yukon group, or in intrusive rocks or metamorphosed areas of Palaeozoic sedimentary rocks. The gold is believed to have been derived from the mineralized altered rocks and from quartz veins, and concentrated in the stream beds as a result of normal erosion. Many of the creeks flowing into Pelly River below Campbell Creek have this geological setting and are worth examining for placers. The deeply incised Pelly River Valley is a product of long period of erosion. Paleocene sedimentary rocks that outcrop along Lapie River and lie upon the crystalline schists are evidence that the valley was cut to that depth during the Cretaceous period. If placer deposits were formed at that time they might still be preserved in some places in the fossil gravel deposits (conglomerate) at the base of the Paleocene sedimentary rocks. Paleocene is also Tertiary. Continued erosion in later Tertiary times destroyed much of the Paleocene strata and much of the contemporary Tertiary volcanic rocks, and gold continued to accumulate on bedrock in Pelly River Valley. During the glacial period ice moved northwest down Pelly River Valley and transported much of the pre-glacial accumulation of gold so that it became mixed with the glacial deposits. In recent time, some of the gold has been retrieved from the glacial drift by Pelly River, as it cuts into these deposits yearly and at each flood stage carries the fine gold downstream to be deposited in the bars. Keele (1910) observed that the gold is generally confined to small areas at the head of each bar, and because of their shallowness and small extent diggings of this nature are soon exhausted. Tributary streams such as Hoole, Horton, Ketza, and Lapie Rivers, flowing across Pelly River Valley, have likewise reworked the superficial deposits and have reconcentrated the fine gold in the bars and on or near bedrock. As the tributary streams flow from the mountains at right angles to the direction of ice movement along Pelly Valley, it is certain that the Tertiary gravels in the mountain valleys were afforded some protection from the erosive action of the main ice body, but local valley glaciers were evidently large enough in most instances to remove the older gravels. Placer miners prospecting these creeks should watch carefully for signs of the Tertiary gravels in protected places, as they may contain coarse placer gold, provided the rocks of the area are favourable. The only remnant of Tertiary gravels seen by the writer was east of the road near mile 104, where a thickness of 100 feet of partly cemented gravels is exposed for half a mile along a rapid stream. The contact of these gravels with old, quartz-sericite schists is exposed half a mile east of the road, and the gravel at and near bedrock in that vicinity might be worth testing for placer gold.

Last season the writer tested the gravels at short intervals for 300 feet along the southwest side of Pelly River commencing 100 feet northwest of the Canol Road. Gravel ranging from half an inch to 3 inches in diameter taken from the upper part of the bank yielded between 30 and 50 fine colours of gold to a pan, but coarser gravel from the river bottom contained only a few colours to a pan, probably because it had been reworked recently by very fast flood waters.

Placer deposits discovered about 1905 on Iron Creek, a tributary of Sidney Creek, about 9 miles northwest of mile 30, Canol Road, are described by Lees (1936). At the time of his visit 18,000 cubic yards of gravel had been washed, but recovery was not high. The deposits include both reworked glacial till and some rotted pre-glacial gravels lying on bedrock.

Some placer gold has also come from Cottonwood Creek, a tributary of Nisutlin River that crosses the Canol Road near mile 40; also from Brown Creek a tributary of Sandy Lake, about 5 miles west of the Canol Road to the northwest of Quiet Lake. A little gold was taken from Brown Creek last season by Messrs. Clyde Wann and P.E. McNee of Whitehorse. Fine gold was reported to occur along Nisutlin River by McConnell (1898), but he states that it was not found there in paying quantities.

Lode Deposits

Mackenzie and Pelly Mountains adjacent to the Canol Road are virtually virgin ground, unexplored and neglected by prospectors except along the main streams where early miners tested and worked some of the gravel bars for placer gold. The narrow strip of territory along the road, explored during the past two seasons, yielded interesting discoveries, and, consequently, the region as a whole is recommended to the prospector. Vein deposits were found in both Palaeozoic formations and Yukon group rocks, and were most abundant near intrusive stocks of granite and diorite. There are numbers of these intrusive stocks, both large and small, in the region, and evidences of some mineralization were found associated with several of them.

A quartz vein 3 to 15 feet wide is exposed for several hundred feet in a saddle in a roof pendant of Yukon schists some 3 miles northwest of mile 10. The vein strikes southeasterly and towards its southeast end joins with a shorter vein from the north side to form a V-shaped body of vein quartz. It is sparsely mineralized with pyrite, most of which has been leached from the surface outcrop. Two small grab samples collected from the vein assayed a trace of gold each.

Quartz veins are particularly numerous in Yukon group rocks intruded by the Rose River granodiorite batholith. They are also plentiful where the Yukon group schists and slates are intruded by diorite stocks in the mountains east of Lapie Lakes. A mineralized zone on the mountain east of mile 99 (elevation, 5,650 feet) carries a little galena, jamesonite, and arsenopyrite. A hand specimen of vein matter from this assayed: gold, 0.005 ounce a ton; silver, 1.54 ounces a ton; and lead, 3.82 per cent. A number of roof pendants of crystalline limestone are enclosed in granite on the mountain near mile 93. They may be worth examining for occurrences of scheelite, though none was seen in last season's preliminary examination.

The barite veins discovered by the writer's party on the mountain 1½ miles west of mile 118, and later staked as the Norma and Lucky Lu claims, occur in Palaeozoic limestones. They are fissure fillings along subsidiary faults that branch from a major fault zone confined within a band of shales. A diorite dyke that outcrops 1,000 feet north of the major fault contains small irregular veins and replacements of barite. This relationship suggests that the mineralizing, barite solutions may have been given off by the deeply concealed, parent magma that supplied the intrusive diorite.

The zone in which barite veins might be expected to be found is 4 or 5 miles wide, one 2-foot barite vein having been seen on the mountain slope north of mile 119 and another on the north slope of the mountain 2 miles southeast of mile 121. Late in the autumn of 1944, P.E. McNee reported finding other barite veins both east and west of the road at mile 117, and in some of these he found galena and pyrite and some copper stain.

A 3-foot vein, well mineralized with pyrite and galena, was exposed by a bulldozer during construction of the road at mile 121.5 (See description of Canusa group). The vein occurs along a sheared zone in what are believed to be Palaeozoic shales. A somewhat similar vein is exposed during periods of low water in the shales in the bottom of Lapie River near mile 129.

Many small quartz veins and a few large ones were noted on the mountains on the southwest side of Pelly River Valley not far from one of the larger Pelly Valley faults. Some of the small veins on the mountain north of the road contain small, green, micaceous crystals and a little azurite, malachite, and chalcopyrite. Some tetrahedrite was seen in a 1-foot vein 3 miles south of the bridge over Lapie River, and a representative sample of this vein assayed: gold, 0.025 ounce a ton and silver, 3.63 ounces a ton. Quartz veins in the latter locality are white and barren-looking on weathered surfaces, but many of those broken into were found to contain a little pyrite or were marked by a few cavities from which pyrite cubes had been leached.

The report by Johnston (1936), dealing with the geology along Pelly River, states that, "Some pyrite and chalcopyrite were seen in such veins on the ridge bordering the north side of Pelly River just west of Ross River, on the ridge between Pelly and Glenlyon Rivers, on Rose Mountain ridge, along Pelly River near the upper end of the Detour, and on the east side of Harvey Creek. Pyritization is prominent in shear zones in greenstones intrusive into members of the Lower Palaeozoic (?) group along the lower part of Anvil Creek, and in the andesites of the ridge separating Pelly and Glenlyon Rivers".

Chips of vein quartz obtained by the writer from half a dozen narrow quartz veins at the waterfall on Lapie River (mile 130.5) assayed collectively: gold, 0.01 ounce a ton.

Half a mile south of Ross River and 5 miles east of the mouth of Tenas Creek, considerable vein quartz was seen at the fault(?) contact of fine-grained, green andesite with red slates and argillites. The andesite forms a prominent ridge for 8 or 9 miles along the south side of the river, and its contact with the slates and shales forms a geological structure favourable to vein deposition.

Three miles east from the west end of Riddell (Dragon) Lake, a 3-foot shear zone is exposed in a hill of gritty quartzite 600 feet south of the lake shore. The sheared rock is chloritized and impregnated with pyrrhotite. A small representative sample of the pyrrhotized rock assayed: gold, 0.005 ounce a ton.

On the east side of Sheldon Mountain, at an elevation of 5,400 feet, a 2-foot quartz vein is exposed for 50 feet across a dyke of porphyritic granite. The vein carries about 5 per cent arsenopyrite. A chip sample taken across this vein assayed: gold, 0.015 ounce a ton. At an elevation of 4,500 feet on the northeast slope of the mountain an outcrop of pyrrhotite about 1 foot wide and 2 feet long shows through a shallow soil covering. This vein is in purple slate interbedded with greywacke, hornfels, and limestone. A specimen of the sulphide assayed: gold, trace; copper, 0.20 per cent. A third specimen was collected from the south slope of Sheldon Mountain in the granite area at an elevation of about 6,000 feet; it came from a small vein containing a little arsenopyrite and assayed: gold, 0.02 ounce a ton; tin 0.06 per cent.

About 6 miles north of mile 241, limonite has been deposited from spring water flowing down a steep rocky talus slope. The bedrock is sandstone and greywacke interbedded with conglomerate composed of angular to partly rounded fragments of chert and black carbonaceous shale. The limonite deposit is about a foot thick and 50 feet wide, and extends for 250 feet down the slope. The spring issues from the conglomerate at an elevation of 4,800 feet, and it is believed that the conduit is a vertical fault extending up the ravine but concealed from view by blocks of talus. An assay on a small sack of the limonite gave: iron, 52.99 per cent; manganese, nil.

Itsi Mountains were visited only at their northwest extremity, where hornfels, quartzite, and limestone are intruded by the granite stock that forms the core of these mountains. The intruded rocks at their contacts are baked and impregnated with pyrrhotite.

A sample of carbonaceous shale collected from an outcrop on the south bank of the South Fork of Macmillan River, where the road is nearest the water, at mile 238, was tested with the spectroscope by F.J. Fraser, of the Geological Survey, and found to contain 0.1 to 0.3 per cent vanadium. A coal analysis on this sample by the Bureau of Mines, Division of Fuels, Ottawa, gave: moisture 0.7, ash 89.7, volatile matter 2.7, and fixed carbon 6.9 per cent. There are numerous other beds of carbonaceous shales in this vicinity, and their vanadium content might be worth investigation.

At an elevation of 4,600 feet on the steep mountain slope west of mile 130, an 8-inch deposit of barium carbonate (witherite) is interbedded with dark shales. It is a dark grey rock resembling limestone, but contains siliceous rounded aggregates about the size of small peas that stand out on the weathered surface. The dark colour is imparted by minute flakes of carbon sprinkled through both witherite and siliceous granules. Minute veins of witherite less than 0.05 inch wide traverse the rock. The deposit extends for at least 50 feet along and down the slope. The bed from which the sample was collected is probably not sufficiently high grade to be of present economic value. An analysis by the Bureau of Mines, Ottawa, of the sample from the 8-inch bed follows:

		Per cent			Per cent
BaO	-	64.40	SrO	-	0.54
CO_2	-	18.54	MgO	-	0.13
SiO_2	-	11.94	SO_3	-	0.51
CaO	-	0.68	Fe_2O_3	-	0.29
Al_2O_3	-	0.54	Loss on ignition	-	1.33

The combined BaO and CO_2 content are equivalent to 82.88 per cent of witherite in the sample.

Another witherite deposit was found during the 1945 field season. It is 100 feet higher up the slope, from the last described occurrence, and about 100 feet below the top of the mountain. It is a bedded body 2 to 3 feet wide, enclosed in dark shales that strike north 65 degrees west and dip 75 degrees northeast. The vein weathers a light grey, and is speckled with small, darker, siliceous granules. It is exposed for only 30 feet, being drift covered towards the west and pinching out on the east at a drag-fold. A 2- to 3-inch vein of pure white witherite runs along the north side of the deposit for several feet, and a few quartz stringers occur there also. The presence of the small, white witherite vein shows that witherite was deposited from vein-forming solutions, so that the larger impure deposits may have been deposited in a similar way. They probably formed through replacement of the shale along bedding faults that followed and enveloped narrow siliceous layers that were shattered to form the siliceous granules that are prominent on the weathered surface of the carbonate deposit. An analysis of a sample of the grey carbonaceous rock by the Bureau of Mines, Ottawa, shows a witherite content of 86.15 per cent. The full analysis is as follows:

		Per cent
$BaCO_3$	-	86.15
$SrCO_3$	-	0.48
Al_2O_3	-	0.82
SiO_2	-	10.88
CaO	-	trace
MgO	-	trace

The presence of major faults trending northwest along Pelly River Valley, coupled with the fact that placer gold occurs along Pelly River from its mouth to Campbell Creek (50 miles east of Ross River), suggests the probable presence of gold-bearing veins along subsidiary faults both along the valley bottom and in the bordering mountains. The presence of extensive drift deposits will, unfortunately, hinder the search for such veins along much of the valley, but large numbers of veins are known to be present in the steep, rocky mountain slopes on the southwest side of the valley. Systematic sampling of the larger veins or groups of small veins will be necessary in the search for commercial gold-quartz deposits.

The possibility of finding bedded hematite deposits in the region northeast of Sheldon Lake should also be kept in mind. Joseph Keele (1910) has already reported the occurrence of hematite on Gravel (Keele) River, about 10 miles below the mouth of Natla River, which is roughly 65 miles northeast of Christie Pass. He describes it as coarsely laminated hematite and red siliceous slate having a thickness of from 50 to 100 feet. It is underlain by 1,000 feet of dolomite and argillite and is overlain by about 2,000 feet of conglomerate, succeeded by 1,100 feet of brown micaceous slates. These rocks did not yield fossils, and were thought by Keele to be of Lower or Middle Cambrian age. An average sample of the ore, as collected by Keele, assayed 25 per cent iron.

Mining Claims

Canusa Group

These claims are astride the Canol Road one-quarter mile north of mile 121. They were staked by Messrs. N. Robert and U.J. Arsenault for the Consolidated Mining and Smelting Company in June 1945. A quartz vein 3 feet wide is exposed on the roadside for 10 feet. The vein contains pyrite and holds about 8 per cent galena. Much of the pyrite has oxidized, leaving cellular quartz. The writer collected a chip sample across the vein, which assayed: gold, 0.01 ounce a ton; silver, 1.34 ounces a ton; lead, 5.19 per cent. The ground below the road drops off at a steep angle for several hundred feet to the level of Lapie River, and on this slope the vein is exposed again in a sheared zone in a trench 30 feet wide. The wall-rock is altered shale, locally changed to talc schist and kaolinized slate. The principal vein in the 30-foot cross trench is 3 feet wide, but a number of other quartz lenses less than 6 inches wide occur at intervals of 2 to 5 feet across the sheared zone. They carry a little pyrite, most of it oxidized, and a little galena. The veins strike about north 55 degrees west and dip northeast at 35 to 80 degrees. About 100 feet south of the 30-foot trench a parallel vein outcrops on the steep slope. It is exposed for some 20 feet, ranges from 6 to 16 inches in width, and is composed largely of quartz containing less than 10 per cent galena.

Norma and Lucky Lu Claims

The Norma and Lucky Lu claims were staked by Mr. L.S. Fraser and his partner to cover the upper part of Barite Mountain 1½ to 2 miles west of mile 118 on the Canol Road. Barite veins occur here in late

Palaeozoic limestones on the southwest side of a steep mountain ravine that leads up along a 33-degree slope to a high saddle. The limestones southwest of the ravine strike northwest and dip 50 degrees northeast. The ravine is incised on a band of black shales about 100 feet thick, and on the northeast side of the ravine the shale is overlain successively by quartzite, dolomite, limestone, greywacke, and more shale beds. North of the 100-foot shale band, near the mountain top, the beds dip nearly vertically, and farther down the slope, on the east side, they are overturned. This deformation was accompanied by faulting in a northwesterly direction along the 100-foot band of shales, and differential movement produced numbers of subsidiary faults branching off to the southwest from the shale into the limestone; it is along these that the barite was deposited.

The barite veins are widest at the contact of the limestone with shale in the bottom of the ravine, and narrow in a southwesterly direction, generally pinching out in 200 or 300 feet. They range from 1 to 10 feet in width, and are most abundant between elevations of 4,800 feet and the top of the mountain, at an elevation of 6,100 feet. They include more than a dozen strong veins, one of which, between elevations 5,950 and 6,100 feet, occurs in a zone of brecciated limestone 30 feet wide partly replaced by barite. Most of the veins strike from 45 to 70 degrees east of north, and their dips range from vertical to 75 degrees southeast. They consist of a good grade of white barite, no sulphides being seen in them. In most of the larger veins, there are two types of vein material, a coarsely crystalline variety of white barite marked by occasional flecks of dark colour, and a pure white, finely crystalline barite. Probably the coarsely crystalline variety was deposited first, as it is generally confined between bands of the finely crystalline barite. The veins were judged from preliminary inspection to contain about 50,000 tons of proved barite, with much additional prospective barite.

The following are analyses of barite specimens collected from near the top of the mountain and tested by the Bureau of Mines, at Ottawa.

	Coarse barite Per cent	Fine barite Per cent
$BaSO_4$	99.20	99.70
$SrSO_4$	0.23	0.17
CaO	0.23	0.10

Transportation costs will probably prohibit the shipment of barite to points remote from the Yukon. The deposits might be used to supply heavy muds to assist in oil-well drilling where gas pressures are encountered, whenever such drilling is carried out in areas contiguous to the Alaska Highway. The rock takes a good polish and because of its weight would be ideal for manufacture of book ends, paper weights, etc., useful in Yukon tourist trade.

NOTES FOR PROSPECTORS

(1) The northeast border of the Anvil Mountains batholith has never been prospected and represents 80 miles of virgin ground, of which nothing is known as yet.

(2) There is good evidence of profound faulting along the trench-like Pelly Valley, and one might expect to find subsidiary faults near the large faults. Veins that occur along the lesser fissures may be among those that have supplied the gold to the gold placers of Pelly River. Major fault zones have almost invariably been found to be associated with valuable mineral deposits elsewhere in Canada.

(3) The granitic stocks that intrude Palaeozoic strata in the Mackenzie Mountains comprise prospecting ground well worth examination.

(4) The Yukon group rocks along the borders of the Quiet Lake and Rose River batholiths are, theoretically, particularly favourable for prospecting, but the occurrence of barite- and galena-bearing veins in the Palaeozoic rocks 20 miles southwest of Pelly River prove that none of the formations southwest of Pelly River can be overlooked in the search for mineral deposits.

(5) The gravel bars of Pelly River contain much fine placer gold, and where it has been concentrated at the heads of bars or in slack water at bends, it should be possible for small operators with proper equipment to recover it at a profit. The river is about 500 feet wide where the Canol Road crosses it, but a flat bench of reworked gravel that forms its banks on the southwest is from $\frac{1}{2}$ to $\frac{3}{4}$ mile wide, and near-surface concentrations of fine placer gold might have formed at numerous places across this bench as it was built by the meandering river, so that the zone worth testing for placer gold concentrations is indeed large. As the gravels were formed by reworking and cutting down through better than 100 feet of boulder clay, there is reason to believe that at least some coarser gold might have been concentrated along the base of the gravels, on top of the underlying glacial boulder clay. Theoretically this contact should lie near the present level of the river bottom, so that a drill capable of penetrating only 20 or 30 feet would be required to test for gold along the floor of the gravel formation. Near bedrock banks the depth would be greater, due to excessive downward deflexion of water currents.