C. M. Sternberg

CANADA
DEPARTMENT OF MINES
HON. T. A. CRERAR, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

BUREAU OF ECONOMIC GEOLOGY
GEOLOGICAL SURVEY

MEMOIR 203

Geology of Teslin-Quiet Lake Area, Yukon

BY
E. J. Lees

OTTAWA
J. O. PATENAUDE, I.S.O.
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1936

Price, 25 cents No. 2429

Looking from near mount M'Clintock northeast across Teslin valley.

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CONTENTS

Illustrations

25590—1½

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CHAPTER I

INTRODUCTION

Teslin-Quiet Lake area has received some attention from prospectors, but mining engineers and financial interests have given it little attention though it is one of the most accessible parts of Yukon. The geology of the area is such as to warrant the search for mineral deposits and gold placers, and silver-lead lode deposits have already been discovered.

The part of the district herein reported upon has an area of 1,700 square miles. It is bordered on the east by the valley of Nisutlin river and extends west to include the valley of Teslin lake and river. The northern boundary is in part defined by Boswell river; the southern boundary crosses the foot of Teslin lake.

The survey carried on during the summer of 1935 was of reconnaissance character. A topographic map made in 1931 and 1932 by R. Bartlett of the Topographic Division of the Geological Survey was used as a base for the geological mapping. S. C. Robinson, J. M. Black, D. C. Malcolm, B. Woodsworth, and A. S. MacInnes rendered efficient service as field assistants.

H. S. Bostock supervised the organizing of the field party and the preparation of the map and report. To many residents of the country the writer wishes to express thanks for their kindness and their aid in carrying out field work.

Whitehorse, Yukon, is the main distributing point for the region. Small stocks of supplies are kept locally by the traders at Teslin Post. Airplanes may be hired at Carcross and Whitehorse about an hour's flight from the area.

The district may be reached by water from Whitehorse. Steamers ply regularly on Lewes and Yukon rivers between Whitehorse and Dawson. There is, however, no regular service on Teslin river at present, although the river is navigable for small steamers, and normally twice a summer a small freight boat owned by Taylor and Drury, Limited, ascends to Teslin lake. Indians, trappers, and traders are continually travelling on Teslin and Nisutlin rivers in small motorboats.

The area may be reached by several overland trail routes. A trail runs from Carcross to Tagish and thence by M'Clintock river and Mary river to Teslin river at its confluence with Mary river. Another route runs from Tagish through Squanga valley to Teslin river, 3 miles below the outlet of Teslin lake. A trail runs from Atlin, B.C., to Teslin Post. A route from Juneau, Alaska, enters the area by ascending Taku river and thence by trail to the south end of Teslin lake. A branch trail from Atlin joins this trail. Another route used is from Wrangell up Stikine river and

Telegraph creek to the south end of Teslin lake. A trail connects Teslin Post at the mouth of Nisutlin bay with the upper Liard River country 150 miles to the east. Besides these established trails indistinct and less used routes cross the mountains. The trails within the area that are most used are shown on the accompanying map.

The climate is cool in summer because of the northern latitude and the mountainous character of the country. Almost continuous daylight prevails throughout May, June, and July. The rainfall is moderate; irregular showers are frequent throughout June and July. The snowfall is not excessive; generally there is about 1½ to 3 feet of snow on the ground in Teslin valley during the winter. Occasionally low temperatures are reached. The winter is long and the daylight short. Rivers close in the latter part of October or November and do not open again until May.

Timber line lies at 4,000 to 4,500 feet above sea-level. White spruce, balsam fir, black pine, aspen and balsam poplar, scrub alder, and willow are the chief trees. Pines follow the areas of sandy soil and spruce and balsam clothe the moss-covered lower mountain sides. Stands of timber suitable for general mining purposes are usually to be found in the large valleys. Trees commonly range from 4 to 12 inches in diameter, but occasionally reach 16 inches.

The district contains an abundance of game and is frequently visited by big game hunters. The fauna embraces moose, caribou, grizzly, black, and brown bear, wolf, coyote, fox, wolverine, lynx, marten, mink, weasel, muskrat, porcupine, marmot, rabbit, ground squirrel, pika, red squirrel, chipmunk, and mice. Grouse and ptarmigan are the native game birds. Grayling, lake trout, whitefish, and pike or maskinonge are the principal fish. Moose are abundant along Nisutlin river, Teslin lake, and adjoining part of Teslin river. Caribou of the woodland species are abundant on the mountains above timber line east of Teslin river. Bears are more frequently seen on the mountains around Boswell valley. Coyotes are numerous and frequent the ranges of the moose and caribou. Geese and ducks are abundant in late August and September on the delta of Nisutlin river. There was an abundance of grouse, ptarmigan, and rabbits in 1935.

The first exploratory survey through Teslin district was made by F. Schwatka, C. W. Hayes, and M. Russell who entered the region from Taku river in 1891, and passed down Teslin lake and river. Hayes, the geologist of the expedition, published notes on the geology and topography of the region passed through.

Arthur Saint Cyr made an exploratory topographic route survey through the region in 1897 from Telegraph Creek on Stikine river along Teslin lake and river to its confluence with Lewes river. He returned up Teslin river to Mary river, leaving the district by M'Clintock portage. The following year he topographically mapped Nisutlin river to its source streams, then Quiet lake, and Big Salmon river to its confluence with Lewes river.

R. G. McConnell made a geological exploration in 1898 of Big Salmon river, Quiet lake, Nisutlin river, and Teslin river and lake.

In 1923 and 1924 W. E. Cockfield and A. H. Bell mapped the geology and topography of Whitehorse district, which adjoins the area on the

northwest corner. The writer explored Laberge map-area in 1929, 1930, and 1931, under the supervision of W. E. Cockfield and H. S. Bostock. A geological and topographical map was made which overlaps the northwest part of Teslin-Quiet Lake area. A topographical base map was made by R. Bartlett in 1931 and 1932 by photo-topographical methods. In this he covered Teslin river, Teslin lake as far as the British Columbia-Yukon boundary, Quiet lake, and Big Salmon river.

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CHAPTER II

PHYSICAL FEATURES

According to current usage southern Yukon is divided into three major physiographic provinces, Coast range, Yukon plateau, and Mackenzie mountains. Teslin-Quiet Lake area lies within the Yukon plateau, which in the vicinity of this area is broken by higher mountains that rise above its upland surface. These higher mountains make up the major part of the area.

An arm of the relatively low country that lies in the central part of the Laberge[1] district extends southeastward up Teslin valley. The hills in this belt on both sides of Teslin valley rise to 5,000 feet above sea-level and their summits make up the upland surface. A few mountain masses on the west side of Teslin valley rise above the upland surface to heights of 6,000 feet and more above sea-level. To the west, in Whitehorse map-area, elevations such as these form a mountain section of considerable extent.

The eastern edge of this upland area is defined by a valley or series of valleys extending southeasterly from the lowest part of Boswell river and holding Baker, Rosy, and Swift lakes, Swift river, and the lakes west of Cone mountain. To the east lies the Sawtooth range whose northern limit is defined by the east-west valley of Boswell river. The range is rugged with numerous cirques and "knife edge" ridges. The highest point in the range reaches 6,875 feet above sea-level. Mountains continue southeast of the Sawtooth range, but are not as high nor as rugged. The country west of the Sawtooth range is also mountainous, with a number of peaks rising to elevations of 6,500 feet or more.

The drainage of the entire area is tributary to Yukon river by way of Teslin river and its tributaries. Teslin (or Hootalinqua) river and Teslin lake occupy a relatively straight valley running northwest for 250 miles from the divide with the Stikine watershed in northern British Columbia to the confluence of Teslin and Lewes rivers in southern Yukon. The bottom of Teslin valley is from 1½ to 4 miles wide. The elevation ranges from somewhat under 2,000 feet above sea-level at its confluence with Lewes River valley to 2,250 feet above sea-level at Teslin lake. The bordering upland surface lies 2,750 feet above the valley floor.

Teslin river has an average width of 500 to 600 feet. Throughout the lower part of its course for 95 miles, from the confluence with Lewes river up to near 100 Mile creek, it meanders in the glacial drift deposits that cover the valley floor. The river is cutting laterally into the deposits at the bends but is now cutting downward very slowly, if at all. Bedrock outcrops at only one or two places along the river. The average rate of flow along the lower 95 miles of the river is around 4 miles an hour. At two of the fastest parts of the river, namely Roaring Bull rapid, located 1 mile below the confluence of Indian river, and the rapids opposite the

[1] Lees, E. J.: Geology of the Laberge Area, Yukon; Trans. Roy. Can. Inst., No. 43, vol. XX, pt. I, pp. 1-48 (1934).

mouth of Boswell river, a boat capable of travelling 7½ to 8 miles an hour in quiet water can just make headway. Above 100 Mile creek Teslin river flows slowly with few meanders.

Teslin lake is 123½ miles by river above the confluence with Lewes river, it is 60 miles long and 1½ to 2 miles wide, and the part of the valley occupied by the lake is of the same width in its northern half as that of the river. Midway along the lake the bounding hills are lower and two large bays, Nisutlin and Morley, extend to the east. Nisutlin river enters Nisutlin bay.

Boswell river is the principal tributary of Teslin river below Teslin lake. It is a rapid stream, 28 miles long and 100 feet wide 400 yards above its confluence. Bedrock outcrops at several points along the lower part and not again until 24 miles above its mouth. At high water it cannot be forded by man and not until it branches 20 miles above its mouth can trees be felled to cross it from the trail that follows the north side of the valley.

Indian river enters Teslin river at the head of Roaring Bull rapid and about 3 miles below Boswell river. Several miles above its mouth it runs through a rock canyon. At a moderate stage of water, in June, it is 30 feet wide and 1½ feet deep, with a rate of flow of about 5 feet a second 100 yards from its mouth.

Nisutlin river is the largest stream flowing into Teslin lake. It approaches Quiet lake from the east to within 4 miles, to enter a wide valley which has a trend a little east of south. It flows in this valley for 67 miles, measured in a straight line. The lower 7 miles of this part of the river swings southwest, possibly forced in that direction by the confluence of Wolf river, 3½ miles above Nisutlin bay. Nisutlin river has an average width of 200 to 400 feet. At a moderately low stage of water, in late July, it had a depth of 1½ feet or less over nearly the whole width at a few points above the confluence of Sidney creek. Near and immediately below the confluence of Wolf river the current is rapid up to 6 miles an hour. Above this, to near the confluence of Sidney creek 61 miles by river from the mouth, the current is slow, from 1 to 3 miles an hour. From Sidney creek to Cary portage, a farther 16 miles by river, the river becomes rapid, up to 5 miles an hour in places. Above the portage rapids are reported numerous. Nisutlin river is navigable for small motor boats at least as far as the portage. Cary portage leading to Quiet lake, 4 miles distant, is low, swampy in its central part, and broken by three lakes which shorten the portage by one mile. The river bars for the lower 50 miles by river between Wolf river and Sidney creek are sand bars except those near the confluence of Wolf river. Above Sidney creek they are gravel bars.

Wolf river is a tributary of Nisutlin river, with a volume about one-third to one-half that of the main river above the confluence. It drains a lake of considerable size situated near the continental divide opposite the headwater streams of Liard river. It is reported not to be navigable for small motor boats.

Sidney creek is the largest tributary of Nisutlin river on the west. This stream is referred to by Saint Cyr[1] as Muddy river. It and its tributaries,

[9] Saint Cyr, A.: Exploration of the Country East of Teslin Lake; Dept. of Interior, Ann. Rept. 1899, Appendix No. 20, pt. VI, p. 77.

Evelyn creek and Iron creek, drain a large section of the country southwest of Quiet lake. Several miles above its confluence with Evelyn creek, Sidney creek has a width of about 60 feet, a depth of from 1½ to 4 feet, and flows with moderate velocity. Evelyn creek has about two-thirds the volume of Sidney creek above the confluence of the two.

Quiet lake has a length of 18 miles, a maximum width of 2½ miles, and an elevation of 2,580 feet above sea-level. The southern two-thirds of Quiet lake trends north and south parallel to Nisutlin valley; the northern third, together with another lake, Sandy lake, into which it drains, occupies a narrower, northwesterly trending valley. High mountains, up to 6,445 feet above sea-level, border Quiet lake on the west. A depression continues from the south end of Quiet lake to join Nisutlin valley. This lowland is less than 370 feet above Nisutlin river, the maximum elevation that the portage reaches according to Saint Cyr's[1] survey. Quiet lake may have drained by this lowland to Nisutlin valley in pre-Glacial time.

[1] Saint Cyr, A.: Exploration of the Country East of Teslin Lake; Dept. of Interior, Ann. Rept. 1899, Appendix No. 20, pt. VI, p. 82.

CHAPTER III

GENERAL GEOLOGY

GENERAL STATEMENT

The rocks of the area include both sedimentary and volcanic types intruded by basic and acidic rocks. The oldest group, the Yukon group, consists of a metamorphic complex of schists, greenstone, limestone, argillite, slate, and quartzite. It is at least in part of Palæozoic age, but may be in part Precambrian.

The Yukon group is invaded by large and small bodies of igneous rocks of Mesozoic, possibly in part Tertiary, age. The group of metamorphosed rocks and the invading granitic rocks occupy all the eastern part of the area and extend west nearly to Teslin valley. This valley and the immediately bordering country are mainly underlain by Jurassic sedimentary and volcanic rocks belonging to the Laberge series. With the Laberge series occur sediments of the Triassic Lewes River series and also volcanic rocks younger than the Laberge series. The Mesozoic sediments and volcanic rocks are invaded by bodies of serpentine and of intrusives ranging in composition from quartz diorite to hornblendite. Other intrusive bodies consist of granite and of granodiorite.

Pre-Glacial unconsolidated and partly consolidated gravels, glacial deposits, Recent gravels, and volcanic ash make up the overburden.

Era	Period	Series	Lithological character
Cenozoic	Modern	Recent	Gravel, sand, and volcanic ash
		Pleistocene	Clay, till, silt, sand, and gravel
	Tertiary		Gravel
			Basalt and dacite
Mesozoic or later	Jurassic or later		Granite porphyry and felsite
			Lamprophyre
			Granite and granite-gneiss
			Granodiorite
Mesozoic	Jurassic or later		Quartz diorite, diorite, and hornblendite
			Serpentine
			Andesite and agglomerate
	Jurassic	Laberge series?	Basalt, andesite, agglomerate, and tuff
		Laberge series	Argillite, quartzite, tuff, agglomerate, and andesite
	Triassic	Lewes River series	Limestone and argillite
Palæozoic and Precambrian?		Yukon group	Argillite, slate, marble, limestone, quartzite, quartz-sericite schist, quartz-chlorite schist, hornblende schist, and greenstone

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YUKON GROUP

The rocks of the Yukon group form a belt bordering, on the east, south, and west, a granite batholith extending west from Quiet lake. Small scattered outcrops of the Yukon group, too small to represent on the accompanying map, occur west of Teslin river on the hills around Squanga valley.

The Yukon group within the area consists of interbedded quartzite, argillite, limestone, volcanic rocks, and schistose facies of these various rocks. Dense, green, igneous rocks, probably altered volcanics, are referred to as greenstone where more precise determinations have not been made. The group appears to consist of a lower division of quartz-mica schists, quartzites, and crystalline limestone, a middle division of quartzite, argillite, and crystalline limestone, and an upper division of argillite and greenstone. This is essentially the sequence found by McConnell[1] on Big Salmon river.

Schistose facies of quartzites, argillites, limestone, and greenstone make up the rock sequence on the north side of Boswell valley. The schists are quartz-sericite schist, quartz-biotite schist, argillaceous biotite schist, and quartz-hornblende schist.

A specimen of greenstone from near the granite on the ridge east of Falls creek is a dense, green rock with good cleavage. Under the microscope the rock shows a well-developed schistose structure and consists of 65 per cent to 70 per cent green amphibole in small rods, 20 per cent plagioclase about andesine in composition, 5 to 10 per cent magnetite, and 5 per cent or less of other unidentified minerals. The rock is thought to have been originally volcanic.

Black slates and argillites are of considerable thickness on the lower slopes of the north side of Boswell valley 10 miles above the river mouth. Black slates and argillites outcrop along Slate creek and on the west side of Red mountain. Somewhat similar argillites lie at the contact with the granite batholith on the hills between Sidney and Boswell basins. All these slates and black argillites apparently form one member of considerable thickness trending southeastward across Boswell basin.

A thick section of Yukon group rocks lies between quartz diorite 1½ miles north of the highest peak of the Sawtooth range. The dip is 80 degrees north. It is not known which side is the higher stratigraphically. From north to south the section is estimated as follows:

	Feet
Sericite schist	50
Covered interval	170
Limestone	50
Covered interval	180
Quartz-sericite schist	500
Sheared argillite and slate	340
Quartz-sericite schist	220
Sheared argillite and slate	120
Limestone	100
Quartz-sericite schist	50

[1] McConnell, R. G.: Report on Field Work in Yukon. Exploration in the Yukon; Big Salmon and Nisutlin Rivers and Teslin Lake; Geol. Surv., Canada, Sum. Rept. 1898, pt. A, p. 49.

	Feet
Two beds of limestone 10±feet thick interbedded with quartz-sericite schist	50±
Quartz-sericite schist and quartz-sericite-chlorite (?) schist	400
Limestone	50±
Sericite-chlorite (?) schist	750
Limestone	50±
Sericite schist	380
Limestone, interbedded with green chlorite (?) schist. NOTE. This limestone is buff in colour contrasting with all the preceding which is grey to white. All the limestones are crystalline	920
Total thickness of section	4,380±

At the north end of the Sawtooth range several hundred feet of somewhat schistose white quartzite dips under Tertiary volcanics. A wide area of basic greenstone lies east and south of this quartzite. Beds of marble up to several hundred feet thick outcrop among the greenstones. The structure is confused by intrusion of quartz diorite. Southward from this, in the Sawtooth range east of Swift lake, schistose quartzites predominate.

In the southern continuation of the Sawtooth range, around the heads of 100 Mile, Evelyn, and other creeks, the rocks are quartz-mica schists, white marble, and, possibly, some greenstone. The quartz-mica schist at one locality has a granular texture and well-developed schistosity, with white mica glistening on the cleavage surfaces. Under the microscope it consists of 60 per cent quartz and feldspar, 35 per cent white mica, 5 per cent biotite, and a few pyrite cubes. The feldspar is glassy, showing both twinned and untwinned sections. Because of the close resemblance of the quartz and glassy feldspar only an approximate estimate of each may be given. Possibly 35 to 40 per cent of the rock is quartz and 20 to 25 per cent feldspar.

The rocks north of Sidney creek in the vicinity of Iron creek are silicified argillites, quartz-mica schist, and greenstone.

The mountain north of the lower part of Sidney creek and overlooking Nisutlin valley is made up of greenstone. The greenstone area south of Evelyn creek east of the granite stock is probably a continuation of the greenstone north of Sidney creek. The rock one-quarter mile east of the granite contact is a fine-grained, granular, schistose greenstone with some quartz lenses along the planes of schistosity. The composition is 35 per cent quartz, 55 per cent hornblende, 5 per cent biotite, and 5 per cent of other minerals, possibly epidote and titanite. The hornblende holds numerous inclusions of quartz.

The ridge between Quiet lake and Nisutlin river is made up mostly of greenstone. A small part of the rock at the southenr end of the ridge may be altered greenstone or altered sediment. A specimen taken one-third mile east of a bay 2⅛ miles north of the south end of Quiet lake is a grey, granular, quartz-biotite schist. Under the microscope it is seen to consist of 45 to 50 per cent quartz, 25 per cent biotite, 15 per cent white mica, 1 to 2 per cent garnet, and 5 to 10 per cent of another mineral, possibly colourless epidote.

Outcrops are rare northeast from Quiet lake and east of Sandy lake. A few occur on the steep slopes to the lakes. All outcrops are of black slate and argillite.

The rocks along the west side of the northern third of Quiet lake are quartzite, limestone, black argillite, and slate. A section of part of these rocks west of Quiet lake was measured 3 miles south of the north end of the lake. The strata dip east at about the same angle as the slope of the country and, therefore, dip parallel to the slope. The estimated thicknesses are subject to considerable probable error. From the east or supposed top of the section to the west or bottom the section is as follows:

	Feet
Limestone, bluish grey, crystalline	200
Covered, equivalent thickness	390
Limestone, bluish grey, crystalline with fragmentary fossils	200-920
Argillite	420
Limestone, bluish grey, crystalline	780
Quartzite, white	910
Limestone, bluish grey, crystalline	110
Argillite	240
Total thickness	3,280-4,000

This section is probably stratigraphically underlain by further limestone, argillite, and quartzite that lie to the south. Black argillite outcropping around the lower part of Brown creek and also east of Sandy lake probably belongs above it. The greenstone east of Quiet lake may be still higher in the stratigraphic succession.

White quartzite 1¾ miles west of Quiet lake and 6½ miles south of the north end of the lake is irregularly mottled bluish white and white. Some bands weather somewhat more readily than the rest of the rock. In thin section it consists of 60 to 70 per cent quartz, 30 to 40 per cent colourless pyroxene, apparently diopside, and a minor amount of carbonate. The constituents lack crystal boundaries, but none of the quartz shows any evidence that it was ever in the form of rounded grains. It is thought that possibly this quartzite is a partly replaced dolomitic limestone.

The Yukon group strata bordering the north end of Quiet lake are folded and faulted, but schistosity is not strongly developed. The dip of the sediments is to the northeast away from the granite body to the west. North of Sidney creek the dip is to the south, also away from the granite. West from Iron creek the strata bordering the batholith dip westerly, but where the granite border assumes a north course the dip is northeast towards the batholith. The predominant dip of the sediments along Boswell valley is northeast with a southwesterly dip here and there. A marked schistosity is developed in the strata of Boswell valley. The schistosity dips northeast for the most part at a lower angle than the bedding. The general strike of the rocks of the Yukon group is north 60 degrees west. The structure is, however, complex and the rocks frequently strike in other directions.

The name Yukon group has been widely used in Yukon for metamorphic rocks variously thought to be Precambrian and Palæozoic. Fragmentary fossils of indeterminate nature found east of the north end of

Quiet lake indicate that at least a portion of the rocks here called Yukon group are probably Palæozoic. Both Palæozoic and Precambrian rocks may be present.

LEWES RIVER SERIES

The name Lewes River series was given to a Triassic series occurring in Laberge map-area, interbedded and consisting of argillite, greywacke, and massive limestone up to 3,900 feet thick or more. A comparatively small belt of the Lewes River series occurs at the northwest corner of Teslin-Quiet Lake area. A second occurrence is on a hill south of Squanga lake where limestone believed to belong to this series outcrops. Elsewhere throughout Teslin-Quiet Lake area the Lewes River series is lacking.

The rocks of the series in Teslin area are black argillite and massive, bluish grey, crystalline limestone. Several limestone members, or repetitions of the same member, 100 to 200 feet thick, interbedded with argillite members about 200 feet thick, form the belt of Lewes River series at Sheldon creek. The limestone is less crystalline than the marble of the Yukon group. Fragmentary fossils found at Sheldon creek permit the correlation of these rocks at Teslin area with the Lewes River series in the Laberge district, known to be of Upper Triassic age.

The Lewes River strata at Sheldon creek lie on the steep hill-side below volcanics and argillites assigned to the Laberge series. The contact is not exposed, but a marked angular unconformity is indicated. The relation of the limestone of the Lewes River series to the adjacent serpentines and volcanics at Squanga valley was not ascertained.

LABERGE SERIES

The Laberge series forms a belt outcropping on both sides of Teslin valley from near Teslin lake to near Boswell river. To the east it is limited to the first line of hills along Teslin river, but to the west it extends for many miles.

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. The tuffs are dense rocks in which small feldspar and quartz grains may occasionally be seen. A thin section of massive, fine-grained, grey tuff from the hill southeast of 100 Mile creek examined under the microscope was seen to consist of irregular, embayed fragments of quartz, plagioclase, untwinned feldspar, small volcanic rock fragments, carbonate, chlorite, and a small amount of another mineral, probably epidote. The rock was relatively fresh. Another specimen of tuff from the west side of the hill south of the mouth of 100 Mile creek had a finely granular appearance. In thin section it was seen to be a crystal tuff consisting of irregular fragments of quartz, plagioclase, untwinned feldspar, white mica, and small fragments of volcanic rock the same size as the crystal fragments. Some epidote was

present and carbonate was abundant. The interbeds of tuff range from a fraction of an inch to hundreds of feet in thickness.

On the west side of Teslin valley opposite the mouth of Swift river, argillite attains a thickness in excess of 4,500 feet if no unrecognized repetitions of beds are present.

In the vicinity of Sheldon creek andesitic flows and agglomerates containing fossiliferous limestone boulders lie on the hill-side above the Lewes River series. Argillite outcrops representing several members from 20 to 200 or 300 feet thick lie among the volcanics. The argillites are apparently interbedded with the volcanics and the whole is taken to be Laberge series. The series may reach 3,500 feet or more in thickness here.

Volcanics consisting of tuffs and some flows outcrop with argillite on the hills along the west side of Teslin valley from Sheldon creek to Squanga creek. At some distance west from the river the volcanics exceed the argillites in amount.

Strikes and dips of the rocks of the Laberge series along Teslin valley indicate an anticline following the valley from Teslin lake to north of Mary river, where it passes to the northwest out of the valley to cross Sheldon creek near the forks. If this interpretation of the structure is correct the Laberge series is separated from the Yukon group to the east either by a closely folded syncline or by faults, or by both.

Fossils of Lower and Middle Jurassic (Liassic to Lower Inferior Oolite) age were obtained by Cockfield and Bell[1] from the Laberge series in Whitehorse district. Fossils of Lower Jurassic (Liassic) age were obtained by the writer[2] from the Laberge series in Laberge map-area. The rocks of the series in Teslin area were traced into Whitehorse area and correlated with rocks there called Laberge series. Because of a massive conglomerate member in the middle of the Laberge series in the areas to the west it is thought that the ages of the lower and upper parts of the series may differ considerably. It is not known with which part of the series the rocks of Teslin-Quiet Lake area are to be correlated. It is believed that part of them may be correlatives of the strata immediately above the massive conglomerate of Laberge district.

LABERGE SERIES (?) VOLCANIC ROCKS

Volcanic rocks apparently of the same general age as those interbedded with the Laberge series occur with considerable thickness between 100 Mile landing and Teslin lake. With the volcanic rocks are scattered interbeds of argillite. These assemblages of volcanic rocks contrast with most of the other bodies of volcanic rocks mapped as Laberge series, in that volcanic rocks make up 90 per cent or more of the rocks instead of 60 per cent or less.

The common rocks are green, chloritic andesites, agglomerates, and tuffs. More basic rocks form Streak mountain and another area east of the outlet of Teslin lake.

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[1] Cockfield, W. E., and Bell, A, H.: Whitehorse District, Yukon; Geol. Surv., Canada, Mem. 150, p. 21 (1926).

[2] Lees, E. J.: Geology of the Laberge Area, Yukon; Trans. Roy. Can. Inst., No. 43, vol. XX, pt. 1, pp. 22, 23 (1934).

West of the mouth of 112 Mile creek, northwest of Streak mountain, the rocks include dense, green and mottled green and red, andesitic varieties, pyroclastics, or agglomerates.

The rocks on Streak mountain are basic and occasionally somewhat coarsely crystalline. A specimen from the north side of the mountain is a dark grey, fine-grained rock with large cleavage faces of hornblende that flash in the sunlight, but otherwise the hornblende is not readily distinguished from the rest of the rock. A thin section was seen to consist of pale yellowish green hornblende making up 75 per cent of the rock. Other minerals present are a fine aggregate of epidote, white mica, carbonate, and magnetite or chromite. The hornblende has a sieve texture and may be secondary.

The rock east of Squanga lake is a green volcanic of andesitic appearance, with occasional small feldspar phenocrysts. Some of it is dense andesite or basalt; hornblende phenocrysts are sometimes present and part of it is amygdaloidal.

West of Teslin lake on the side of Hayes mountain the rock consists of green, chloritic andesite and andesite breccia or pyroclastics with angular volcanic fragments somewhat lighter in colour than the matrix. A specimen of fine-grained, green andesite with some small black crystals, when examined in thin section is seen to be highly propylitized. Chlorite and another mineral, apparently fine-grained epidote, mask most of the rock.

Pyritized volcanic rocks form a small outcrop on the east shore of Teslin lake 1½ miles from the outlet. The rocks are probably dacites. A few feldspar phenocrysts are visible. Northeast of this the rock is light greyish green to darker green, bearing hornblende phenocrysts varying from few to abundant. A little argillite is interbedded with the volcanic rocks. A specimen of this rock taken ⅔ mile east of a point 1½ miles south of the outlet of the lake is a grey rock with elongated, shiny, black hornblende phenocrysts 5 mm. in length in an indeterminate, irregularly crystalline, grey groundmass with some iron sulphide. A thin section is seen to consist of hornblende and highly altered feldspar phenocrysts in a considerably altered groundmass. The texture is masked, but may be described as holocrystalline porphyritic. The mineral composition of the rock is 10 to 15 per cent quartz, 25 per cent hornblende, and 60 per cent indeterminate material, mostly feldspar and its alteration products, white mica, zoisite or clinozoisite, carbonate, and fine black products, probably iron oxide.

Two miles east of the outlet of the lake the rock is greyish black with numerous green pyroxene phenocrysts and some carbonate. The rock is seen in thin section to consist of 40 per cent pyroxene phenocrysts. The groundmass is too finely crystalline to permit the minerals to be identified with certainty. A little highly birefringent mineral, possibly talc or carbonate, replaces the phenocrysts. The rock may be a basalt or augitite.

It is not definitely known that all the rocks described here as "Laberge series (?) volcanics" belong with that series. Those of Streak mountain and those east of the outlet of Teslin lake, in particular, may be of different age.

ANDESITES AND AGGLOMERATES

Andesites and agglomerates outcrop around the lower part of Boswell river, west of Rosy lake, and west of Boswell River mouth. They extend northward forming the Seminoff hills of Laberge map-area.

The volcanic rocks along the lower part of Boswell river are moderately fresh, fine-grained andesite, occasionally with some epidote. Some are amygdaloidal, with amygdules of calcite and an unidentified dark green mineral. Plagioclase phenocrysts are present in a fresh, dense green, aphanitic groundmass.

South of Boswell river the volcanic rock is a green, andesitic agglomerate with large, semi-angular fragments of dark green rock of medium-grained, granular texture (crystals 4 mm. long). A thin section of the angular fragments consists of 70 per cent fresh albite showing both polysynthetic albite and pericline twinning, and 30 per cent pale green amphibole, much of which is bladed. The texture is between panallotriomorphic and panidiomorphic. No other rock exactly like these fragments was recognized in the area. Possibly they are fragments from the throat of a volcano.

The volcanics west of the mouth of Boswell river consist of tuff, agglomerate, and volcanic flows. Some of the agglomerate has rounded volcanic pebbles; some is composed of angular fragments of hornblende andesite. The tuff is in part purple and green and contains some pyrite.

The relations of these volcanics to the other rocks of the area were not determined. Similar volcanic rocks extend northward and form Seminoff hills. In the northern part of Seminoff hills[1] in Laberge area, the volcanic rocks apparently unconformably overlie the upturned and eroded Tantalus conglomerate. The age of the Tantalus conglomerate based on some fossil plants is late Jurassic, or more probably Lower Cretaceous. The volcanics, therefore, are not older than late Jurassic and probably are younger. These volcanics are correlated with volcanics variously called Hutshi-Schwatka and Hutshi groups[2] in reports referring to the areas northwest of Teslin-Quiet Lake area.

SERPENTINE

A number of small bodies of almost pure serpentine up to 1½ miles in diameter are scattered throughout the area. The major part of the serpentine forms stocks west of Teslin river. One stock is 5 miles southwest of the mouth of 100 Mile creek, another forms a high, buff-coloured mountain 5 miles north of Streak mountain, a third forms the higher part of Hayes mountain, and three occur on the mountains around Squanga lake. Besides these there are two small stocks in the upper part of Boswell valley and one on the high hills near the head of Sidney creek.

Most of the serpentine is massive and dark green and on the weathered surface varies from light green to buff. Parts of the serpentine are dense;

[1] Lees, E. J.: Geology of the Laberge Area, Yukon; Trans. Roy. Can. Inst., No. 43, vol. XX, pt. 1, pp. 28-29.

[2] Cairnes, D. D.: Preliminary Memoir on the Lewes and Nordenskiöld Rivers Coal District, Yukon Territory; Geol. Surv., Canada, Mem. 5 (1910).

other parts show the remains of crystals, up to 8 mm. long, that have now a waxy yellow colour and preserve a good mineral cleavage. These were probably pyroxene crystals prior to serpentinization. Both varieties occur in the same stocks.

Thin sections of one specimen of green-weathering, dense, greenish black serpentine and one of spotted green serpentine from the mountain 5 miles north of Streak mountain, were examined under the microscope. Both consisted almost entirely of fine-bladed serpentine with dusty black particles of chromite or magnetite.

Irregular dykes 2 or 3 inches wide of coarse pyroxenite, with crystals 15 mm. long and showing good cleavage, cut the serpentine. In thin section under the microscope the dykes are seen to consist entirely of pyroxene.

The contact of the serpentines with other rocks wherever observed is sharp. The presence of large remnants of waxy yellow crystals believed to have been pyroxene before alteration, and the occurrence of the serpentine as bodies rounded in plan, apparently stocks or pipes, indicate that the serpentine bodies are intrusive. They apparently intrude the Yukon group. Stock-like bodies of serpentine occur west of Teslin river among rocks of the Laberge series and volcanic rocks believed to belong to the Laberge series, thus indicating that the serpentine masses intrude these rocks although nowhere were they seen to cut the Laberge series. Their age may be placed as Jurassic or younger.

QUARTZ DIORITES, DIORITES, HORNBLENDITES, AND RELATED ROCKS

Rocks varying from basic granodiorite to hornblendite form irregular stocks in the Sawtooth range from Boswell river to near the outlet of Teslin lake. A few small intrusions of these rocks lie west of Teslin river around Squanga valley.

These rocks are characterized by the development of white mica and clinozoisite or zoisite as alteration products, and are commonly sheared rocks of the composition of quartz diorite. The body of them forming the north side of the Sawtooth range exhibits much variability in composition, and the rocks have an irregular, splotchy appearance due to the presence of altered light and dark minerals with irregular boundaries. The rocks vary from hornblendites to quartz diorites. The rock of the summit of the ridge is a basic granodiorite. It is the most acid variety present and with the exception of the hornblendites is the freshest.

The most abundant facies of this group of intrusives is a sheared quartz diorite. It forms the bulk of the rock on the west side of the Sawtooth range and its continuation southward around the heads of Evelyn, 100 Mile, and 112 Mile creeks. With the sheared rocks there are, here and there, areas of less sheared quartz diorite. The rock occurring around Squanga valley is of the less sheared type.

A specimen of the most basic facies was obtained 2½ miles northwest of the highest peak in the Sawtooth range. It is greenish black, medium grained, and mainly composed of hornblende crystals up to 5 mm. long. Some patches of this rock contain a little light-coloured mineral. A thin section under the microscope shows the rock to consist of 75 per cent green

hornblende, 20 per cent augite, 2 to 3 per cent feldspar (orthoclase and albite), less than 1 per cent greenish brown mica (biotite), a little black ore mineral, and a minor amount of other unidentified mineral.

Diorite outcrops between the andesite and the massive serpentine on Hayes mountain. The rock is dense to medium grained and dark green, the dark constituents being more conspicuous than the light. A thin section under the microscope is seen to consist of pale green amphibole and feldspar with abundant alteration products. The feldspar is plagioclase at least as basic as andesine. A little of the feldspar may be orthoclase. A felt of alteration products, clinozoisite, and carbonate, makes up about 60 per cent of the rock.

A specimen of diorite from a locality 2½ miles north of the highest peak in the Sawtooth range is typical of a light-coloured facies found on the north side of the range. It is spotted green and white, with rods of light green amphibole 3 to 5 mm. long in a white mass composed of areas having outlines of feldspar crystals. A thin section under the microscope shows 25 per cent green-bladed amphibole in a mass of fine-grained clinozoisite or zoisite making up 70 per cent of the rock; about 5 per cent of quartz is present as interstitial material. The bladed amphibole has completely replaced a previous mineral, probably hornblende. Another specimen of this rock shows a different type of metamorphism. The rock consists of a pale emerald green, micaceous mineral (mariposite?) and a white, fine, sugary grained mass. A thin section under the microscope shows the rock to be composed of 25 per cent colourless mica and 75 per cent fine grains of clinozoisite or zoisite.

A specimen of quartz diorite less sheared than the average, obtained at the Moose Hill group of mineral claims 7 miles up 112 Mile creek, may be taken as showing most nearly the original composition of the greater part of the intrusives. It is a grey, medium-grained rock (grains 2 to 3 mm. long) with quartz, white feldspar, and hornblende recognizable. A thin section under the microscope shows it to consist of 15 to 20 per cent quartz, 60 per cent plagioclase about andesine in composition, 15 to 20 per cent hornblende, and 1 to 2 per cent apatite, titanite, and iron ore minerals. The quartz shows strain shadows; the feldspar has largely changed to white mica and clinozoisite or zoisite. The hornblende is relatively fresh except around the edges which have been embayed and altered. A little light-coloured biotite, apparently secondary, and some chlorite are present. Both appear to replace hornblende. A minor amount of a mineral, probably epidote, is also present.

A specimen of the most acid and freshest facies, a basic granodiorite, was obtained from the summit of the Sawtooth range. It is a medium-grained, grey rock (minerals 2 to 4 mm. long). Quartz, feldspar, hornblende, and a little pyrite are recognizable. A thin section examined under the microscope shows it to consist of 15 to 20 per cent quartz, 5 to 10 per cent orthoclase, 50 per cent plagioclase (at least as basic as andesine Ab_{67}), 20 per cent hornblende, 3 to 5 per cent of another mineral, probably pyroxene, and 2 per cent of accessory apatite and iron ore minerals. Some replacement of the hornblende and the supposed pyroxene by secondary hornblende and by chlorite has taken place. The plagioclase has been considerably replaced by white mica and some clinozoisite or zoisite has developed.

The rocks of this group intrude members of the Yukon group. West of Teslin river, on the east side of Hayes mountain and again 10 miles north of Squanga valley, diorite outcrops among the Laberge volcanics and presumably intrudes them. A diorite outcrop, too small to show on the map, intrudes andesite on the west side of Hayes mountain, and east of Squanga lake a body of serpentine appears to lie in diorite. The quartz diorite and related rocks are thus Jurassic or younger.

GRANODIORITE

Three stocks of granodiorite lie west of Teslin river: one extends from mount M'Clintock across Mary river; a second forms a high peak southwest of 100 Mile creek; and the third is on the north side of Streak mountain. A small intrusion outcrops southeast of 112 Mile (Johnson) creek. East of Teslin river poorly exposed bodies of similar rock 3 miles north of Rosy lake are doubtfully correlated with this rock.

The distinguishing characteristics of this rock are: the high percentage of plagioclase; low orthoclase content; the presence of some quartz and generally of both biotite and hornblende. The rock in all the stocks is a fine- to medium-grained, grey, biotite-hornblende granodiorite with the minerals about 2 to 3 mm. long. The amount of biotite varies from equal to, or greater than, that of hornblende to almost zero. The rock shows a little alteration. Two thin sections were examined, essentially alike: one from the stock 2¼ miles west of the mouth of Swift river consists of 5 to 10 per cent quartz, 10 per cent orthoclase or microperthite, 60 per cent plagioclase (about andesine Ab_{64}), 8 per cent hornblende, 12 per cent biotite, 1 to 2 per cent titanite, 1 to 2 per cent magnetite, and 1 per cent apatite and zircon. The rock is fresh, only a minor amount of epidote, and paragonite has developed in a few plagioclase crystals; a little chlorite replaces the biotite. The texture is hypidiomorphic granular.

South of Mary river the argillaceous rocks of the Laberge series take on a silicified appearance adjoining the granodiorite stock. Countless stringers of granodiorite penetrate the metamorphic zone of argillite and greenstone around the granodiorite stock on the north side of Streak mountain. The intrusion of these stocks of granodiorite was thus later than lower Middle Jurassic. The granodiorite stock on mount M'Clintock lies partly in Whitehorse map-area. It was there mapped as Coast Range intrusives by Cockfield and Bell.[1]

GRANITES AND RELATED ROCKS

Biotite granite forms a batholith lying between Teslin river and Quiet lake north of Boswell river and Sidney creek. This batholith has a length of 40 miles and a width of 20 miles. South of this a smaller batholith or stock lies between Teslin and Nisutlin rivers, extending for 22 miles from Sidney valley to near the outlet of Teslin lake. Another stock of this rock outcrops on the northwest side of Hayes mountain, west of Teslin lake. Granite-gneiss, pegmatite, aplite, and, probably, lamprophyre are related to the granite.

[1] Cockfield, W. E., and Bell, A. H.: Whitehorse District, Yukon; Geol. Surv., Canada, Mem. 150, pp. 31, 32, and map (1926).

The distinguishing characteristics of the granite are the universal presence of biotite to the exclusion of primary hornblende or augite, the high percentage of potassic feldspar relative to plagioclase, and the freshness or general lack of metamorphism.

Five thin sections were examined from widely different localities, two from the batholith north of Boswell river, two from the same batholith east of Quiet lake, and one from the stock at Hayes mountain. The average composition of the five specimens is 26 per cent quartz, 32 per cent microcline, 15 per cent orthoclase, 18 per cent plagioclase (oligoclase Ab_{77}), and 7 per cent biotite. A little muscovite is present in some, but is absent in others, and a minor amount of apatite is present in some. A small amount of paragonite is developed in the plagioclase of some specimens. One specimen showed a slight amount of replacement of biotite by hornblende and other specimens showed a slight amount of replacement of the biotite by chlorite. The specimens varied from coarse-grained granite to coarse-grained porphyritic granite, grey in colour with a slight tinge of pink. Phenocrysts of feldspar reached 30 mm. in length, the material around them being a normal, coarse-grained granite. A salmon-pink, coarse-grained porphyritic facies outcrops between the north and middle forks of Boswell river. The feldspar phenocrysts are up to 25 mm. long. A thin section of this was one of the five examined. The only essential difference in this specimen was that the microcline was at the maximum limit of 40 per cent with 10 per cent orthoclase, and the plagioclase was apparently more sodic (about albite-oligoclase Ab_{90}).

The border of the batholith is generally sharply marked. Commonly the medium- to coarse-grained facies come almost to the contact; variations occur at the border, however. A gneissic facies lies along Quiet lake at Crater creek. Dykes are abundant beyond the contact in the schists north of Sidney creek and pegmatitic and aplitic facies form the border north of Boswell river.

Biotite granite-gneiss outcrops at the lower canyon of Crater creek about 1 mile from Quiet lake. Drift surrounds the outcrop along the canyon, so that the transition to the normal granite of the batholith is not revealed. The rock is grey with a decided gneissic texture and breaks best parallel to that texture. Biotite is more abundant than in the normal granite. Some orthoclase forms occasional eye-shaped phenocrysts 7 mm. in length, and the other constituents are from 1 to 3 mm. long. A thin section contained 35 per cent quartz, 30 per cent orthoclase, 20 per cent plagioclase (oligoclase-andesine about Ab_{70}), 13 per cent biotite, and some muscovite, apatite, zircon, and iron oxide. The quartz shows strain shadows. The feldspar and biotite are fresh with an almost negligible development of white mica and kaolin in the feldspar and chlorite replacing biotite.

Muscovite is abundant in the border facies on the north side of Boswell river 10 miles above its mouth. The rock approaches pegmatite in character. Some of the feldspars 25 mm. or more in length enclosed quartz, a little pink garnet is present, and fine-grained, light-coloured apophyses cut the schists nearby at this locality and elsewhere.

A pegmatite body more than 25 feet wide outcrops a mile or more from the granite, among limestone and quartzite of the Yukon group 700 feet from the west shore of Quiet lake, 6½ miles south of the north end of the lake. It contains quartz, feldspar, muscovite, tourmaline, and pink garnet. The minerals reach 50 mm. in length. All the feldspar in the one thin section examined was albite (Ab_{93} or more sodic). A slight kaolinization of the feldspar is the only alteration apparent.

A small body of a fine-grained, pink rock cuts a basic, gneissic border facies of the quartz diorite 5 miles north of Rosy lake. Only pink feldspar and a little hornblende at the contact can be seen with the unaided eye. It is grouped tentatively with the granite.

The granite may be seen intruding the Yukon group along the contact north of Boswell river and on the ridge south of Evelyn creek. West of Teslin lake, on the west side of Hayes mountain, a number of alined outcrops of biotite granite run among the serpentine near the contact of the two. The inference is that the granite cuts the serpentine. Some light-coloured apophyses and some small intrusions of quartz-feldspar-biotite porphyry cut fine-grained green rock believed to be diorite, which is intruded into andesite near the granite stock. The biotite granite becomes fine in grain on the ridge south of Evelyn creek as the quartz diorite is approached. The relative freshness of the rock compared with much of the quartz diorite also indicates that it was intruded later than the quartz diorite. The age of the granite is, therefore, late Jurassic or younger.

LAMPROPHYRE

A number of dark green, dense to fine, granular, lamprophyre dykes cut schists and marble of the Yukon group and quartz diorite between the heads of Evelyn, 112 Mile, and 100 Mile creeks. They are from 100 feet to 1½ miles from the main granite mass. Other lamprophyre dykes cut the Yukon group north of Boswell river.

A specimen of lamprophyre outcropping among schists of the Yukon group between the heads of 112 Mile and Evelyn creeks is a fine, sugary grained rock. Microscopically it is seen to be composed principally of plagioclase and hornblende with a tendency for both constituents to have their own crystal boundaries. The composition is 5 per cent quartz, 60 per cent plagioclase (labradorite about Ab_{45}), 30 per cent hornblende, 1 per cent or less apatite, 2 per cent unidentified mineral, possibly epidote or pyroxene, and 2 per cent magnetite. Some of the hornblende appears to be brown, basaltic hornblende. The rock is tentatively classified as a spessartite.

A lamprophyre dyke 8 feet wide cuts slates on a creek tributary to Boswell river on the north, 10½ miles from Teslin river. It is about equidistant from the diorite stock south of Boswell river and the biotite granite batholith north of the river. The rock is a dense, uniform greenish grey rock. In thin section the principal constituents are seen to be 5 per cent quartz, 50 per cent feldspar, 14 per cent hornblende, 6 per cent pyroxene, 5 per cent magnetite, and 10 per cent carbonate. The feldspars are full of dusty products, either inclusions or alteration products, and could not be

determined definitely but appear to be albite. The hornblende is green with some pleochroic brown material, either basaltic hornblende or biotite partly replaced by hornblende. Some alteration of ferromagnesian constituents to chlorite has taken place. This rock is tentatively classified as a spessartite.

A small, altered, irregular dyke in a fault in slates near the preceding is a greenish grey rock. Under the microscope the rock is seen to now consist of 30 per cent quartz, 60 per cent carbonate, and 10 per cent light green micaceous mineral. In thin section the sections of mica have a width about one-quarter to one-third the length, and contain small needle-like crystals of unidentified mineral as inclusions. The alteration of this rock resembles alteration of some of the diorite of the stock to the south.

The occurrence of the lamprophyre dykes cutting the Yukon group in the vicinity of the granite batholith suggests their affinities as differentiates of the granite, hence their age is Upper Jurassic or younger.

GRANITE PORPHYRY AND FELSITE

Granite porphyry and felsite form small, scattered bodies throughout the area. The largest stock lies west of the mouth of Boswell river. A number of dykes outcrop south of this around Sheldon creek, Little river, and Augusta mountain. Zones of dykes are abundant in upper Boswell basin and on Red mountain.

The rocks are cream-coloured porphyries with small, scattered, quartz and feldspar phenocrysts in a dense, cream-coloured, felsitic groundmass. Occasionally the phenocrysts are scarce or lacking and the rock may then be designated as a felsite. A pale-coloured variety outcrops on Red mountain. It is so white and the feldspar phenocrysts so pale in colour that it resembles the surrounding quartzites. Other specimens on Red mountain have small, weathered, biotite phenocrysts, along with quartz phenocrysts, in the usual cream-coloured, felsitic groundmass.

A specimen of the cream-coloured quartz-feldspar porphyry from a dyke 1 mile north of the 15-mile cabin on Boswell river is typical of these rocks. It has small, scattered phenocrysts of quartz and feldspar 3 mm. long in a dense, cream, felsitic groundmass. A small, thin section of this has none of the scattered phenocrysts in it. It consists of quartz and feldspar. The feldspar, probably orthoclase, is filled with small laths of other feldspar, probably plagioclase, and some white mica.

The common rock of the intrusion west of the mouth of Boswell river is the typical quartz-feldspar porphyry with small quartz and feldspar phenocrysts in a cream-coloured, felsitic groundmass. Some outcrops are of another facies, in which quartz, feldspar, and biotite phenocrysts 2 to 3 mm. long make up 40 to 50 per cent of the rock, and are set in a dense, brown, felsitic groundmass.

The dykes cut the Yukon group in the Boswell basin and the Laberge sediments on the west side of the stock opposite the mouth of Boswell river and in the hills around Sheldon creek, Little river, and Augusta mountain. Their age is thus Jurassic or younger. The proximity of some of

them to the granite batholith in the upper Boswell valley suggests a relation to that body. They may, however, be younger, and thus the youngest intrusives in the area.

BASALT AND DACITE

Red-weathering, chocolate-brown to black basalt and dacite occur in two areas to the north and south of the lower stretch of Boswell river. The rocks are fresher than any of the other volcanics in the area.

The basalts outcropping north of Boswell river are dense, dark chocolate coloured, amygdaloidal, with occasional feldspar phenocrysts of the same colour and 2 to 3 mm. long. The amygdules are a yellow carbonate. The rock weathers red. Basalts outcropping east of the north part of Baker lake are black, dense, hard, and shiny. Some at least contain pyrite and weather red. A thin section of the basalt is seen under the microscope to be a fine-grained rock with 40 per cent elongated laths of plagioclase (andesine or more basic), 15 per cent pyroxene and small granules of pyroxene or olivine, 5 per cent magnetite, and a 40 per cent residuum of dusty glassy matter. No alteration is apparent.

Dacites outcropping south of Boswell river, east of the south end of Baker lake, are dense, purplish to chocolate-brown, with occasional quartz amygdules. They ring when struck with a hammer and are fresh in appearance. A thin section of the dacite three-quarters mile east of the south end of Baker lake is cryptocrystalline, and apparently composed of feldspar and probably quartz. Carbonate is abundant, part of which appeared to be pseudomorphous after a pre-existing mineral, probably hornblende. No hornblende or any other ferromagnesian mineral is present in the one section examined.

The dacite east of the south end of Baker lake contains in its base a few pebbles of granite containing bleached biotite. From this it is inferred that the granite batholith was unroofed before the dacite was outpoured. The rock forms a veneer on the valley side, outcropping over a vertical range of 2,000 feet. Some shearing in the basalt north of Boswell river, without accompanying alteration, is taken to indicate that some structural deformation has taken place since the flows were extruded. These rocks are thus considered to antedate the formation of the present Teslin Valley system. The age is believed to be Tertiary. A correlation with the Carmacks volcanics is probable.

PRE-GLACIAL GRAVELS

Unconsolidated and partly consolidated gravels lie beneath glacial till and gravel along several of the small creeks. On Little Bear creek north of the 5-mile cabin on Boswell river slightly consolidated gravel outcrops are surrounded by soil. The gravel is composed mostly of schistose argillite and occasional water-worn granite pebbles. The pebbles are heavily coated with iron oxide which acts as a cementing material. A small patch of similar gravels cemented to bedrock is exposed by placer workings on Iron creek. Unconsolidated stream gravels with rotted, water-worn granite boulders up to 1 foot in diameter lie below blue glacial till on Iron creek.

Unconsolidated gravels lie below glacial deposits in some of the creek valleys immediately to the north of Teslin-Quiet Lake area. There they are rusty and contain irregular, angular fragments of bedrock, mostly schist, with some rounded boulders of basic igneous rock of local origin, and are devoid of foreign rocks. It could not be said with certainty that no foreign boulders are present in the gravels in question in Teslin-Quiet Lake area, but this is believed to be the case. The gravels contain rotted boulders and some of them show a degree of consolidation not present in the Glacial and Recent deposits that overlie them. For these reasons they are considered pre-Glacial in age.

GLACIAL AND RECENT DEPOSITS

Glacial and Recent deposits are extensive throughout the district. The valleys are filled with morainal, glaciofluvial, glaciolacustrine, and Recent reworked stream deposits. Glacial erratics cover the hills.

The glacial till or boulder clay consists of blue, sticky clay with scattered pebbles.

Glaciofluvial deposits of sand and gravel commonly show bedding and occasionally crossbedding. Some deposits contain thick beds of sand, but mixed sand and gravel is more abundant.

Glaciolacustrine deposits are exposed in flat terraces and represent deposits scores of feet thick. They are light cream to white, thin-bedded silts.

Clay and sand beds filling the lower Nisutlin valley are believed to be lacustrine or glaciolacustrine.

Recent sands and gravels along the rivers and their restricted flood-plains are mainly rewashed glacial deposits.

So far as known all the glacial deposits within the district belong to the latest stage of Pleistocene glaciation.

VOLCANIC ASH

A thin bed of unconsolidated, white, volcanic ash, from 2 inches to 4 inches thick, covers the other deposits. The presence of the ash on some terraces 3½ feet above high water along Teslin river and its absence from nearby terraces lying below the 3½-foot datum indicate that the ash fell at a time when the river level was about 3½ feet higher than at present. The ash is covered by sand and soil of varying thickness, from a fraction of an inch to 2½ feet or more. The layer immediately below the ash is brown, as if vegetation had been killed at the time, or just before, the ash fell.

CHAPTER IV

ECONOMIC GEOLOGY

INTRODUCTION

Teslin-Quiet Lake district is on the whole relatively unprospected ground. Large quartz veins holding lead and silver minerals outcrop in the Boswell basin and east of Rosy and Swift lakes and also at the head of 112 Mile creek. From time to time samples from the district have been reported to yield assays high in silver and gold. Several groups of mineral claims have been staked and some of them prospected by trenching and by one short adit.

Fine gold has been taken from a number of bars on Teslin and Nisutlin rivers. Livingstone and neighbouring creeks immediately to the north of this area have produced $1,000,000 in placer gold. The following creeks in Teslin-Quiet Lake area are gold bearing: Little Bear, Machete, Bull, Falls, Slate, an unnamed creek tributary to the south end of Baker lake, Rosy, Sheldon, 112 Mile, Iron, Sidney, Cottonwood, Crater, Brown, and, possibly, Granite.

All the lode deposits and quartz veins so far found in the district are in the Yukon group or in quartz diorite. All the placer-bearing creeks, with a few exceptions, flow across these same rocks. The best paystreaks in the Livingstone camp [1,2] were in the base of rusty pre-Glacial gravels. The more favourable creeks, therefore, should be those following courses transverse to the direction of movement of ice in the main valleys, because they would be protected by surrounding hills from excessive erosion by the ice-sheet.

The tributaries of Nisutlin river between Sidney creek and Quiet lake and streams entering the west side of Sandy lake and the west side of the north end of Quiet lake although not flowing in the most favoured direction had a certain amount of protection from major ice movements, and have escaped valley glaciation because they head in hills not high enough to have produced valley glaciers. Creeks flowing southwest in the mountains east of the first line of hills along Teslin valley, namely those tributary to Baker, Rosy, and Swift lakes, Swift river, and creeks between 100 Mile and 112 Mile creeks, should also be favourable for the occurrence of placers, but prospecting of them will be difficult due to deep burial by glacial deposits.

LODE DEPOSITS

A number of mineral claims have been staked on the north side of Boswell river 15 miles from its confluence with Teslin river. The claims lie on the nose of a ridge between the north fork of Boswell river and the

[1] Bostock, H. S.: The Mining Industry of Yukon, 1931; Geol. Surv., Canada, Sum. Rept. 1931, pt. A, pp. 1-7.

[2] Lees, E. J.: Geology of the Laberge Area, Yukon; Trans. Roy. Can. Inst., No. 43, vol. XX, pt. 1, p. 7 (1934).

first creek to the west. Steeply dipping quartz veins, up to 10 feet wide, strike in various directions. They lie in a northwest-trending zone and cut schists, quartzite, and limestone of the Yukon group near a quartz porphyry dyke. They are about 1½ miles from the contact of the granite. The work done on the claims consists of a number of open-cuts and the commencement of an adit; no work is being carried on at present. The veins carry silver-bearing galena in a gangue of quartz. A selected sample of pieces of quartz with galena from a vein cutting limestone assayed 94·14 ounces of silver a ton and a trace of gold.

Mineral claims have been staked at various times on the north side of Boswell river at points between 20 and 24 miles from the river mouth, eight having been staked there at recent dates. Quartz veins up to 30 feet wide outcrop in a belt trending north 60 degrees west, which is also the strike of the principal veins. Other veins run in various directions. The belt of veins starts at the granite contact 24 miles up river and runs diagonally away from the granite down stream. The veins cut schists of the Yukon group and the principal ones dip away from the outcrop of the granite. Numerous open-cuts have been made and one adit 120 feet long has been driven. The adit is in biotite schist and cuts 15 feet of quartz at its inner end. The reported objective of the adit, never attained, was to cut the nearby granite contact. Silver-bearing galena, with occasionally a little molybdenite, occurs in the quartz. Three selected samples of quartz with galena assayed, respectively: silver 45·68 ounces a ton, gold none; silver 22·10 ounces a ton, gold a trace; silver 21·58 ounces a ton, gold a trace.

Thirty mineral claims have been staked by Indians on the west side of Red mountain and across the divide between Slate and Red Mountain creeks. The rocks there are schists, quartzite, and limestone of the Yukon group intruded by light-coloured, quartz-feldspar porphyry. A large stock of diorite lies to the west, which is variable in composition and extensively sheared and saussuritized. An emerald-green, micaceous mineral believed to be mariposite has been developed in some of the altered diorite. The writer was shown lumps of galena as large as the hand from a vein in a creek bed, now unexposed.

Quartz veins cut the schists and quartzites of the Yukon group on the west side of the Sawtooth range east of Rosy and Swift lakes. Copper and silver have been reported from this vicinity.

The Moose Hill group of mineral claims is located at the head of 112 Mile creek east of Teslin river, in the southern extension of the Sawtooth range, about twenty-five to thirty mineral claims having been staked. Here quartz veins cut a quartz diorite stock, and some are iron stained. The veins have variable dips, some of them being steep. A pile of samples at the old campsite at the Moose group contain galena with some pyrite in a gangue of quartz.

PLACER DEPOSITS

Little Bear creek is the second tributary on the north side of Boswell river. The whole creek was staked in 1904 and it is reported $3.50 a day could be made working it. Wages paid at Livingstone camp were, how-

ever, $4 a day, and this circumstance drew the miners away from Little Bear. It is reported that bedrock was never attained except at the site of a reef that crosses the channel. Some gold is said to have been obtained in 1932 at the reef, but not elsewhere. The old workings along the lower, narrow or canyon part of the valley were restaked in 1934. The rocks along the canyon are greenstone and schist. The stream in June at moderate water was 5 feet wide and 8 inches deep, with about 7 per cent grade. At the old workings there are piles of sluiced gravel, a pit, and a shaft, now slumped in. The gravels contain rusty quartz float.

Machete creek is the third tributary on the north side of Boswell river, 8½ miles from its mouth. In 1905 a prospector diverted the creek and claimed he reached bedrock and obtained gold. Relatively recent workings consist of a ditch 30 feet long and 3 feet or more deep that cuts partly across a bed in the stream. The overburden is probably from several to 30 feet or more in depth. The stream in the latter part of June is 10 feet wide and 8 inches deep, with a grade of 7 or 8 per cent.

Sheldon creek is a tributary of Teslin river from the southwest. Gold was discovered on the west fork, 9 miles up stream from Teslin river; the workings are best reached by trail from Little river. Seven men working one summer are reported not to have reached bedrock, but to have taken $40 from an area the size of a tent, and since then a number of people have worked there. In 1934, two leases, each 1 mile in length, were staked. The west fork is dammed off from the main channel by glacial gravels and the stream has been forced to cut a new channel across a rock spur. The old buried channel lies to the south of the new one. The workings are above the canyon. Argillite, volcanic flows, and volcanic agglomerate form the bedrock and outcrop at several places along the side of the creek, and glacial gravels form an extensive terrace on the south side of the valley near the lower end of the west fork.

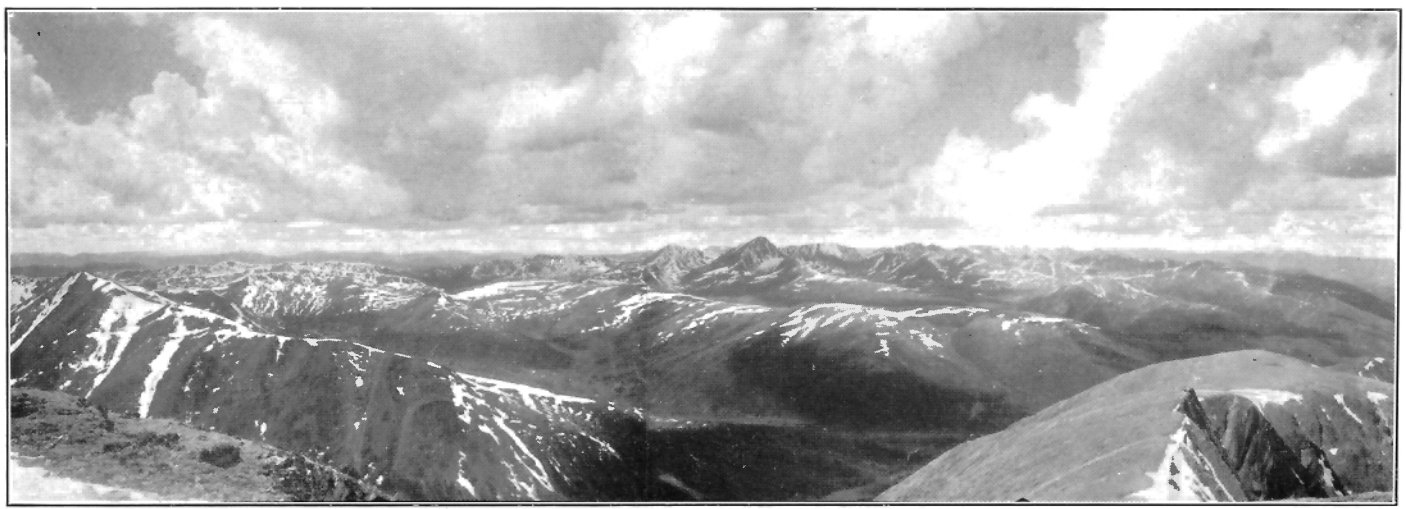
The Iron Creek placer deposits were discovered about 1905 and the creek was staked along its lower 3 miles. About this time the neighbouring tributaries and Sidney creek were also staked. Work was carried on by hand and it is reported that some operators recovered $70 to $80 a month. About 1915 Blick, now of Telegraph Creek, brought in a crew of five men and put in one-half mile of ditch and flume. His workings consist of two cuts or ditches 1½ miles up stream from the present camp. No records of the results are available, and after two years he allowed his claims to lapse. About 1921 Bonebreak and his associates bought all existing claims and commenced operations at the present site with a crew of ten to twelve men. A small monitor, a sawmill, and, later, a caterpillar tractor were brought in, and a ditch and flume 1 mile long were built. After some prospecting one small pit was hydraulicked across the creek from the present by-wash dam; the recovery is unknown. Subsequently, the claims were allowed to lapse. In 1932 the Inca Mining Corporation staked the lower 3 miles and had five men prospecting. They put in an open-cut and several shafts, continuing the work in 1933. In 1934, under the management of L. W. Staples, they brought in a crew of twenty-two men with about 40 tons of equipment. A summer tractor road was built from Nisutlin river, 13 miles distant, using parts of a former winter tractor road. The old flume and ditches were enlarged, three monitors installed,

and, to date, 18,000 cubic yards of gravel have been washed. The values from the washings were mostly obtained from near the present creek. The recovery was not high and at the time of visit the crew had been reduced to four and a drill was being brought in to search for an old channel.

The lower reaches of the creek lie between glacial terraces 250 feet high with rim rock of argillite and schists. Below the lowest workings the creek cuts a canyon through the rock. The workings have been concentrated along the gravels of the present creek. Some booming done from the flume on the south side of the creek, and several exposures above the workings on the north side of the creek, show the unconsolidated deposits to include rotted pre-Glacial gravels at the bottom, overlain by glacial till, with interbeds of glaciofluvial sand and gravel. The glacial till consists of blue clay with scattered pebbles.

Cottonwood creek is a tributary of Nisutlin river immediately south of Quiet lake. The creek valley is narrow and steep walled. L. Sarilla has been working on the creek in 1934 and 1935, but nothing of commercial value is yet reported.

Brown creek is a tributary of Sandy lake in the Big Salmon drainage basin. The creek flows over sheared argillite and other rocks bordering the granite batholith, and where it enters Big Salmon valley it has a small canyon in argillite. A man named Brown, after whom the creek is named, is said to have made several grub stakes working at the head of the canyon. Two placer claims were staked on the creek in 1934.



Looking from ridge between Falls creek and north fork of Boswell river across Boswell valley to the Sawtooth range.

INDEX