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POTENTIAL MINERAL RESOURCES OF YUKON TERRITORY

By

H. S. Bostock

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Illustration

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INTRODUCTION

In considering the mineral potentialities of Yukon Territory, certain factors in its history should be borne in mind. The territory, first entered by prospectors in the 1880s, yielded the finest poorman's gold field in history in the discovery of the Klondike placer creeks in 1896. The great richness of the placers and ease of recovery of their gold led to the sudden development of that district and to the organization of a transportation system connecting it with ocean shipping at Skagway. At the same time, however, the idea became general that only gold could be profitably mined in Yukon, and the lack of interest in the rich silver veins on Galena Hill, which were known by many men for a decade before anyone sampled them, is an instance of its effect. This idea and the lack of any encouraging discovery of lode gold in the Klondike kept the search focused on placer gold, for which the Yukon south of Ogilvie Mountains has been well prospected. The local difficulties of lode prospecting in this northern country added to this narrow outlook and discouraged prospecting. The effective prospecting season is short. The percentage of rock exposure, everywhere small in the Cordillera, is even less in the Yukon, where bedrock is commonly covered by thick moss. Prospecting for lode deposits is largely confined to bedrock exposures, as trenching is hindered by the persistence of frost in the overburden. Except for trapping and some woodcutting, there is no industry within the Yukon by which an independent prospector can earn a grubstake in winter. As a consequence, would-be lode prospectors become primarily trappers or turn to the gradually subsiding placer mining for a living. The war of 1914-18 drew away most of the younger, enterprising Canadians and British, never to return. As the high-grade silver-lead mining of the Mayo district grew it brought some revival of interest in prospecting in the 1920s and did something toward dispelling the "only gold" attitude in the Yukon, but this development was largely due to American enterprise, and throughout the 45 years following the Klondike discovery the main operations were those of British and American capital with limited interests in the territory. Not until the last few years has there been any pressure of Canadian capital to support mining and prospecting in the Yukon. With the decrease in the Klondike gold production at the end of the first decade of the century, transportation facilities, without which there can be no mining, began to decline. A small revival in river transport took place in the 1920s, due to the silver-lead mining, and in the 1930s permanent local roads were built in the Klondike and Mayo mining camps, initially largely by the local companies. With the transfer of the mail service to air transport the main winter trail connecting Dawson and Mayo to Whitehorse was allowed to become impassable. There was no development of a trunk road system between Whitehorse, Mayo, and Dawson, and no complete winter trail or road of any kind connected these points.

These factors resulted in near stagnation of mining in the Yukon, though its climate is the best of any area in the same latitudes in North America except, perhaps, the coastal region of the Gulf of Alaska. The geology of its terrain is favourable, as demonstrated by the numerous widely scattered and varied discoveries made despite the very little prospecting in progress. The main part of Yukon is within a 400-mile radius of Skagway, which is an ocean port offering ease of access for the territory to world commerce throughout the year such as few other parts of Canada can rival. Such factors serve to explain the great mineral potentialities of the Yukon in spite of its small average annual production to date.

GENERAL PHYSIOGRAPHIC AND GEOLOGICAL FEATURES

The main physiographic feature of the Yukon is the broad, basin-like Yukon Plateau, which occupies the central part of the triangular territory. Hyland Plateau, with Liard Plain and Plateau, both partly in British Columbia, in the southeast, and Porcupine Plain and Plateau in the north, comprise two smaller, but similar, basin-like areas in the acute angles of the triangle. These three relatively low-lying areas are separated from each other and bordered by mountains. Yukon Plateau is an elevated area in which scattered mountains and ranges rise above the general surface level. The plateau extends from northern British Columbia, in the southeast, into Alaska in the northwest. Selwyn and Ogilvie Mountains border the plateau on the northeast and north respectively, and Mackenzie Mountains stand behind Selwyn Mountains and extend eastward into Northwest Territories. The Coast Mountains project northwest into the southern part of the plateau, and St. Elias Mountains rise along the southwest border of the plateau on the Alaskan boundary.

The basin-like area to the southeast of Yukon Plateau is a broad wedge of subdued terrain that penetrates from the Interior Plains between the Rocky Mountains and Mackenzie and Selwyn Mountains. It consists of the broad, timbered Liard Plain, roughly centred around Watson Lake, and stretching east to Toobally Lakes; Hyland Plateau, a higher rolling area north of Liard Plain and at the southeast end of Selwyn Mountains; and Liard Plateau, another high rolling area south of South Nahanni River and between Toobally Lakes on the west and Liard River on the east.

In northern Yukon, the low-lying area beyond Ogilvie, Selwyn, and Mackenzie Mountains consists of Porcupine Plateau and Plain. These form a large basin, rimmed on the east by Richardson Mountains, which stand between it and Peel Plateau and Mackenzie Delta, and on the north by the British Mountains along the Arctic coast. The basin opens westward into Alaska and has two other gaps in its periphery, one on the southeast along the fronts of Selwyn and Mackenzie Mountains and the other in the northeast between Richardson and British Mountains.

The main geological units coincide broadly with those of the physiography, but the similarity in topography of the Yukon Plateau and its two satellite basin areas is not duplicated in their geology. Yukon Plateau is a rolling platform of metamorphic rocks largely of Precambrian age. Hollows in the surface of these old rocks contain folded Palaeozoic and Mesozoic sedimentary and volcanic strata, and the whole complex is invaded by large and small bodies of intrusive rocks. Patches of Tertiary sedimentary and volcanic rocks rest on the surface of all these older rocks. The geology of Ogilvie and Selwyn Mountains and Hyland Plateau is somewhat similar, but Palaeozoic rocks predominate and mantle the metamorphic rocks to a greater extent than in Yukon Plateau, and in general intrusive rocks form smaller and more scattered bodies. Much of Liard Plain is drift covered, but it contains Palaeozoic sedimentary rocks overlain in places by basins of Tertiary sedimentary and volcanic rocks. Mackenzie Mountains and Liard Plateau are formed almost entirely of sedimentary rocks. The Coast Mountains have as their core the Coast Range composite batholith of granitic intrusions. This batholith narrows northwestward and continues into Yukon Plateau more than 100 miles beyond the mountains. It is bordered and patched with areas of the metamorphosed, sedimentary and volcanic rocks of the plateau, and is overlain by some Tertiary volcanic rocks. On the southwest, St. Elias Mountains contain some old, metamorphic rocks (Precambrian?) and great thicknesses of Palaeozoic and Mesozoic strata of sedimentary and volcanic origins. All these rocks have been invaded by a great variety of igneous intrusions. Tertiary volcanic and sedimentary rocks cover large areas in some parts of these mountains.

In the north, Porcupine Plateau and Richardson and British Mountains are composed of folded rocks, mainly marine sediments of Mesozoic and Palaeozoic age. In addition, some Precambrian rocks and intrusions outcrop in parts of Porcupine Plateau. Porcupine Plain is underlain mainly by relatively flat-lying Mesozoic marine and continental sedimentary formations on which large patches of Tertiary sedimentary rocks rest.

Yukon Territory is also divisible into two regions distinct from each other in their recent geological history. The southern and eastern parts were largely covered by ice in Pleistocene or Glacial time, and the part lying broadly northwest of Carmacks remained free of glacial ice throughout that epoch and is referred to as 'the unglaciated area'. The glaciated areas are characterized by thick deposits of glacial drift in the lower levels, an irregular topography, and a disrupted drainage marked by lakes, canyons, and rapids. The unglaciated area carries a more even mantle of residual soils; its summits and valleys have more regular profiles; and lakes are few or lacking.

TRANSPORTATION

Transportation throughout the year is a main factor in developing a country, as the Romans understood 2,000 years ago in their exploitation of Gaul and Britain. Yet it long remained an obstacle in the development of Yukon Territory.

Yukon River and its tributaries form a great branching system of waterways connecting railhead at Whitehorse with most parts of Yukon Plateau. But these waterways are only open for the brief summer season, and although they were vital to the Klondike rush and have served the territory during the stagnation that followed they are not sufficient to support further development.

A road system that will be in use throughout all normal seasons is essential. To this end Yukon Plateau and, indeed, the entire territory south of the 65th parallel is well adapted. It is traversed by more numerous and easier routes for roads and railways than other parts of the Canadian Cordillera. Many cross valleys, wind gaps, and low divides form an intricate network whereby well-graded routes through the country can be followed in almost every direction. In addition, the plateau is favoured by natural openings in its bordering mountains leading west and northwest to Alaska, south to the Pacific coast, and southeast by Liard Valley to the Interior Plains.

In the north, however, the basin of Porcupine Plain and Plateau is more isolated. It opens to the west down the valley of Porcupine River into Alaska, to the northeast by a broad gap between British and Richardson Mountains to the Arctic coast, and to the southeast by a corridor between the south end of Richardson Mountains and Mackenzie Mountains to the Interior Plains. It is cut off from the main and most accessible parts of Yukon by the broad barrier of Ogilvie and Selwyn Mountains through which the several passes have elevations as low as 3,500 feet.

Those parts, however, that are near the Arctic coast have an advantage in accessibility, well illustrated in August 1952 when a bulldozer was floated on a barge down Mackenzie River and landed on the sea-shore some miles west of Blow River. From there it was driven inland over the tundra some 50 miles to a prospecting area, where it was used, among other things, to build a landing strip for the air transport of supplies.

At present the effect of the road development of the last few years is very apparent in the Yukon Territory, and indeed this whole northern region of Canada. The Alaska Highway brought a long belt of country both in Yukon Territory and northern British Columbia within reach of motor transport. The encouragement this has given to prospecting and mining is well illustrated by the discovery and development of the asbestos deposit in the Cassiar district of British Columbia and the nickel-copper deposits on Quill Creek near Kluane Lake, both of which are in districts where new handiness to a road has stimulated prospecting.

The main road system into the central parts of the territory has been under construction since 1948, and Whitehorse and Mayo are connected by a well built gravel mining road with ferries over the three main rivers, the Yukon, Pelly, and Stewart. The branch to Dawson is nearing completion, this year, 1953.

The expansion of production from the Mayo mining camp from an annual maximum of between 9,000 and 10,000 tons of concentrates and ore shipped, worth about $2,000,000 when dependent solely on river transportation to about 18,022 tons, valued at more than $8,300,000, for 9 months in 1952, and with the expectancy of greater tonnages, is the direct result of the opening of this road.

Little has been spent on the upkeep of the Canol Road and it has become almost impassable for ordinary motor vehicles. The promise it offers, however, of being readily reopened has proved an encouragement to prospect the areas bordering it. A notable result of this is already apparent. At the end of 1952 the Hudson Bay Mining and Smelting Company reported the presence of low-grade lead-zinc-silver orebody of 9,000,000 tons developed by diamond drilling, near mile 270 from Johnson's Crossing on the Canol Road. Other prospects are reported by various interests, encouraged by the presence of the road to search this remote region.

MODERN EXPLORATION AND MAPPING

In recent years nearly the whole of Yukon Territory has been photographed from the air. Trimetrogon air photographs by the U.S.A.A.F. in 1942 and 1943 were the first available and covered most of the southern part of the territory. This was followed by more complete coverage by the R.C.A.F., also with trimetrogon air photographs but still omitting some parts in the north and southwest of the territory and the better mapped areas in the south. Trimetrogon air photography, however, is not suitable for standard topographical mapping on a scale of about 1 inch to 4 miles with 500-foot contour intervals, or for detailed work in geology or prospecting, and in the last few years most of the territory has been covered by vertical air photography except in the north, in the southeast, and in a few small scattered areas in the south. Control for the plotting of standard topographical maps on the 1 inch to 4 miles scale is also now nearing completion and topographical maps of many new areas are being published.

The trimetrogon air photographs are unrivalled as a means of obtaining quickly a broad idea of the character of any region. The vertical air photography besides supplying the detail for topographical maps serves two purposes: first, as small "work maps" of local areas covered by individual photographs, and second, when assembled into mosaics, for larger "work maps" and particularly to give a picture of the major geological structural features. For prospecting and studying the geology, as well as for topography, all three, the trimetrogons, the verticals, and the mosaics, have their uses.

The air photography of the territory provides a new means of exploring many hitherto unvisited areas, and members of the topographical control surveys have become the initial explorers of many areas and a source of much new general information for the regions they have traversed.

The Geological Survey of Canada has in progress a program comprising: exploration of little known areas; mapping for publication on the scale of 1 inch to 4 miles of the territory, beginning with those areas that are more accessible and developed; and more detailed mapping of selected areas and studies of specific problems.

MINERAL AND FUEL BELTS AND AREAS

Before considering in more detail the several belts and areas, attention may be called to certain broad features of Yukon geology. An irregular belt of old, metamorphosed rocks, partly Precambrian in age, stretches from the northwestern United States through British Columbia and Yukon into central Alaska. In southern and central Yukon it has its greatest width, and the foundation of Yukon Plateau and the bordering mountain areas is formed mainly of these ancient rocks. Mineral wealth is associated with this belt in its more developed areas in the western United States and Canada. In British Columbia, the Sullivan mine at Kimberley, the leading mines of the Cariboo gold field, and many lesser mineral deposits, and in the Yukon most of the mineral discoveries and productive deposits, including the Klonkike gold field and the Mayo silver-lead district, lie in it or near its borders. Indeed, the fact that such a large proportion of the Yukon is underlain by these rocks as compared with other Cordilleran regions is in itself an auspicious augury of its mining possibilities. In addition, the Yukon is favoured by coal measures conveniently distributed in its southern and central parts, and by potential oil reserves in its northern part.

The mineral resources, including the natural fuels, are associated with specific geological areas and belts. Some of these have fairly definite boundaries, based on such features as the Coast Range batholith or the Laberge Mesozoic geosyncline. Others, lying mainly in the less explored parts of Yukon, can be only vaguely outlined, and their delineation here is partly for convenience in description.

Broadly, the belts and areas are divided into two groups, according as to whether they may contain mainly metallic minerals or natural fuels. Their positions are outlined on Figure 1.

MINERAL BELTS AND AREAS

St. Elias Mountains Area

About half of the St. Elias Mountains area is composed of a core of great, ice-bound ranges that rise in precipitous slopes far above the regional snowline and are penetrated by glacier-floored valleys. A few prospectors have explored the outer parts of the glacier valleys, but the inner fastness remains the field of prepared expeditions. It is the outer ranges along the northeast front of these great mountains that are accessible to prospectors and that are referred to here.

Except for the native copper of Kletsan Creek, which was used by the aborigines before the first white man entered the area in 1892, prospecting began in 1903 and brought the discovery of gold on many placer creeks that rise behind the first ridge of mountains along the northeast front. These creeks lie in a belt of relatively mature mountains, and occupy valleys whose floors, lying transverse to the direction of ice movement, were protected from scouring. The advent of the Alaska Highway has permitted the access of heavy machinery for placer operations, and has resulted in larger mining operations on three creeks during the past few years. The highway also aroused fresh interest in lode prospecting. Though a great variety of metallic minerals have been found among the heavy placer concentrates, including those of copper, lead, silver, and platinum, lode prospecting had prior to 1952, only yielded discoveries of copper, which occurs abundantly in the placers in native form. It was found in lode prospects in the White River part of the area, between Donjek River and Kluane Lake, and south of Kathleen Lakes. It is also significant that the Kennicott copper deposit in Alaska lies in the western extension of the area. Float of copper and molybdenum sulphides has been found on Steele Glacier, and sulphide minerals are reported in the mountains south of the glacier. Beds of gypsum outcrop on the northwest side of Slims River near the Alaska Highway. The numerous and varied types of intrusive bodies in the area bear witness to its mineral possibilities.

During the summer of 1952 a deposit of massive sulphides, carrying as much as 8 per cent combined nickel and copper, was found on a west tributary of Quill Creek, 18 miles in a straight line northwesterly from Burwash Landing on Kluane Lake. This discovery of nickel created much excitement and enthusiasm. By the middle of August more than six hundred mineral claims had been staked and recorded around the discovery, and staking spread along the Kluane Ranges, which form the front of St. Elias Mountains, from Slims River to west of White River and several other nickel-bearing sulphide discoveries were made. The original claims were obtained by the Hudson's Bay Mining and Smelting Company, who took full advantage of the transportation facilities afforded by the Alaska Highway. A road about 8 miles long was built from the highway to the deposit and in a few weeks drilling had begun. The company reports that by freeze-up in 1952 shallow drilling had developed 67,000 tons of ore having an average assay value of, copper 1.33 per cent and nickel 1.96 per cent, with some cobalt, gold, platinum, and palladium, giving a gross value of $42 a ton at the current metal prices at that time. The company is continuing its exploration of this property.

Early in 1953 a large mineralized fracture zone carrying nickel was reported in the bank of White River a few miles south of the Alaska Highway and a remarkable wave of intense prospecting took place early in 1953 along the whole front belt of the St. Elias Mountains.

Coast Mountains Belts

Two mineral belts follow the southwest and northeast contacts of the Coast Range batholith, and are distinguishable in the developed areas of British Columbia and southeastern Alaska where they contain many important mines, including among others the Pioneer, Premier, Britannia, Anyox, and Treadwell Alaska. These belts continue into southwestern Yukon, and are shown as the Coast Mountains belts on Figure 1.

The southwestern contact belt in Yukon has yielded no production except some placer gold from a number of creeks, including Fourth of July

Creek, but is known to contain showings of lode gold, copper, tungsten, and molybdenum. Practically no lode prospecting has yet been done on this belt, although in southeastern Alaska it has yielded considerable mineral wealth and similar possibilities can be expected of it in Yukon.

The northeastern contact belt in Yukon has produced $2,711,695 worth of lode copper from the Whitehorse copper belt. In the parts of it that are readily accessible to the White Pass and Yukon railway numerous mineral prospects have been found. These parts are the Whitehorse copper belt, mentioned above, the Wheaton district, and the Windy Arm district. The first is primarily a copper area in which several small copper mines owned by separate companies were successfully operated during the period of 1905 to 1920. Recently, several of these old mines and much drift-covered ground between them have been acquired by a company whose examination has outlined large areas of magnetic anomalies beneath the drift giving reactions similar to those of some of the known orebodies, but drilling encountered no deposits rich enough to mine under existing conditions.

The Wheaton district contains a variety of lode prospects, including some of gold, silver-lead, copper, zinc, and antimony. Several gold and silver-lead properties were prospected in this area, but their value has not been proved. The antimony deposits are of particular interest. They occur along a zone from near Lake Bennett to the northwest side of Wheaton River. In this zone several persistent veins and many small showings have been found. Good mining widths of ore carrying as much as 30 per cent antimony were uncovered, but sulphides of other metals are mixed with those of antimony and prevent the ore from competing with natural ores free of undesirable metals. These deposits are very accessible, and constitute an important antimony reserve for Canada. Between 1908 and 1915 the district was widely prospected but except for temporary revivals of interest in one or other property there has been no effort made in development, although many discoveries appear to deserve more thorough exploration. It is probable that the successful operation of one property in the district would result in the development of several.

A number of gold-silver-lead veins have been discovered in the Windy Arm area near the British Columbia boundary. Considerable work has been done on some of them, but they appear to be judged as marginal deposits in the face of estimated costs of operation.

Where the northeast contact belt crosses the Alaska Highway it has received little attention, but is known to contain copper prospects similar to those of the Whitehorse copper belt. As the Coast Range batholith continues northwest into Yukon Plateau it passes first into an area of nearly continuous drift and thence, beyond Aishihik Lake, into a largely treeless, mountainous region difficult for the individual prospector to explore. Here it remains unprospected though its geological setting affords promise of mineral wealth.

Cassiar Mountains Area

The rocks of the composite batholith of the Omineca and Cassiar Mountains extend northwesterly into southern Yukon from central British Columbia, where a great number and variety of mineral deposits, notably those of the Pinchi Lake mercury mine, the Cassiar asbestos mine, and the old Cassiar placer creeks, are associated with them. Where the area is crossed by the Alaska Highway, silver, gold, lead, zinc, and tungsten prospects have been found in the last few years. The discoveries are scattered along both sides of, and in, the batholithic rocks. Tin has been revealed in assays of tungsten samples from the northeast side of the batholith. Nickel is known to be present in some of the ultrabasic intrusions in adjacent British Columbia but has not been reported here in the Yukon. This area was the first placer mining area in the Yukon, but was never important as such.

Until the Alaska Highway was built this area received no attention from lode prospectors, being remote and inaccessible. The construction of this thoroughfare has greatly facilitated the development of worth-while prospects. The discovery and development of the Cassiar asbestos mine, in the extension of the area south into British Columbia, which came about through the facilities of the road constructed south from the highway to the old placer deposits of McDame Creek, has maintained interest in this area but, though it is being widely prospected, as yet only a little high-grade sacking ore or silver and lead has been shipped from the part of the area in the Yukon.

The rocks of the area, as well as those of the batholith, include sedimentary and metamorphic strata of Precambrian age, and a thick succession of limestone, dolomite, shale, and sandstone, which ranges in age from Lower Cambrian to Permian and Mesozoic. The area is the northern extension of the belt lying southwest of the Rocky Mountain Trench that contains the highly metalliferous Selkirk and Purcell Mountains, and should have similar potentialities.

Pelly Mountains Area

The Pelly Mountains area is a large mountainous tract of almost unexplored country projecting into the Yukon Plateau. Except along its borders close to the main streams of Teslin, Nisutlin, Pelly, Frances, and Liard Rivers, it has been difficult to reach and hard to penetrate. With the building of the Canol Road across it and the use of suitable aircraft, much of it is now relatively accessible for prospecting and could be made so for development. The area contains granitic bodies in prolongation of the axis of the Cassiar batholith, and also basic and ultrabasic rocks, all intruding a huge folded section of strata including metamorphic rocks of Precambrian age and Palaeozoic and Mesozoic strata.

In 1898, the rich gold placers of the Livingstone Camp - production more than $1,000,000 - were discovered on the west border of Pelly Mountains, and since then many small placer creeks have been discovered in its most accessible part between Teslin River and Quiet Lake, and, indeed, gold has been found on many rivers and creeks around this mountain area. The direction of Pleistocene ice movement shows that fine gold of Cassiar Bar on Yukon (Lewes) River came from the vicinity of Livingstone Creek. A similar association is apparent between the bar gold of Stewart and McQuesten Rivers and the placer creeks of the Mayo district. There, however, though bar gold occurs on Pelly and Lapie Rivers on the north border of this area, the rich source creeks apparently remain to be discovered.

Lode deposits containing copper and gold have been discovered on the Teslin slope, and large veins of barite outcrop near the Canol Road on the northeast border of Pelly Mountains. Discoveries of lead and zinc, and high temperature skarn zones are reported on the Glenlyon Range at the northwest end of the area.

Dawson Range Area

A relatively well-defined mineral area along Dawson Range has been prospected to some extent where it is most accessible and has produced small amounts of placer gold and tungsten, and lode gold, silver, and copper. Up to 1931, except for the small copper production, it was known only for its few small, scattered placer deposits, but in that year a gold-bearing sulphide-magnetite deposit was discovered by a prospector while trapping on Freegold Mountain. Lode prospects of gold, silver-lead, lead-zinc, copper, and antimony were soon found in the neighbourhood of this discovery. Among them, the Laforma property was acquired by a succession of companies and prospected. It proved to have a persistent vein with some good ore shoots, from which high-grade pockets were mined, yielding several thousand ounces of gold and silver. The property was closed in 1940 through disagreement between the operators and the owners, but since then some development work has been done in it from time to time.

Sporadic lode prospecting spread from the original area, and 15 miles south of the Laforma led to the discovery of the Brown-McDade gold property. Development showed it to be a low grade but large deposit that would require extensive exploration to prove its value, and it has remained inactive since November 1947. However, work on the property stimulated prospecting in the neighbourhood, and resulted in a wealth of discoveries, including several veins similar to, and within a few miles of the Brown-McDade, and several other lode gold, silver, and lead prospects in the surrounding country. These recent discoveries and those around Freegold Mountain constitute the prospects in the southeast and most accessible end of the Dawson Range.

Beyond Freegold Mountain, the area stretches northwest for 100 miles, and distribution of the mineral discoveries shows a close relationship to accessibility from Yukon River. Some $30,000 or more in gold and a few thousand pounds of tungsten have been recovered from the placer creeks, notably Canadian Creek. Lode prospecting has revealed a small silver-lead vein and some tungsten. Trappers have brought in specimens of vein matter carrying gold, silver, lead, and fluorspar from scattered localities in the area.

Klondike Area

The Klondike area includes the Klondike placer mining district and a wide belt of similar terrain around it. It occupies a large part of the unglaciated country south of Ogilvie Mountains, and has produced more than $225,000,000 in gold, as well as a large quantity of silver as a by-product of gold refining. The richer gold placers are being steadily depleted, but improvements in mining methods and exploration and the increase in the value of gold have from time to time prolonged their life. The same factors in recent years have extended large-scale operations to creeks outside the immediate Klondike, and several dredges and other operations dependent on mechanical equipment have been established. Mining operations, however, in the Klondike itself and close to Dawson have a great advantage in the supply of hydro-electric power generated from North Klondike River. Small amounts of other metals, such as mercury, lead, tin, and platinum, occur in the gold placer deposits of this area; but no placer prospecting except for gold has been attempted, and it is not improbable that some creeks poor or lacking in gold in this unglaciated area may contain concentrations of other valuable heavy minerals.

Several lode gold prospects are known in the Klondike area, particularly in the Klondike placer field itself, but none as yet proved economic, though the geology resembles that of the Cariboo district of

British Columbia where lode gold production has successfully followed placer mining. Silver-lead and antimony veins of good grade have been found in several places; mercury has been found in the gold placers and in small veins at the head of Sixtymile River; and a little asbestos is associated with serpentine bodies north of Fort Selkirk. It is probable that further prospecting in this area may be expected to result in discoveries of lode gold and one or more other metals or minerals.

Pelly Plateau Area

The Pelly Plateau area was entered by white men more than 100 years ago, and has been traversed by five parties of the Geological Survey of Canada, including the first, by G. M. Dawson, in 1887. In spite of the fact that all these exploring parties discovered gold-bearing quartz veins, other metalliferous deposits, and coal, few prospectors have concentrated their work within this area, and no prospects of sufficient merit to attract mining interest were found until 1953 when base metal prospects of interest were reported about 25 miles northwest of Ross River Post. No feature of its geology, however, invites a pessimistic attitude towards this area. Indeed, its rocks and their structure and relationships are favourable, and seem more promising than those of some areas that have received more attention. On the other hand, it must be admitted that, prior at least to the building of the Canol Road, the area was relatively remote. Most of it, too, was intensely glaciated, so that no gold placers of consequence have been discovered in it, and much of the area is covered by drift. Access, except by the Canol Road, is by small boat for at least 200 miles up Pelly River from Fort Selkirk, a trip requiring much time by the prospector, who, faced by the short season, is either forced to spend the winter trapping in the area or to leave before freeze-up after only a short season's work. It contains, however, many scattered lakes suitable for aircraft landings. The Canol Road now traverses the middle of the area, and has been kept serviceable by private interests for trucks and vehicles with four-wheel drives for some distance beyond Ross River Post, where it reaches Pelly River.

This permits ready access to a large part of the area, especially if canoes are available for travel on the streams.

Mayo Area

Mayo area has produced silver, lead, gold, zinc, cadmium, and tungsten to the value of more than $47,000,000 at the end of 1952. This has come mainly from the silver-lead veins of Galena and Keno Hills, but includes more than $2,000,000 in placer gold and about $10,000 in placer tungsten. Lode deposits containing zinc, gold, antimony copper, and tin as their principal metals have also been found in the area, and, in addition, veins containing clear quartz crystals. Further, mercury, tin, bismuth, monazite, barite, and hematite occur in the placers, and many silver-lead veins carry masses of manganiferous siderite in their gangue. This siderite commonly contains about 12 per cent manganese. In 1940 it was estimated that the silver-lead mining had revealed several hundred thousand tons of this material in Keno Hill.

The lode production has been won from high-grade silver-lead veins for which little underground exploration was done until recently, the life of the camp being maintained through the continued discovery of veins at the surface or new pockets of ore underground rather than through efforts to develop reserves or explore the possibilities of deposits. In the past few years, however, planned exploration has yielded spectacular results in the discovery of orebodies and reserves, which have necessitated mining and milling on a larger scale.

Though silver-lead mining at Galena and Keno Hills has persisted almost continuously since 1912 it has never shown such promise for an extended life and expansion as at present.

Placer mining in the Mayo area began a year or so later than that in the Klondike, and though several productive creeks were found their pay areas were not comparable in size and general richness with the main creeks of that district, and the costs of operation in this area are somewhat higher. However, placer mining on a small scale has persisted, and, as in the Klondike area, it expanded in the period lasting for a few years before 1942, benefiting particularly from the introduction of oil-powered mechanical equipment. Such equipment served to revive placer mining on Haggart Creek and Dublin Gulch before World War II, and since 1942 on Clear Creek, where a diesel-powered dredge, with many years of reserve ground, is in operation, and has made Clear Creek the chief source of placer gold in the Mayo area. Other creeks, worked locally by individual miners, have substantial areas of probable low-grade placer gravels awaiting similar treatment.

In Mayo area, placer and lode deposits are grouped around or close to intrusive stocks of granodiorite that lie to the west of the region deeply scoured by glaciation. These stocks are alined in a direction a little south of east in two parallel belts across the area. They continue into the Selwyn Mountains area where glaciation was more intense and where, in consequence, no workable gold placers have been found and as a result little exploration has been attempted. In the Beaver River section, which lies 70 miles north of Mayo, partly in the Mayo area and partly in the Selwyn Mountains area, high-grade lead veins, carrying less silver than those on Galena and Keno Hills, have been prospected, and a few hundred tons of lead ore from them has been mined and brought out by tractors and sleighs to Mayo for shipment. This section is the exception to the rule of 'no placer gold, no prospecting', perhaps due to the fact that the first veins discovered were particularly well exposed.

Cassiterite, a tin mineral, occurs in the gold placers, and has also been discovered in small veins at Dublin Gulch. Tin has also been revealed, spectroscopically, as a constituent of the granodiorite from that locality. Its distribution in the Mayo area suggests that it can be expected to occur with intrusions to the eastward in the Selwyn Mountains area, and leads to the belief that workable lode tin deposits will be found associated with one or other of these stocks.

Mayo area contains a wide variety of mineral deposits and promises great mineral wealth for the future, but, until the last few years, development was handicapped by the long, uncertain, single-season transportation system between Mayo and Whitehorse and the consequent costs held the value of marginal ore at a high level and discouraged the exploration of all but the obviously rich deposits. Now, however, two fundamental steps have been taken to alleviate this difficulty. The mining road for all-season traffic connecting Mayo with Carmacks and Whitehorse has been completed and a hydro-electric power plant of 3,500 horsepower has been brought into operation for Mayo and the mines in the camp. These two projects are doing much to place the whole commerce of the area on a firmer basis and to facilitate the development of new mines; other developments, too, such as the installation of electrically powered dredges on one or other of the larger placer creeks, are now possible.

Selwyn Mountains Area

The Selwyn Mountains area includes Hyland Plateau, which joins the south end of these mountains. This great area, more than 500 miles long, has received little attention in the past and is one of the large relatively virgin belts of prospecting country left in northwest Canada. What little is known of it indicates that it is a terrain of mountains composed largely of thick, folded and faulted, sedimentary rocks of Palaeozoic age, but including some of Precambrian and Mesozoic ages with some areas of volcanic rocks. Numerous intrusions, most commonly granodiorite or quartz diorite but including also varieties of more alkaline and basic composition, are distributed throughout its length. These intrusions are characteristically small scattered stocks, bosses, sills, and dykes. Only in the south part, east of Frances Lake, do the intrusions approach batholithic proportions. The area is divided into two parts, Hyland Plateau and Logan Mountains in the south, Hess Mountains and Wernecke Mountains in the north. These three large groups of ranges, Logan, Hess, and Wernecke Mountains, are the major divisions of the Selwyn Mountains.

In the south the geology of Hyland Plateau appears similar to that of Logan Mountains, so these two parts will be described together. The plateau is relatively accessible, being close to the Alaska Highway, but it is largely covered by drift. It and Logan Mountains, including the parts in the Northwest Territories, comprise an area of about 25,000 square miles, and had never been traversed by a geologist until 1953. G. M. Dawson skirted its west border in 1887, and named the high, rugged peaks east of Frances Lake after Sir William Logan. In 1911, J. Keele travelled around the north end of Logan Mountains and a few trappers, hunters, alpine climbers, prospectors, and mining geologists have visited parts of them. In the last 2 or 3 years survey parties preparing control for topographical maps have penetrated them, and in 1953, E. F. Roots explored a broad belt across them from Watson Lake to the Redstone River divide.

Both mountains and plateau are composed of strata of sedimentary origin, including both metamorphic and normal types, ranging from Precambrian through the Palaeozoic in age. The strata are intruded by many large and small stocks of a variety of compositions, but mainly granitic. Weathered sulphide mineralization is reported to form rusty "haloes" around the contacts of some stocks, and in 1953 a discovery of lead and zinc was staked in one of these "haloes" in the Northwest Territories between the head of Flat River and Brintnell Lake. For many years placer gold has been known in streams along the divide between Pelly, Frances, Finlayson, Hyland, Coal, Rock, and Beaver Rivers in Yukon Territory and Flat and Caribou Rivers and other tributaries of South Nahanni River in Northwest Territories. During the last two decades this knowledge has attracted prospectors to the area south of the 62nd parallel and has resulted in the discovery of deposits carrying lead and copper. Because of the relative accessibility of this southern section of the Selwyn Mountains area for prospecting by reason of the Alaska Highway and the facilities of the Watson Lake airport, during the last 4 or 5 years some companies have been exploring showings in it and some lead-zinc discoveries are reported to have been made, including one of 1,000,000 tons of developed ore 40 miles northeast of Watson Lake near Quartz Lake about 10 miles east of Hyland River.

Northwest of the Logan Mountains, Hess and Wernecke Mountains form the northwestern division of Selwyn Mountains area. Throughout, the division is composed of a mass of ranges separated into groups by a network of large valleys.

As a whole this division has always been difficult to penetrate, particularly in the central and eastern parts although the southeastern part is now relatively accessible by the Canol Road, when this road is serviceable. The western border can be reached by ascending the main streams of Macmillan and Stewart Rivers, and Wind River in the north has long been known as a route of travel, though not an easy one. The division lies mainly in headwater areas and within it the main streams as well as their tributaries are unnavigable, being torrential and small, with canyons and rapids.

In the southeast where Hess River, a major branch of Stewart River and approximately equal to it in size, spreads its branches across the division its dangerous rapids and canyons have long discouraged its use for prospecting and exploration.

The better known parts of the division lie in Wernecke Mountains in the north where the streams are more navigable. Here, Stewart and Beaver Rivers on the south, Wind River on the north, and the passes between them have been used since 1897, when a party of men on their way to the Klondike ascended Peel River, wintered at the mouth of Wind River, and thence crossed to the Stewart. They reported some gold in the region and this with later discoveries and the proximity of the Mayo mining camp has led to prospecting in the Wernecke Mountains from time to time.

The advent of aeroplanes has become an important factor in reaching the remote parts of this division, but not to the extent it has in many other regions, as the lakes are few and small. In recent years it has been found that horses can be used in summer in many parts south of 64 degrees latitude and in some valleys north of this but the lack of trails and the long distances in and out curtail their use.

Besides being covered by air photography and field control for topographical maps, much of this division of the Selwyn Mountains has now been traversed by geological explorations. In the first decade of the century, R. G. McConnell, J. Keele, and C. Camsell carried out a number of explorations along Ross, Macmillan, Stewart, and Wind Rivers by canoe. In 1924 and 1925 W. E. Cockfield mapped part of Beaver River using horses. E. D. Kindle, working from the Canol Road in 1944 and 1945, penetrated the southeastern edge of the division. In 1952 J. O. Wheeler, using horses and supplied at intervals by aeroplane, traversed through the interior of the division in a great loop from Kathleen Lake, across Rackla, Bonnet Plume, and Snake Rivers, southward across the heads of Stewart and Rogue Rivers and thence westward to Macmillan River through much of the gap between the earlier explorations.

The great mass of the division is composed of rocks of sedimentary origin ranging in ages from Precambrian through Palaeozoic to Mesozoic. These rocks are folded, faulted, and invaded by many scattered individuals or clusters of igneous intrusions. The intrusions are characteristically small bodies, commonly less than 2 miles wide and 4 miles long, the largest among them being stocks 8 to 10 miles in their greatest dimension. They vary in composition and include among them, diorite, quartz diorite, syenite, and granite. A notable feature is that several of them are surrounded by a "halo" of rusty weathered rock particularly conspicuous from the air. In addition, volcanic rocks, probably of Mesozoic age, overlie the sedimentary rocks in places and are also intruded by the igneous rocks.

The main areas of Precambrian strata outcrop on the upper reaches of Rackla River and to the northward across Bonnet Plume River. Eastward and southward other areas of late Precambrian or early Palaeozoic strata also occur, but elsewhere the great bulk of the rocks of these mountains are of Palaeozoic age with Mesozoic rocks covering areas on the southwest. Most of the intrusions are scattered southwest of a line from Bonnet Plume River to Keele Peak.

As a whole, the geology of the division is regarded as promising for prospecting, and the areas around the intrusions with particular favour.

To date, the northwest part of the area has received most attention, and discoveries of iron, copper, gold, silver, lead, zinc, Iceland spar, and quartz have been reported. During the last two summers, 1952 and 1953, there has been considerable, though scattered, prospecting in the southern part of the area around Macmillan, Hess, and Rogue Rivers, and some encouraging discoveries of gold and tungsten have been made.

Fragments of hematite iron formation form a large part of the heavy concentrates in the placer creeks throughout the Mayo mining district. They have also been found to be abundant on Upper Stewart River and many of its northern tributaries and in the drainage of Wind, Bonnet Plume, and Snake Rivers. These fragments range in size from boulders 2 by 2 by 3 feet down to sand grains, pieces 2 to 6 inches long being common. Normally their surfaces are much water worn and many have flat, faceted surfaces with rounded edges suggesting ventrifacts. Many exhibit sedimentary bedding and most are heavy enough to be readily recovered in the sluice boxes and judged to contain 40 per cent or more of iron. Nearly all the large pieces are siliceous, which enables them to resist erosion. The sedimentary bedding and grain size commonly show distinctly on their well smoothed surfaces and many too are traversed by veinlets of jasper. Some appear to be of nearly pure, dense hematite. A few are of softer, porous, but equally pure, hematite and occur as small rounded pebbles. Many pieces are identical with some of the hematite ores of the Lake Superior region.

Beds of low-grade hematite were found in place by D. D. Cairnes of the Geological Survey of Canada in the Tindir group, believed to be of Late Precambrian age, along the International Boundary. Also an extensive hematite deposit is reported on Hart River. Both these localities lie to the northwestward of Mayo in the Ogilvie Mountains. An abundance of hematite float has been reported on Bear River, an east tributary of Wind River, by several geologists and prospectors. In 1952 J. O. Wheeler, in the exploration referred to above, searched for the hematite in place at the head of Rackla River without success, but found hematitic quartzite 3 miles east of Pinguicula Lake on Hematite Creek, where a total of 12 to 14 inches of hematitic quartzite is distributed through a 700-foot section, in bands 1 inch to 2 or 3 inches thick. This material was found to contain about 30 per cent iron and was not found either in place or as float along the strike to eastward. Wheeler did not explore to the westward of Pinguicula Lake in the direction of Bear River. He found no more hematite in all his long traverse through the mountains southeast and south to Hess River west of Keele Peak. Keele reports the presence of low-grade hematite ore on Keele River in the Mackenzie Mountains about 70 miles east of the Northwest Territories boundary but none has been found any nearer in this direction. There have been reports of hematite being found in the Logan Mountains on Hyland River but a degree of uncertainty is associated with this report.

The widespread prospecting and exploration of the last few years throughout the Yukon has brought no discovery of iron ore. The likelihood of the existence of a belt or scattered areas of iron formation containing commercial orebodies that appeared earlier to have considerable possibilities, because of the widespread though fragmentary indications, has somewhat diminished. However, no hematite beds have been reported that could supply the larger boulders of hematite float found in the creeks of the Mayo district, and possibility of finding commercial ore remains. The region of their source is now narrowed to that extending westward from Bonnet Plume, Bear, and Rackla Rivers. From there if iron formation is present, it might recur farther northwest on Hart River and in the Ogilvie Mountains towards the International Boundary.

Ogilvie Mountains Area

Despite its general proximity to the Klondike, the Ogilvie Mountains area has been little prospected or explored until recently. The southwest part of the area is a mass of closely spaced ranges largely composed of Palaeozoic and Late Precambrian sedimentary rocks among which there are several small intrusive, granitic stocks. To the northeast, starting near the Peel River divide, broad valleys interrupt the compactness of the mountains. These valleys have long, open, tundra or thinly wooded slopes that rise abruptly along their borders to steep ridges enclosing the ranges. The ridges are composed of tough strata, reported to be largely limestone, and reveal the structure to a remarkable degree. The alinement of their summits trace many long, narrow anticlines and a few, of shorter, more elliptical plan, display generally more similarity to Appalachian structures than to any seen in other parts of the Canadian Cordillera.

In the southwest part near the granitic stocks lode discoveries containing, gold, silver, lead, and antimony are known, and trappers have reported small gold placer deposits and gold-bearing quartz veins on the north side of the divide. The little that is known of the north parts of the area suggests that their main resources may be non-metallics.

No natural route traverses the area. Only a few small lakes have so far been found and, although horses were used successfully by parties surveying for topographical control, travel is nowhere easy.

Northern Area

The northern of the smaller basin-like areas, referred to at the beginning of this report, north of Ogilvie, Selwyn, and Mackenzie Mountains, is one of the least known areas of Yukon Territory. It comprises an isolated unit, more arctic in climate, more difficult to travel in, and distinct in many physiographic and geological characteristics from the main part of the territory to the south. It is occupied mainly by Palaeozoic, Mesozoic, and Tertiary strata: in consequence, its resources are mainly non-metallic and the greater part of it is dealt with later under 'Fuel Belts and Areas'.

Along the west side of this northern area, however, near the International Boundary, older rocks, mainly Palaeozoic but including some probably of Late Precambrian age, are predominant, and, in addition, north of Porcupine River granitic intrusions occur in Old Crow Range and British Mountains, in the Arctic Plateau, and some may be present in Richardson Mountains. These western and northern parts of the area, then, are potential sources of metalliferous deposits. South of Porcupine River, the northward extension of the iron formation referred to in the Ogilvie Mountains area is a possibility, and north of the river the presence of intrusions indicates, in addition, the probable occurrence of deposits of non-ferrous metals.

In this respect the presence of placer gold has been known for many years along Firth River and some neighbouring streams flowing north from the British Mountains. In the last few years prospecting in the Arctic Plateau has revealed a small granitic stock and dykes near the head of Blow River. Close to the stock some placer ground carrying values in gold and tungsten has been discovered as well as some veins carrying pyrite, arsenopyrite, and wolframite. Coal seams have also been found about 10 miles to the northwest. The ground is deeply frozen almost from the surface, but it was not glaciated and in places the granite has been deeply weathered and crumbles when thawed. Buildings, oil fuel, etc., have been flown and some equipment was carried there by the bulldozer brought from Aklavik, mentioned in an earlier section. This prospecting and exploration illustrates how modern equipment is making accessible areas that have long seemed too remote for development.

A few dykes are reported in Richardson Mountains. On the west side of Mackenzie Delta, near Mount Goodenough in Northwest Territories, a small intrusion carrying copper sulphide is also reported. This occurrence suggests that other intrusions may be present in the broad, unexplored, northern part of these mountains within Yukon Territory.

FUEL BELTS AND AREAS

St. Elias Belt

A belt of ten or more detached basins of Tertiary sedimentary rocks containing lignite deposits follows an irregular valley-like feature, the Duke Depression, parallel with and behind the front ranges of the St. Elias Mountains.

These basins have not been mapped, and only two or three of them have been visited by geologists. As many as thirty seams, mostly thin but including a few 3 to 14 feet thick, are known in one of them, and seams several feet thick have been reported in two others. It is believed that most of these basins contain seams of workable thickness. Where the lignite has been sampled it has been found to be low in ash.

In addition, a belt of late Mesozoic strata forms part of the front ranges between Jarvis and Tatshenshini Rivers. These rocks include numerous thin coal seams, the greatest thickness recorded being 7 inches. There is a possibility that better seams may be revealed in the basal beds of these strata by more thorough prospecting.

Laberge Mesozoic Area

A large geosyncline of Mesozoic strata extends northwestward into the platform of metamorphic rocks of the Yukon Plateau from near the British Columbia boundary, and its upper part contains coal measures. A series of basins of these coal measures has been roughly mapped along the southwest and northeast flanks of this geosyncline. The upwarped central part of the structure is largely composed of the Mesozoic strata underlying the coal measures. The principal coal seams are of Lower Cretaceous age, but some are of Jurassic age. The Cretaceous coal has been mined for many years at Carmacks, where it was formerly convenient to Yukon River steamboats and is now adjacent to the Mayo road. This coal is of bituminous and semi-bituminous rank. Only this one basin has been examined with any interest, and it appears to be one of the smaller ones. The coal in it is non-coking. For thirteen of these Mesozoic coal basins, estimates totalling 231,160,000 tons of possible and probable coal in seams more than 3 feet thick are given in the report of the Royal Commission on Coal[1]. These coal areas are well placed in the more accessible

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[1] MacKay, B. R.: Coal Reserves of Canada; Reprint of Chapter and Appendix A of Report of Royal Commission on Coal, 1946 (1947).

central part of southern Yukon.

Tintina Valley Belt

Tintina Valley is a great, trench-like valley traversing much of southern Yukon from Pelly River near Ross River Post northwesterly to pass a few miles north of Dawson and thence into Alaska along Yukon River Valley. The northwest 100 miles or more of this valley in Yukon Territory is floored by Tertiary sedimentary rocks containing seams of lignite. This long, trough-like area of coal measures constitutes a great reserve of lignite in a relatively accessible part of Yukon. The report of the Royal Commission on Coal estimates 112,000,000 tons of probable and possible lignite for one-tenth of its conservatively estimated area. The lignite has been mined in three localities and found to be of good grade.

It seems probable that with more geological exploration and mapping other, though smaller, basins of Tertiary lignite-bearing sediments will be found farther southeast along Tintina Valley. Coal float has, indeed, been reported in the upper part of the Pelly River drainage.

Liard Plain Area

Liard Plain is one of the outstanding broad hollows in the western mountains of Canada. It is largely drift covered, and though it has been examined by the Geological Survey along the Alaska Highway and Liard and Frances Rivers, the geology of its broad expanses is little known. In places along the highway and rivers Tertiary sediments with lignite seams have been found. The Royal Commission on Coal gives those in Yukon Territory an area of 5 square miles and a total of 3,730,000 tons of probable and possible mineable coal, but it would not be difficult to envisage, within the wide expanses of Liard Plain in Yukon Territory, 100 square miles or more of these lignite-bearing measures.

Liard Plateau Area

Liard Plateau is underlain by much the same geological formations as those of the Rocky Mountain Foothills, and similar resources of coal and oil may yet be found in it.

Northern Coal and Oil Areas

Little is known of Yukon Territory north of the Ogilvie Mountains. However, much of this arctic terrain is characterized by a few, large, relatively simple features, and, consequently, it is assumed here that information gained on a part of one of these features is generally applicable to the whole feature.

The coal and oil potentialities are treated separately. For coal, there appear to be three large Mesozoic areas and four smaller Tertiary areas; the latter may overlie parts of Mesozoic areas.

The coal areas are as follows:

- Mesozoic coal areas
  - Peel Plateau area
  - Porcupine River area
  - Arctic Coast area
- Tertiary coal areas
  - Bonnet Plume area
  - Old Crow area
  - Bell River area
  - Old Crow Plain area

Mesozoic Coal Areas

Peel Plateau Area. Continental Cretaceous sediments including seams of lignite outcrop in the banks of the lower part of Peel River in Yukon Territory. These rocks are believed to be the surface formation of Peel Plateau on each side of the river over an area, in the territory, of more than 1,200 square miles, so that a large reserve of this coal is possible.

Porcupine River Area. In the Porcupine Plain the same continental Cretaceous beds as those of Peel River and the Arctic coast occur in places along Porcupine River from Rock River on the east to near Old Crow village in the west. The plain includes about 8,000 square miles in which areas of these strata may occur near the surface, but as underlying, older strata and overlying Tertiary beds are present in places along the river it is probable that the occurrence of the Cretaceous coal measures is restricted to partly covered synclinal basins and will only be accessible for mining where they are not deeply covered by Tertiary beds. Even with these limitations a large reserve could still be present, but no outcrop of coal has yet been discovered and so little is known of the area that any conclusions must be highly speculative.

Arctic Coast Area. Continental Cretaceous sediments resembling those of Peel River underlie the Arctic coast, and probably Herschel Island, of Yukon Territory for a distance of more than 100 miles. They extend inland at least 20 miles, and are believed to outcrop in synclines to the south in the broad gap of the Arctic Plateau between Richardson and British Mountains, accounting for the coal reported in an earlier section at the head of Blow River. Lignite has been mined from these beds at Moose River, close to the northwest tip of the Mackenzie Delta, and a few miles west of the Yukon-Northwest Territories boundary, and outcrops of lignite have been found on Babbage River 50 miles to the west. From these facts it is apparent that an important reserve of coal may lie in this area.

Tertiary Coal Areas

Bonnet Plume Area. A basin of Tertiary sediments outcrops on the lower reaches of Bonnet Plume and Wind Rivers. It contains many seams of lignite, including one 40 feet and others 8 feet thick. The area of these strata is approximately 400 square miles, so that a large reserve of coal may be present.

Old Crow Area. Two basins of Tertiary strata overlie Cretaceous formations along Porcupine River on each side of the village of Old Crow.

These strata are probably part of the same group as the Tertiary coal measures of the Bonnet Plume area, and, though in their few exposures along Porcupine River no coal outcrops, it is likely to be present.

Bell River Area. This is a broad hollow of about 400 square miles, and no outcrops are recorded along the rivers in it. Its surface resembles those of the areas of Tertiary rocks of the Old Crow area, and it is reasonable to suppose that it is underlain by the same strata.

Old Crow Plain Area. North of a ridge of hills that extend eastward from the Old Crow Range on the north side of Porcupine and Driftwood Rivers, Old Crow River drains the broad flat of Old Crow Plain. This plain is part of the larger Porcupine Plain, and has an area of about 1,500 square miles. No examination has been made of it. Its surface, nearly half of which is covered by ponds and small lakes, is known to be composed of unconsolidated deposits of gravel and silt covered by a thick layer of peaty vegetable material. It is probable that in this area, too, Tertiary strata containing coal measures are present and lie beneath the superficial deposits.

Petroleum in Northern Yukon Territory

The region in Yukon Territory north of Ogilvie, Selwyn, and Mackenzie Mountains was given little attention in the search for oil during the period of the Canol project in 1942 and 1943, chiefly due to remoteness from the Canol pipeline and the general idea that mountain structures prevailed. As a result, only those parts of the region east of Richardson Mountains adjoining the Mackenzie River area and along the Arctic coast have been referred to in publications as having oil possibilities.

The region lies at the northeastern terminus of the North America Cordillera where the northwesterly trending structures of western Canada meet the northeasterly trend of the mountain ranges of Alaska. This circumstance is reflected in the structure and physiography of the region. The dense mass of mountains to the south, with their closely spaced structures, give place here to more open and subdued topography, with broad hollows bordered by low ranges within a terrain commonly regarded as largely mountainous. In this region, some mountain ranges, Richardson Mountains and the easterly parts of British Mountains and Keele Range, may contain local oil reservoirs. As they appear to have more open structures than the ranges to the south, their rocks are believed to be mainly marine sediments of Mesozoic and Palaeozoic ages, and intrusions are relatively few or lacking. However, the possibility is remote, and it is the belts of plateaux and intermontane basins and plains, where the structures are more open and the sedimentary sections are believed to be thicker, that are considered to hold practical possibilities for oil reserves.

The first evidence of oil in the region was reported by C. Camsell, who described bitumen veins and petroliferous strata along Peel River below the mouth of Wind River. Examinations were made in the vicinity of this discovery during the Canol explorations. The occurrences lie in a structural zone that diverges from Mackenzie Mountains on the southeast and curves northwest and then north into Richardson Mountains. In it, erosion has exposed Cambrian strata along the main structure, so that this particular locality is probably not a prospective oil reserve.

To the northeast, however, between Peel River and Richardson Mountains, there is a broad unexplored area in Peel Plateau within Yukon Territory, 40 miles wide and 80 miles long in its extreme dimensions. The marine Cretaceous and Devonian strata that lie beneath the continental Cretaceous coal measures outcrop along Peel River and are probably continuous throughout the plateau area, which with its flat to gently undulating surface suggests open structures with oil possibilities.

In the north, the coastal belt in front of British and Richardson Mountains is the eastward end of the Point Barrow area in Alaska where the presence of oil has been established. Though the belt is narrow in Yukon, it contains marine Mesozoic strata at the surface in places and is generally regarded as having oil possibilities.

From the coast, the Arctic Plateau opens southward through a gap 30 miles wide between British and Richardson Mountains, and to the west and southeast forms a border between these ranges and the Porcupine Plain. Bitumen veins have been found in this gap, on the divide between Blow and Babbage Rivers to the north and Old Crow River to the south, but their occurrence has not been investigated. The surface formations are believed to be the same as those along the coast to the north, and air photographs show many cuestas and mesas that exhibit broad, undulating structures characteristic of many oil fields. The presence of the granitic stock and dykes near the head of Blow River in this general area, mentioned in an earlier section, is a discouraging factor with respect to oil possibilities.

To the southwest of the Arctic Plateau and west of Richardson Mountains, the Porcupine Plain, 180 miles long and 60 miles wide, forms the outstanding intermontane basin of the region. The bitumen veins on the Arctic divide and those on Peel River, near the two extremities of this plain, suggest the continuity of petroliferous strata throughout its length, and, particularly in the southern and eastern parts most remote from intrusions, indicate its possibilities as an area of potential oil reserves.

Published accounts of geological explorations reveal that only one route has been followed across the Porcupine Plain. Around the borders of the plain, the Richardson Mountains, the Arctic Plateau, and the Porcupine Plateau rise gradually from the plain and contain subdued areas where open structures suggest the possible occurrence of local, potential oil reservoirs. Porcupine Plain, however, warrants more attention, but as it affords few exposures, its underlying rocks are best judged by those of the surrounding upland areas. On the west, along the 141st Meridian in the Keele Range, Precambrian (?) and Lower Palaeozoic strata are capped by Cretaceous beds, which cover large areas to the southwest. To the northwest, in the Old Crow Range, older strata, including perhaps Precambrian rocks, are invaded by a large intrusion that extends to within a few miles of Old Crow village at the west edge of the plain. On all other sides, except on the northwest and north, where the relation is uncertain, the topography exposes thick sections, believed to be of Mesozoic and Palaeozoic sediments, partly of marine origin, dipping beneath the plain with outward facing cuestas.

Porcupine Plain may be described in greater detail under its several physiographic subdivisions. The Bell basin is in a central position where Bell and Eagle Rivers join and flow into the Porcupine. The Eagle Plain, the largest subdivision, lies to the south and southwest. To the northwest, opposite the northeast end of Keele Range, Porcupine River flows north through a narrow, undulating 'waist' in the Porcupine Plain. Beyond this, Driftwood and Porcupine Rivers occupy a depression extending westerly and bordered on the north by low hills, on the far side of which lies the broad flat of Old Crow Plain.

The outcrops along Bell and Porcupine Rivers exhibit a thick section of Mesozoic, mainly marine strata, including some Cretaceous continental beds, overlain, near Old Crow village, by synclines of continental Tertiary beds and underlain by Palaeozoic marine strata, the last exposed in a broad anticline along Porcupine River some way below its junction with Bell River. The surfaces of Bell basin and Old Crow Plain give little clue to their underlying structures, but suggest basins of Tertiary beds similar to those along Porcupine River, mantled by younger unconsolidated deposits and underlain by the same Mesozoic and Palaeozoic strata.

Eagle Plain has the largest area of all the subdivisions of the Porcupine Plain. It is believed to be underlain by the same Mesozoic and Palaeozoic formations that contain petroliferous beds on Peel River to the southeast. Its drainage pattern, plotted from air photographs, suggests gently undulating structures that may form oil reservoirs.

In conclusion, the potentialities for oil in northern Yukon can only be appraised from meagre information, but this indicates some possibilities of oil reservoirs. Eagle Plain, occupying an area of about 5,000 square miles, and Peel Plateau east of Richardson Mountains are regarded with the most favour, but the border areas on the east, northeast, and south of Porcupine Plain as a whole also have possibilities.

Concessions for prospecting for oil, granted in the southern part of the Eagle Plain and in Peel Plateau, are being explored this year (1953) and the information gained will enable a much more confident appraisal of all the resources of this region.