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TERRITORY of ALASKA
DEPARTMENT of MINES

REPORT on the PLACER DEPOSITS of the UPPER KOBUK GOLDFIELDS, 1931

by

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I N T R O D U C T I O N

The gold placer area herein considered lies north of the Kobuk River, on streams flowing through or from the Cosmos Hills, approximately between longitudes 156°W. and 158°W., and latitudes 66°N. and 67°30'N., or about 1400 square miles.

The general characteristics of the country are: first, the broad, gently rolling lowland valley of the Kobuk River; second; rising abruptly to the north of the Kobuk lowland, the rugged highland known as the Cosmos Hills, culminating in peaks between four and five thousand feet high. This highland is cut by low valleys and passes into isolated groups of mountains. The highest peaks are mostly those nearest to the Kobuk lowland. Third, a broad intermontane lowland of very little more elevation than the Kobuk lowland, lying between the Cosmos Hills and the Baird Mountains.

The area was first explored in 1884 by Lieut. G. M. Stoney and by Lieut. J. C. Cantwell (on separate expeditions). In 1901, W. C. Mendenhall made the first geological examination of the Kobuk River and incidentally of the region herein considered. His results were published in U.S.G.S. Professional Paper No. 10. In 1910, Philip S. Smith made a much more complete examination for the U. S. Geological Survey. The results of Smith's

expedition were published in U.S.G.S.Bulletin 480, pages 271-305, and more completely in U.S.G.S.Bulletin 536.

On the present examination the writer was alone with the exception of an Eskimo packer and guide. He left Fairbanks by airplane on August 22, 1931, arriving at the airplane field at Dahl Creek on the evening of the same day. August 23rd was spent in an examination of lower Dahl Creek. On August 24, he left with an Eskimo guide for California Creek. On August 25, Lynx Creek, Upper Canyon Creek and California Creek were examined and roughly mapped. On August 27, an examination was made of upper Dahl Creek, upper Ruby Creek, Riley Creek, upper Ryan Creek, and the asbestos prospects on Asbestos Mountain, returning to headquarters on lower Dahl Creek that same night. On August 28, the outfit was backpacked from Dahl Creek to Long Beach on the Kobuk River, where a boat was secured and everything transported 12 miles down the river to Shungnak Village. On August 29 the outfit was backpacked across country to the camp of the Alaska-Kobuk Mines, just below the canyon on Shungnak River. The time from August 30 to September 13 was spent in examining and roughly mapping the Cosmos Hills with their attendant streams and valleys, from Woodchopper Creek to Wesley Creek, besides the adjacent Kobuk River lowland on the right limit of the Kobuk River. On September 14, the writer left Shungnak Village on the R. F. Ferguson diesel scow down river for the Haralan coal mine.

Every assistance possible was rendered by the miners and

prospectors in the district. The writer wishes to express his appreciation of their many courtesies.

GEOGRAPHY

DRAINAGE

All the drainage of the area ultimately flows into Kobuk River. The drainage of the south face of the Cosmos Hills is directly tributary to the Kobuk. With the exception of Ambler, Shungnak and Kogoluktuk Rivers, all these southward-flowing streams are small. The main streams, such as Woodchopper, Cosmos and Wesley Creeks head in very low passes occupied by lakes.

The drainage from the northern face of the Cosmos Hills flows northward into the aforementioned intermontane lowland, ultimately joining Ambler, Shungnak or Kogoluktuk Rivers. The Shungnak and Kogoluktuk Rivers cross the intermontane lowland in a southwest direction, and, ignoring the very low divides between all three rivers, break through the Cosmos Hills in narrow canyons and rapids. Altogether this drainage north of the Cosmos Hills presents some very peculiar features which possibly can be tentatively accounted for by the effects of severe glaciation combined with great changes in base level.

RELIEF

The Kobuk River lowland is from 300 to 500 feet above sea level and is a region of low, rolling, fairly well drained gravel hills rising in the vicinity of Riley Camp and Shungnak Village to about 300 feet above the river. Near Riley Camp several well-marked river channels cut through the hills at different levels.

Numerous lakes, some with gravel beaches, are scattered throughout the lowland. South of the Kobuk River, the lowland appears more swampy although the same rolling hills continue to the Selawik or Shekluksbuk Mountains. At Shungnak Village, the Kobuk lowland from the Cosmos Hills on the north to the Shekluksbuk Hills on the south, is about 12 miles wide.

North of the Kobuk lowland, the Cosmos Hills rise abruptly to 3000 and 4000 feet in elevation. The range shows a fairly even and steeply truncated frontage to the south, but on the northern side is very uneven, running out into long spurs and ridges. The Cosmos Hills, as mentioned before, are cut into isolated groups of mountains by steep-walled, flat-bottomed valleys, some of which are occupied by only minor streams in no way commensurate with the size of the valleys.

North of the Cosmos Hills is another lowland bordered on the north by the abruptly rising Baird Mountains. This intermontane lowland has more relief than the Kobuk lowland. It merges with the Kobuk lowland in a broad pass at the mouth of Ambler River and continues on westward at least as far as Redstone River. The eastern end is probably near Beaver Creek. Very little information could be secured on the intermontane lowland east of Kogoluktuk River. However, a large lake is said to occur in its eastern end. The larger streams arising in the Baird Mountains flow across the intermontane lowland in a southwesterly direction and, excepting Ambler River, cut through the Cosmos Hills in narrow canyons. The divides between the Kogoluktuk, Shungnak and Ambler Rivers in the intermontane lowland are said

to be so low and so gradually sloping as to be almost imperceptible when crossing from one river system to another. Looking down from the height of the Cosmos Hills, the divides appear as part of a distinctly marked river valley lying between two highlands.

North of the intermontane lowland the Baird Mountains rise abruptly to about four thousand feet above sea level from a base truncated to an even line parallel to the longer axis of the lowland. From a distance the Baird Mountains appear to have remarkably concordant summits. Their mass is deeply grooved by the flat-bottomed fairly wide valleys of the main streams flowing from them. Very little is known about the Baird Mountains or the upper reaches of the rivers rising in them. Few prospectors or whitemen have ever penetrated into them and the natives seem to have lost all knowledge of what they are like.

GLACIATION AND NIVATION

At present, so far as seen or known, there are no glaciers in or adjacent to the area of the Upper Kobuk Goldfields. The three large rivers flowing through the area may head in small, unknown glaciers far back in the Baird Mountains. However, during Pleistocene times the region was extensively glaciated.

Nivation is undoubtedly a great factor in producing the steep-walled effect of many of the smaller stream valleys which could not in the past ages have held glaciers. However, nivation results were seen in surprisingly few places considering the latitude of the region. It may possibly be that the light snow-

fall does not allow sufficiently large drifts to form. Also the large amount of surface, frost-riven material lying on all steep, higher slopes and ready to slide by the action of snow water or rain into any hole, may mask, after melting, the plucked-out depressions left by snow banks. On the lower and more gradual slopes marked solifluction may have the same effect.

E C O N O M I C S

POPULATION

At no time has the Upper Kobuk Goldfields supported over 50 whitemen. At the present time there are 12 whites and probably as many natives engaged in regular mining activities. There are also 3 whitemen prospecting on various creeks in the area. Besides the above, there are about 5 other whites engaged in occupations other than mining or prospecting in the district, and possibly 60 natives scattered up and down the upper Kobuk River. These natives make excellent workmen and constitute a small potential labor supply for the district.

TRAVEL AND TRANSPORTATION

A diesel-engined freight scow makes several trips a season from Kotzebue at the entrance to Hotham Inlet to the small trading village of Long Beach (Kobuk). Several other small gasoline-driven boats owned by miners, natives or trading companies, make irregular freighting trips in the summer from Kotzebue to Long Beach. The average charge for freight in large lots is, as nearly as can be ascertained, from $15 to $25 a ton from Kotzebue to Shungnak or Long Beach. Passageway can be arranged on any

of the above boats, fares being a matter of individual negotiation.

There is a very good airplane landing field at Dahl Creek about 4 miles from Long Beach. As this landing field is quite far from any accomodations, it is best, in times of low water, to land airplanes on the bar across Kobuk River from the Village. Airplane fare from Fairbanks to Long Beach is about $200, and from Kotzebue to Long Beach about $75.

CLIMATE

The climate of the upper Kobuk region is distinctly sub-arctic. Temperature records have been kept for many years by one of the miners on Dahl Creek. Although these records are not official and have not been made use of by the Weather Bureau, yet they serve as an indication of temperature range. The climate is more nearly like that of the Yukon Valley than that of the Bering Sea or Arctic Coast. Temperatures as low as -60°F. have been noted, while most of the summers are warm enough to grow luxuriant gardens of the hardier vegetables. High wind storms in winter are of rather infrequent occurrence. The snowfall averages from 2 to 4 feet. The summer seasons are short, averaging for mining by present methods, from 110 to 140 days.

VEGETATION

The Cosmos Hills seem to be entirely unwooded. However, all the larger stream valleys in the hills support a thin growth of spruce, none of which grows over 18 inches in diameter at the butt, nor over 40 feet high. In the Kobuk lowland, spruce timber is confined to fringes along the rivers and some of the main streams, with occasional groves and patches along some of the morainal hills.

At the southern foot of the Cosmos Hills facing the Kobuk lowland, is a heavy growth of small birch and quaking aspen. Beautiful small groves of birch are also scattered on the tops and sides of the rolling hills throughout the Kobuk lowland. So far as seen the intermontane lowland and Baird Mountains are entirely devoid of timber. Except on the highest rocky mountain peaks, wherever there is no timber, the ground is covered with a luxuriant growth of moss, grass and lichens.

ANIMAL LIFE

Caribou and sheep have been exterminated from the Cosmos Hills and adjacent lowlands many years ago, although they may still exist in reduced numbers in the Baird Mountains. A few black and grizzly bears may still survive on the less frequented creeks and river bottoms. Practically the only perennial game within reach of the miners are ptarmigan, and show-shoe and Arctic hares, all of which vary greatly from year to year in their abundance. Water fowl are plentiful on the rivers in summer.

Of the furbearers there is a small and diminishing number of land otter, fox, lynx, mink and marten. A few beaver occur at the headwaters of Kobuk River. Parka squirrels, and the large blue Kobuk whistling marmots, known as "siksikpuk", were not seen, and have probably been locally exterminated by the natives.

Kobuk River and its tributaries support fish in great numbers and variety. These range from the great white fish called by the natives "shee", through salmon, salmon trout, char, ling, and river herring, down to the ever-present pike, pickerel and

grayling.

A constant supply of fresh meat may be bought at all times and at a very reasonable price from the Eskimos owning the numerous reindeer herds which roam all over the Kobuk country.

Mosquitoes, horseflies, gnats and midges are a torment to man and beast alike from early June until the middle of September.

G E O L O G Y

The rocks of the Cosmos Hills are both sedimentary and intrusive in origin. Besides these some of the greenstone beds may represent altered effusive basaltic flows.

The sedimentary and greenstone beds are stated by Philip S. Smith in U.S.G.S.Bulletin 546, to belong to the so-called undifferentiated Paleozoic metamorphic schists and limestones".

The intrusives consist of a light-colored granitic rock, much sheared in places and megascopically resembling an ordinary biotite granite.

The greenstones interbedded with the metamorphic schists range from a greenstone schist to greenstone, serpentine and nephrite. They may in part, as said before, represent much altered basic flows and intrusions.

STRUCTURE

The structural relationship of the rocks in the Cosmos Hills is enormously complex. It would take detailed mapping combined with correlations with other fields to work out the interrelations. The dominant strike appears to be east and west with the beds dipping vertically or very steeply to the south. In the canyon

of Shungnak River, the contact between the schists, slates, conglomerates and greenstones (and therefore probably the original bedding planes of the sedimentary rocks) is an undulating line. The strike of the contacts (bedding planes) varies from being parallel to the schistosity or cleavage to an angle of 30° to the schistosity. The dip of the bedding planes is much steeper than the schistosity. The schistosity dips at an angle of 60° to the southwest. The Cosmos Hills, themselves, with the two adjacent lowlands, seem to be one of a series of parallel anticlinoria composing the broad general anticlinal uplift of the Brooks or Arctic Range. Drainage lines, where not modified by glaciation, are controlled by this east-west fold structure.

SEDIMENTARY ROCKS

The sedimentary rocks of the region consist of schists, slates and metamorphic conglomerate and limestone.

At the mouth of the canyon on Shungnak River, the bedrock consists of a blocky, dark-colored slate or phyllite, with thin bands of what appears, megascopically, to be a fine grained reddish sandstone. Many small flakes of mica are noticeable in a hand specimen. These may or may not be an original constituent of the rock, though megascopically all the flakes appear to have a definite orientation and therefore probably to have been secondarily developed. From its appearance, this rock seems much younger than the schists, slates and metamorphosed conglomerate just north of it and may possibly belong to the much later cretaceous or early tertiary rocks outcropping south of Kobuk River. The contact with the rocks farther north was obscured.

North of the above slates and phyllites, about 1/4 mile from the mouth of the canyon, the bedrock of Shungnak River is a light-colored, coarse-grained metamorphic conglomerate. This conglomerate becomes dark-colored, finer grained and more schistose towards the north. The width of outcrop is about 1/8 mile. Above the conglomerate is a very fine-grained, thinly laminated slate. This slate apparently grades into a pink-colored schistose rock, then back to fine-grained, light-colored slate. The total width of the schist and slate outcrop is about 1/8 mile.

North of the above slate is a greenstone dike about 300 feet wide, then slate and schist for about 1/2 mile, then greenstone outcropping again.

On Bismark Mountain, west of Shungnak Canyon, the first rock encountered on the south slope up to the first peak, is fine-grained slate grading into a fine-grained metamorphosed conglomerate. On the second or north peak, is a sandstone or conglomerate, metamorphosed to such an extent that in parts of a single hand specimen, it has become a mica schist. To the north of the last conglomerate is a broad outcropping of greenstone, in places altered to serpentine.

On Shungnak Mountain, east of Shungnak canyon, the first rock encountered is slate. North of the slate and composing the summit of the mountain, is fairly coarse metamorphosed conglomerate. Succeeding each other to the north from the conglomerate are: first, pinkish schist; second, slate; third, greenstone; fourth, slate and phyllite; fifth, greenstone schist; sixth, slate; seventh, greenstone; eighth, limestone (on Aurora Mountain). Across Cosmos

Creek on Cosmos Mountain, slate, greenstone and limestone were recognized from a distance in the order named towards the north. The limestone appears to be a capping on Aurora Mountain and on the northern end of Cosmos Mountain.

The northern end of Inerevuk Mountain is capped with limestone showing a distinct contact with the greenstone. The mountain on the right limit at the head of Dahl Creek, is capped with limestone showing a distinct contact (probably non-conformity) with the underlying schist.

On Dahl Creek the succession of rocks composing the bedrock from south to north is as follows: first, blocky, dark-colored slate grading into carbonaceous schist; second, coarse, metamorphic conglomerate outcropping in a belt about 1/8 mile wide about 1/2 mile above (north of) the mouth of the canyon; third, carbonaceous and quartzite schist as far as Stockley Creek; fourth, greenstone and serpentine as far as Contact Creek; fifth, carbonaceous schist over the top of the Riley Creek divide; sixth, a fine-grained black slate composing the bedrock on Riley Creek.

The rock section from California Creek north across Kit Creek and upper Lynx Creek is as follows: first, on the left limit of California Creek, quartzite schist and metamorphosed conglomerate; second, in bedrock of creek, greenstone schist; third, on top of divide, greenstone; fourth, greenstone schist; fifth, fine-grained carbonaceous slate as far as the middle of Kit Creek; sixth, soft micaceous schist on lower Kit Creek and upper Lynx Creek; Also float was found resembling in every way the pinkish schist and metamorphosed conglomerate found on Bismark Mountain

and in Shungnak Canyon. All these rocks are stratigraphically correlated by the U.S.G.S. in Bulletin 536, with rocks of similar nature in other parts of Alaska of paleozoic and pre-paleozoic (precambrian) age. The limestone appears to be a capping on some of the mountains and not to be interbedded with the schists and other rocks.

IGNEOUS ROCKS

On lower Lynx Creek, about 1/2 mile below the mouth of Kit Creek, occurs a gneissic rock composed of quartz, feldspar and mica. Farther west in the valley of Kogoluktuk River, float from the same intrusion did not show the gneissic structure but appeared to be a true muscovite-biotite granite. The extent of this granitic outcrop was not ascertained but it is said to extend over into Glacier Creek across Kogoluktuk River. Many large subangular boulders of this granite appear in the gravel of Dahl Creek below the canyon.

Greenstone outcrops in two places on Shungnak River, in one place on Cosmos Creek, on Dahl Creek and on California Creek. This greenstone is, for the most part at least, undoubtedly metamorphosed basic igeous rock.

Boulders of a basic igneous rock, apparently a pyroxenite, are found in the gravels of Shungnak River, on upper Riley Creek and occasionally on Dahl Creek. These must have been brought by glacial action from the Baird Mountains. Their occurrence will be discussed later.

UNCONSOLIDATED DEPOSITS

The Kobuk lowland and the intermontane lowland are both filled to an unknown depth with moraines and outwash material.

There glaciated

Likewise the valleys of Shungnak and Kogoluktuk Rivers, and Cosmos and Wesley Creeks, have been filled with extensive glacial deposits. On the other creeks in the Cosmos Hills, the creek wash appears to be normal, ranging from 3 to 10 feet in depth.

No evidence in Cosmos & Wesley Creeks

The outwash and morainal material has been little effected in general by subsequent erosion. Kobuk River has cut a trench from 80 to 100 feet deep into the glacial deposits. At Shungnak village there is a distinct line of moraines across the Kobuk lowland from north to south. Where examined north of the river, plainly marked river channels could be traced at different levels, one as high as 125 feet above the present river. Several small lakes and ponds are distributed throughout these moraines from 75 to 100 feet above the level of the present river. The material in the above moraines, where cut into bluffs by the river, shows much water action, though many large facetted boulders were also seen. No stratification of the material was noticeable. It would appear as though the glacier had worked in and pushed up into a moraine previously waterworn sands and gravels of the original Kobuk river valley.

The intermontane lowland appears to be filled with gravel. This deposit is mainly outwash material derived by glaciation from the Baird Mountains besides some recent stream gravels along the main rivers and creeks. Due to lack of time, no detailed examination was made of the intermontane lowland. The problem of the placer gold in the creeks of the Cosmos Hills is directly connected with the Pleistocene glaciation of the Baird Mountains. Definitely to solve this problem, a detailed study of the

extended outward into the lower country to the north and south of both ridges." However, it is thought by the writer that the above statement is too conservative and that glaciation was much more extensive, at least south of the Noatak valley. It is probable that during the late Pleistocene the entire watershed of Kobuk River was covered by an ice cap centering in the Baird Mountains. How far south this ice cap extended, whether it surmounted the Shaklukshuk Range and the Waring Mountains and occupied the valley of Selawik River, only future exploration and study will show. However, from the appearance and height of the outwash filling on the north side of these mountains and from their low rounded contour, it would not seem as though they would afford an obstacle to the southward spread of an ice sheet of any great thickness.

During, or just after, the period of maximum glaciation, the elevation of the land above sea level was at least 300 feet lower than at present. Since the disappearance of glaciation, there has been a gradual rising of the land with a tilting of the surface from north to south. Although part of the land surface was below sea level, it is not thought that at any time was the Kobuk valley, excepting that part west of Kiana, invaded by the sea. At its greatest extent the Kobuk-Noatak ice cap probably floated on its western edge in the waters of Kotzebue Sound and discharged icebergs into the Arctic Ocean. The thickness of ice formerly covering the Kobuk valley can possibly only be determined by future detailed study. However, certain rounded shoulders on Ferguson Peak, Bismark and Shungnak Mountains, would indicate that

the thickness was around 2,000 feet. The higher peaks of the Cosmos Hills, and also of the Baird Mountains (where the thickness of the ice may have been much greater) thrust through the ice cap as nunataks.

After the recession of the ice cap to the central plateau of the Baird Mountains, the valley of the Kobuk was filled with ice which spread below Hotham Peak in piedmont lobe. From an airplane the tongue of land separating Selawik Lake and Hotham Inlet from Kotgebue Sound has every appearance of an old moraine. This appearance would corroborate the opinion of A. H. Hershey (in Journal of Geology, Vol. 17) as mentioned in US.G.S. Bulletin 815, page 246. The above tongue of land would then be the moraine from the piedmont lobe of the Kobuk glacier.

Below Kallarichuk River there is a marked constriction of the Kobuk valley to the width of about 2 miles. Below Trinity Creek this constriction gradually widens out in the regular bell-mouth of a valley of a glacial feeder to a piedmont lobe. From a short distance above this constriction bedrock outcrops in the river banks for 6 to 10 miles downstream. The hills on each side of Kobuk River at this point show distinct signs of glacial action. The above constriction looks very much like the usual glacial rock bar, only on a much larger scale than ordinarily seen. It is thought that there was a comparatively rapid retreat of the Kobuk glacier to about the mouth of Kallarichuk River where a comparatively stagnant mass of ice was kept from disappearing for a very long time by feeders down the main valleys from the Baird Mountains.

The next stage in ice recession would be the disappearance of the ice from the Kobuk lowland with the old feeder glaciers terminating individually a short distance from the fronts of the Kallarichuk and Cosmos Hills. Hunt River shows distinct morainal and outwash deposits at its mouth, as also do Redstone and Ambler Rivers though to a less extent. The intermontane lowland was filled with ice which surmounted the low divides at the heads of northward flowing streams in the Cosmos Hills besides discharging westward by way of Ambler River. The largest of these southward-flowing outlet glaciers were in the valleys of the Shungnak and Kogoluktuk Rivers. On Shungnak River there are morainal and outwash deposits spread out for four or five miles from the base of Cosmos Hills. Besides these, there is, opposite Bismark and Shungnak Mountains, a glacial rockbar and canyon which may mark the location of the original divide. The Kogoluktuk outlet-glacier seems to have spread in a piedmont lobe cut into the Kobuk lowland, the line of moraines across the valley at Shungnak Village marking its extent. Granitic erratics in lower Dahl Creek and at Shungnak Village would tend to confirm this moraine as from the Kogoluktuk glacier rather than from a glacier down the Kobuk valley itself. Besides the above moraine, there appear to be morainic ice deposits in the Kogoluktuk valley at its debouchment into the Kobuk lowland and a glacial rock-bar and moraine at the granite contact just above Lynx Creek constituting the so-called falls (rapids) of the Kogoluktuk. Many of the lower peaks of the Cosmos Hills resemble

the steep-sided rounded forms of tinós, though because of the comparative softness of the country rock these forms are not so characteristic or noticeable as the typical ones of Norway.

The next stage in ice recession was the disappearance of the ice from the intermontane lowland and the melting back of the ice cap on the Baird Mountains to a central nucleus. This stage probably much resembled the present stage of glaciation on the Kenai Peninsula. Outlet glaciers still flowed down the main valleys but did not penetrate far into the intermontane lowland. The present discordant drainage through the Cosmos Hills was inaugurated as these glaciers gradually withdrew up their valleys.

The last stage was the disappearance of the ice to the present few hanging glaciers on the highest mountains.

All evidences of previous glacial stages except the last, or Wisconsin stage, have been obliterated. However, more detail work in the region may bring to light other and older till sheets than those easily seen on the surface in reconnaissance work.

It is interesting to note in connection with glaciation in the Arctic or Brooks Range, that there is a mountain, called by the native Eskimos "Pahpiuk" (Fishtail) Mountain, in line with the longest diameter and at least 50 miles north of Lake Selby, which still seems to be ice-capped and with fair-sized glaciers flowing from it. As seen from an airplane this mountain

appears two or three thousand feet higher than the rest of the range, which fact would account for the preservation of the ice on it.

ECONOMIC GEOLOGY

HISTORY of MINING AND DISCOVERIES

The first discovery of gold, so far as could be ascertained, in the Noatak-Kobuk region, was made, paradoxically, in the most inaccessible part, at the head of Noatak River on Lucky Six Creek in 1899 by a party consisting of T. W. Pearson, Lewis Lloyd, James Clark, James Akamaa, J. W. North and Milton Latten. As nearly as could be ascertained gold was discovered on Dahl Creek in 1901. Although it is stated in U. S. G. S. Bulletin 536, page 131, that work had been done on Shungnak River since 1898, no authentic report could be obtained of any work having been done on this river before 1901 or 1902. Riley Creek was discovered shortly after Dahl Creek and named after the river steamer John Riley, as was also the first white settlement on Kobuk River, Riley Camp. Wesley Creek was first prospected by Wesley, who died on the creek. California Creek was first prospected by Paul Primer who abandoned the creek as worthless. In 1915, R. F. Ferguson sank in the canyon a little below Primer's shaft and three feet deeper, finding pay. In the fall of 1931 Paul Primer found pay on Jay Creek, a hitherto unprospected stream.

MINING ON VARIOUS CREEKS

SHUNGNAK RIVER

Mining below the canyon on Shungnak River was carried on

from the earliest days of whitemen on the Kobuk River up to about 1915. Harry Brown was the last man to mine with Eskimo labor at this place. For many years the ground lay idle until in about 1928 it was restaked and the Kobuk-Alaska Mines was organized to prospect and mine it. At present this company holds about 92 claims comprising about 3,000 acres.

The deposit is a reconcentrated glacial moraine and outwash plain. The canyon of Shungnak River is cut through, as mentioned previously, a glacial rock-bar, which may have been the old divide separating original north and south drainage systems. Various saddles in this rock-bar, as it rises towards Shungnak Mountain, may be the old channels of former lateral streams along the Shungnak glacier. The canyon itself is approximately 150 feet deep where the walls are highest. A short distance below the canyon, about the middle of the Joe Association claim, bedrock pitches abruptly to an unknown depth. On the lower end of the same claim a drill hole 40 feet deep did not reach bedrock. Below the canyon the river has cut a bench about 1/2 mile wide into the moraine and outwash material spread out from the base of Bismark and Shungnak Mountains. The present river flood-plain is about 500 feet wide and is from 10 to 25 feet below the level of the above bench. Above the mouth of Bismark Creek the bench is mostly on the right limit of the river. At the mouth of Bismark Creek and for 1/2 mile below, it narrows to about 1/4 mile. Below this again the bench widens out to 1/2 mile, mostly on the left limit and gradually merges with the flood plain. About 1/2 mile below the last point, the bench suddenly widens to

about 1 mile, the river flowing approximately through its center. Again about 3/4 mile below the last point bluffs from morainal hills approach the river on the right limit for at least 2 miles. Below this last point the bench widens and gradually merges with the flood plain of Kobuk River. The fall of the river from the north end of the Bismark Association claim to the north end of the Neversweat Association claim is about 80 feet or 0.45 per cent grade. The normal flow of the river is about 800 second-feet.

The gold in Shungnak River seems to be of local bedrock origin. It is thinly disseminated throughout the outwash material, concentrating by local erosive agencies on the surface to about 2 cents a cubic yard. In the previously described bench the gold has been concentrated from at least 50 to 100 feet of reworked material. There has also been a certain amount of gold derived from the erosion of the canyon itself. This fact is born out by the gold mined in and just below the canyon being coarse, rough and rusty, with many small nuggets. Elsewhere the gold is very fine (flour gold). At the mouth of Bismark Creek there has been a still more intensive concentration and consequently higher values. At the mouth of the canyon is where mining was continued longest by Harry Brown, who used the old crude shovelling-in method.

From a short distance up in the canyon to the mouth of Bismark Creek, wherever there was a small section of flood plain, shovelling-in operations were conducted in the early days of the Kobuk down to about 1915. The ground is all thawed

except possibly part of the outwash apron about 1/2 mile from the river on the lower left limit. Therefore only very shallow pits could be dug a short ways back from the river. The river bench itself did not pay to mine by shovelling-in. So mining was limited laterally to the final river concentration and to material from the erosion of the canyon. On the left limit, about 100 feet in elevation above the river, is an old abandoned ditch which was designed to bring water from some small draws running from the south face of Shungnak Mountain. Although this ditch would have furnished plenty of head for a small hydraulic plant, there is no evidence of any other kind of mining but shovelling-in. Water for these small operations was taken by small wing dams and hose from the river or from Bismark Creek.

Besides prospecting, the Kobuk-Alaska Mines Company had built in 1929 a small ditch about 1700 feet long from Bismark Creek. The dimensions of this ditch were 3 feet wide on the bottom by 2 feet deep on a grade of 13.2 feet to the mile or about 0.25 per cent. About 1300 feet of 18 to 9-inch pipe conducted the water under a 74-foot head to a No. 2 giant with a 3-inch nozzle. Bismark Creek has a fairly steedy flow ranging from 4 to 12 second-feet and averaging about 8 second-feet. The sluice is 202 feet long, the upper 70 feet cast-iron Hungarian riffles, the rest pole riffles. The sluice is 36 inches wide and 18 inches deep, and is set on a grade of 8 inches to 12 feet or about 5.56 per cent. About 40 feet from the end of the sluice, an undercurrent discharges to one side. This under-

current is 11 feet long by 6 feet wide, and is set on a grade of 16 inches to 12 feet or about 11.12 per cent. The end of the sluice projects out over and dumps directly into a cut bank of the river. Water for the bywash and sluice boxes is obtained by a small secondary ditch about 100 feet long from Bismark Creek. The giant requires about 3 second-feet of water and the bywash about 2 second-feet. The deposit mined in 1931 lies on the left limit side of the mouth of Bismark Creek at the foot of what is evidently part of the original outwash apron. The depth to bedrock is unknown. The depth mined and which carries pay, is about 8 feet. The section mined is as follows: 1/2 foot of moss and soil; 4 feet of sandy silt; 4 feet of gravel; 2 to 6 inches of black, finely broken, slatey material and sand which is taken as bedrock. The gravel is coarse and sub-angular. Boulders are very numerous and occur up to 3 feet in diameter. Some show facetted sides but no striations, and all are water-worn. The gold is very fine and platey. It occurs all through the gravel but is specially concentrated on top of the final black stratum. The gold is valued at $16.70 an ounce. The pit taken out by September 1931 was approximately 100 by 100 feet in size, amounting to about 3000 cubic yards. At the cleanup made during the writer's visit, the recovery was said to have been about 90 cents a cubic yard.

The pit is in a part of the previously described right limit river bench eroded by Shungnak River from the old outwash apron. It is evident that the river flowed at this level for a long period of time until it began to aggrade its bed with silt

and cut back a flood-plain into the morainic deposits. A slight further elevation of the surface re-established the grade allowing the river to take its present comparatively straight course at a lower level. Bismark Creek in cutting across a corner of the river bench, further concentrated the values so as to make the ground rich enough for shovellingin.

In 1929 the Kobuk-Alaska Mines hydraulicked out a cut on the right limit and about 300 feet downstream from the 1931 pit. This cut was approximately 150 by 100 feet, and about 6 feet deep. The black stratum or false bedrock is here about 6 feet above river level. The cut is partly in the last downstream point of the right limit river bench and partly in outwash material. The results are said to have been about 55 cents a cubic yard. The outwash material carried very poor values, 7 cents a cubic yard or less. Below this last cut, the river cuts the old outwash apron in a steep bluff composed of facetted and rounded boulders and sand without stratification, a typical till partially morainic but with some water action.

On the Gold Bank Association claim about 180 feet up Bismark Creek from its mouth, 2 small prospect pits are said to have yielded 155 cents and 93 cents a cubic yard, respectively. On the Clark Association claim on the outwash apron about 100 feet above the level of the river, a small test pit is said to have prospected 7 cents a cubic yard. On the 313 Association claim in a bar near the river bank, a small test pit put down to water level is said to have yielded 243 cents to the cubic yard. Slightly downstream from the last, on the Jim Association

and on the right limit about 10 feet above the river in a slight bench, a test pit is said to have prospected 57 cents a cubic yard. On the Wien claim up on the left limit river-bench about 10 feet above the level of the river, a test pit is said to have prospected better than 50 cents a cubic yard. Near the south corner of the Twins Association claim, a test pit is said to have prospected better than 50 cents a cubic yard. On Joe Association claim in several cuts at the present river level on the right limit, an average recovery of 243 cents a cubic yard is said to have been obtained.

The Kobuk-Alaska Mines had purchased in 1931 a Crescent (Sauerman) bottomless 1½ cubic yard scraper and transported it to the camp at Bismark Creek. This scraper has a 7/8-inch Robling loading cable, a 3/4-inch pull-back cable and a 1/2 inch flying-block cable. A combination 46-horsepower American boiler and hoist was landed at the mouth of Shungnak River in 1931 and hauled by its own power overland to Bismark Creek in the spring of 1932. This boiler is said to use 3 cords of wood in 24 hours. Water is furnished by a centrifugal rope driven pump furnishing 2,000 gallons a minute against a 40-foot head. For night work there is a flood-lighting system driven by a steam turbo-generator. The entire outfit cost about $40,000 landed at Bismark Creek ready for operating. In the summer of 1932, the above outfit was set up on the Joe Association claim and is said to have yielded very excellent results.

In 1931, 6 men and a manager were employed by the Company. Wages for common labor were $5 a day and board. Board cost the company about $2 a day per man. Eskimos were employed for all unskilled labor.

The area that can be made to pay with the present method is thought to be confined to the river-benches nearest to the canyon, and the present beds of Shungnak River and lower Bismark Creek. It is also thought that the pay will not extend down from the surface over 10 to 20 feet. The yardage therefore, if the above observations are correct, cannot be large. However the investment is small so that with careful handling the project should yield a fair profit.

In the spring of 1931 H. R. Norsworthy and Geo. C. Crangle, representing eastern capital, sank a number of drill holes on the lower or downstream end of the Kobuk-Alaska Mines holdings. Their best drill hole is said to have been obtained on a bar near the river. No bedrock was found. The deepest hole was 42 feet. The holes appear too irregularly spaced and too bunched together to give the ground a fair test. This drilling campaign was undertaken to test the lower ground for dredging. Although the ground is all thawed, the great number of fairly large boulders would make working it by a small dredge very difficult. As the values extend only a short distance below the river-bed and also as a payable area is rather limited, it is not thought that a large dredge would be justified.

On Axels Gulch, about 1/2 mile upstream from its confluence with Bismark Creek, Axel M. Hanson sank in 1929 a shaft 80 feet deep, all in fairly fine glacial outwash material. No bedrock was reached and Hanson died before he could finish the shaft.

WOODCHOPPER CREEK

This is a fairly large creek heading in a rather low divide on the west side of Bismark Mountain. It flows in a westerly direction emptying into Kobuk River near the mouth of Ambler River. The bedrock at the head of the creek is composed of phyllites and slates and does not look favorable for gold. However, prospects are reported to have been found on the creek. These may be from the reconcentration of material from the outwash apron of the old Shungnak glacier. It is thought that, at the time of the Shungnak glacier, when the intermontane lowland was an ice reservoir, a small tongue of ice pushed over the divide at the head of Woodchopper Creek.

COSMOS CREEK

This is a large creek about 4 miles east of Shungnak River. It heads against a very low divide in the northern part of the Cosmos Hills and flows south to Kobuk River. The stream runs in a narrow, flat-bottomed, rather steep-sided valley which narrows to a canyon between Shungnak and Cosmos Mountains just before entering the Kobuk lowlands. Just below the canyon it is joined by a small right limit tributary from Shungnak Mountain known as Warren Creek. About 1/2 mile below the confluence of Warren Creek are about 500 acres of the best stand of spruce timber seen on the upper Kobuk.

Many holes have been sunk on Cosmos Creek near its head. The ground at this place was about 10 feet deep. So far as could be ascertained no encouraging prospects were found. Warren Ferguson sank two shafts on the creek just below a large left limit tributary and about 1/2 mile above the canyon. Both holes

were about 40 feet deep and were abouy 1/8 mile apart up and down stream. The ground was frozen and composed of practically all fine gravel with very few boulders. The bedrock is reported as a very light-colored greenstone schist, with the schistosity dipping vertically. The bedrock in the lower shaft is said to be pitching steeply downstream. In the lower shaft Ferguson also drifted 20 feet toward limits thereby practically cross-cutting the creekbed. No concentration was found although fine colors were all through the gravel from the surface to bedrock.

Just above the canyon is an old ditch from the creek and evidence that shovelling operations had been attempted in early days. No information could be obtained on these workings which from their slight extent were evidently unsuccessful.

It is thought that during the time of the Shungnak glacier, a small stagnant ice-tongue extended over the divide and down Cosmos Creek a short distance, or even possibly as far as the canyon. The valley was filled with rather fine outwash material carrying fine gold. This material the present comparatively feeble stream has not had time to rework and concentrate the values. It is thought that the best place to prospect on Cosmos Creek would be just below the canyon and at the junction with Warren Creek as at this place there would have been more normal stream action and consequently a gold concentration likely to occur.

CAMP CREEK

This is a small creek heading in two forks in Cosmos Mountain and flowing south into Kobuk River below Riley Camp. No prospecting has been done on this creek so far as could be ascertained. A small amount of pay might be found below the

forks but there has not been enough erosion for a large deposit to have been found.

WESLEY CREEK p 128-14

This is a large creek about 2 miles east of Camp Creek. Flowing south to Kobuk River, it heads in a very low divide occupied by lakes which drain north to the head of Ruby Creek. Wesley Creek occupies a rather wide U-shaped valley much too large for the size of the stream. Before the valley debouches into the Kobuk lowlands it narrows to almost a canyon. The creek gravels are thawed.

Wesley prospected on the Creek for many years until his death. It is said that fine gold was found all through the gravel but no concentration although no shaft has ever actually been sunk to bedrock.

During the time of the Shungnak glacier, a small, fairly quiescent ice-tongue occupied the valley of Wesley Creek. The gravels in the creek valley are evidently derived from outwash material, and because there has not been enough stream action since the time of glaciation, it is not likely that any concentration or pay gravels of any extent, will be found.

RUBY CREEK W 128-39

This is a large creek heading into Imerevuk Mountain and against Wesley Creek, and flowing north into Shungnak River. Much placer gold prospecting has been done on Ruby Creek, the details of which could not be ascertained. However, it is said the creek was a small gold producer in early days. No one has worked on it for several years.

As an ice tongue extended through the pass at the head of Ruby Creek into Wesley Creek during the time of the Shungnak Glacier, it is not likely that the upper end of the creek would have pay gravel in it. However, in the lower part of the creek the ice should have more or less preserved part of the pre-glacial deposits and some pay be present.

JAY CREEK K+ 28-33.

This creek is a comparatively large left limit tributary of Ruby Creek heading against a left limit tributary of Cosmos Creek north of Cosmos Mountain. Paul Primer was prospecting on Jay Creek during 1930 and 1931. However, at the time of the writer's trip to the Kobuk, he was down on Ambler River prospecting on Aggie Creek. It was reported that in the fall of 1931 pay was struck on Jay Creek and that Primer was preparing to put 5 men to work shovelling-in during the summer of 1932.

Analogous to lower Ruby Creek the pre-glacial placer deposits of Jay Creek have been preserved, rather than swept away, by the Ambler glacier. However the creek is so small that no great extent of pay is likely to be found.

DAHL CREEK K+ 28-14 31-34

This creek has been since early days the main gold producer of the upper Kobuk Goldfields. It is about 9 miles long, the upper 5½ miles being within the Cosmos Hills. It heads in a low pass against a small right limit tributary near the head of Ruby Creek. It flows east for about 1/2 mile, then south to the Kobuk lowland, then southwest to join Kobuk River about 2 miles

below Long Beach. Where the creek turns from flowing east to south there are also comparatively low passes north into the head of Riley Creek and east into Ryan Creek. The upper part of the valley of Dahl Creek is wide and U-shaped. However below Contact Creek it narrows and the grade becomes steeper, finally contracting about 5/8 mile below Harry Creek to a canyon about 1 mile long. Below the canyon the creek runs in a narrow flood plain cut into the outwash material of the Kobuk lowlands. On the lower end of Claim No. 2 Below Discovery about 1/4 of a mile below Lloyd's workings, the bedrock pitches abruptly to the south to an unknown depth. At Lloyd's workings the creek has a grade of about 2 per cent and carried about 500 miners inches of water in the latter part of August, 1931. From Lloyd's workings to the mouth of Harry Creek the grade is about 2.6 per cent. From the mouth of Harry Creek to Johnson's workings the grade is about 1.67 per cent. From Johnson's workings to the mouth of Stookley's Creek the grade is about 3.24 per cent.

Lewis Loyd is mining on Claim No. 1 and No. 2 Below Discovery Association. He has mined out on the right limit next to the creek-bed an area approximately 1500 feet long by 30 feet wide, and on the left limit next to the creek-bed an area approximately 800 feet long by 20 feet wide. The depth to bedrock is from 2 to 7 feet. The bedrock is composed of blocky slate and schist. The gravel is medium fine (containing pieces up to 2 inches in diameter) and well waterworn. Distributed through the gravel are quite a number of large boulders. Most of these are of greenstone or metamorphosed conglomerate. Besides these there

unconsolidated glacial deposits of the intermontane lowland and the Baird Mountains should be made.

QUATERNARY AND RECENT HISTORY

It is thought that in the late Pliocene, the general base-level of the entire Kobuk-Noatak drainage was several hundred feet lower than at present. The intermontaine lowland was a major river valley running in a structural trough similar to the galley of the present upper Colville River north of the Arctic or Brooks Range. It is possible that the analogy with Colville River can be carried further and that the intermontane lowland may have been the main Kobuk valley, the present Kobuk valley above Ambler River corresponding to Awuna River north of the Colville. Only intensive study of the upper or eastern end of the lowland will show the former relationships. The longest or main drainage from the Cosmos Hills seems to have been north into the intermontane lowland. The Cosmos Hills were a rather high range dissected by comparatively deep and fairly mature valleys and the Baird Mountains probably did not stand so high above the general relief of the region as at present.

It is the generally accepted opinion that the Kobuk-Noatak drainage was not occupied by any great extent of ice during the Pleistocene. To quote Philip S. Smith in U.S.G.S. Bulletin 815, page 242, "there was not a continuous sheet of ice within the area outlined but rather a collecting ground that roughly corresponded with the main ridges between the Kobuk and Noatak and between the Noatak and Colville, from which tongues of ice

are a few large erratic boulders of gneissic granite rock which occur in gravel of this claim but no farther up the creek. The gold is fairly coarse ("shotty") but with few nuggets. It lies in the lower 18 inches of gravel but does not penetrate into the bedrock. It is worth about $16.50 an ounce. The pay is very erratically distributed on the creek. There is no regular paystreak.

Lloyd collects the water with a low dam, then booms it by means of baffle-boards against the side of his cut. In this way all but the lower 18 inches of gravel is removed. This 18 inches of gravel along with 3 or 4 inches of bedrock is shovelled into the sluice boxes. The maximum amount of water available is about 3000 miners inches, the minimum about 200 miners inches, and the average about 500 miners inches. Lloyd uses 36 feet of 12 by 12 - inch sluice boxes, set on a grade of 9 inches to 12 feet or about 6.25%. Hand-sawed wooden riffles are used in the boxes. The ground is said to yield approximately 31 cents to the bedrock foot or average about 167 cents a cubic yard. The length of the season is about 130 days.

It is thought that the pay on Lloyd's ground will be confined to the flood-plain of Dahl Creek, at any place not over 400 feet wide. As said before the pay will be found to be distributed in irregular areas in the gravels throughout the flood-plain, not in a regular paystreak.

About 1/4 mile below Lloyd's ground, on the left limit about 1/8 mile from the creek, three shafts have been sunk, all within 300 feet of each other. Two of these shafts were 40 feet

deep and one 80 feet deep. None were bedrocked. The section was composed of alternating layers of sand and gravel dipping at a slight angle to the south. Fine colors of gold were found in the sands and gravels of all three shafts, as high as 2 cents a pan having been obtained in one of them. However it is thought that the shafts have been sunk mainly in outwash material and that there is very little chance of finding a concentration and pay in them.

1428-19

Michael J. Tuohy mines about 1/4 mile above Lloyd. Due to rheumatism he has done very little actual mining in the last few years, confining his work mainly to assessment work on his claims. Approximately 2 acres of ground have been shovelled-in in the creek channel and on the right limit adjacent to the creek channel opposite Tuohy's cabin. The depth to bedrock is from 2 to 8 feet. The gravel looks to be slightly more bouldery than that on Lloyd's ground. The ground is estimated to have yielded approximately 19 cents to the bedrock-foot, or average about 102 cents to the cubic yard.

About 1/4 mile above his cabin, on the right limit, Tuohy claims to have located an old channel. He has cross-cut this channel with two lines of shafts about 500 feet apart. Each line had three shafts sunk on it. The channel is said to be about 30 feet wide. No bedrock was reached, although shafts 25 feet deep were sunk in the channel. From a shaft in the upper line, Tuohy claims to have recovered 32 cents a pan, and from one in the lower line, 34 cents a pan. At the lower line of shafts the surface of the ground is about 10 feet above the level of the creek. If this is, as claimed, an old channel, it

must have a much steeper grade than the present creek. The bedrock outcrops in the canyon not over 1/2 mile above. As erosion in the canyon must have lowered the bedrock considerably, the grade, in order to meet the previous surface, must have been 3 or 4 per cent. This channel would be the steep gully of a pre-glacial mountain stream whose valley lower Dahl Creek has occupied.

On the Ptarmigan Association claim in a bench on the left limit opposite Lloyd's cabin, Tychy sank a shaft 25 feet deep. Water prevented sinking further and reaching bedrock. He claims 18 inches of the gravel in the bottom of this shaft would yield 25 cents a pan.

KKOE-14

"Yukon Charlie" Coffin, a native, owns the ground at the mouth of Harry Creek. No one was on the ground when visited, though he and several other natives are said to work on the ground every fall.

KKOE-14

Fred Johnson and Axel M. Hanson hydraulicked from 1920 to the fall of 1930 on claim No. 2 Above Discovery, about 3/8 mile above the mouth of Harry Creek. On the death of Hanson in the winter of 1930-1931, work was suspended. In the summer of 1932, Johnson is said to have resumed operations. The bedrock is mica-schist contacting with grey limestone on the right limit. The depth to bedrock is 10 to 15 feet. The gravel is coarse (pieces up to 6 inches in diameter) and subangular, with a few greenstone boulders up to 3 feet in diameter. The section to bedrock is; one foot of sod, moss and soil; one foot of silt and sand (muck); 8 to 12 feet of gravel. The ground is all thawed. The gold is both fine and coarse. The fine flakey gold is found all through

the gravel, the rough coarse gold on or in bedrock, but not far down into bedrock. The gold is valued at $17.20 an ounce.

Johnson and Hanson have mined over about 42,200 square feet of bedrock. Water is obtained from Dahl Creek just below the mouth of Stockley Creek by means of a 28-inch pipe line taped down to 9 inches for the giants. The length of the pipe line is 3060 feet and the head is 101 feet to the top of the pit. About 100 miners inches of water were available at the latter part of August 1932. The tailings are stacked with a No. 2 10-inch giant using a 1⅜-inch nozzle. Hydraulicking into the boxes is done with two No. 2 10-inch giants using 2 and 3-inch nozzles. However only one of these last two giants is used at a time. 48 feet of 24 x 36-inch sluice boxes with cast-iron Hungarian riffles are used. The grade of the boxes is 10 inches to 12 feet or about 6.95%. The total cost of the equipment landed on the claim was about $8,000.00. The ground is said to have yielded up to and including 1929, about 8 cents a bedrock foot or about 22 cents a cubic yard. In 1930 the ground is said to have yielded about 7.6 cents a bedrock-foot or about 20.5 cents a cubic yard. The ground is owned by E. E. Patterson (Kotzebue Fur & Trading Co.).

Dahl Creek has been worked continuously from below Johnson's pit to about 1/2 mile below Harry Creek. The width of the workings averaged about 20 feet. The depth to bedrock ranged from 6 feet at the upper end of the worked ground to 4 feet at the lower end. The gold is said to have been coarse, one nugget worth $620 having been found just below the mouth of Harry Creek.

A few silver nuggets have also been found with the gold.

During the time of the Shungnak glacier, the head of Dahl Creek was occupied by a small ice-tongue. At its greatest extent there was possibly a narrow stagnant ice-tongue extending below Stockley Creek and uniting at its upper end with the ice-tongue extending down Riley Creek. Dahl Creek has had such a steep grade that it has been able to rework and remove the rather small amount of outwash filling back as far as Stockley Creek, and cut down into the underlying bedrock. The gold is probably mainly of local bedrock origin. It possibly has been derived partly from the pre-glacial valley and partly from post-glacial erosion and reconcentration. The depth to bedrock will probably increase from Johnson's pit upstream to approximately the original depth of the outwash filling. The pay on Dahl Creek above the canyon seams to have been more regular in distribution than that in the creek below the canyon. This is possibly due to the gold having been reconcentrated and eroded from the underlying bedrock in place, where below the canyon much of it may have been carried down from upstream in times of high water. The greenstone contacts with the schists at Stockley Creek. It is thought that, due to this chage in bedrock and to the absence of reworking of the gravels from higher upstream, the pay will not extend much farther than where Johnson is at present mining.

Lower Dahl Creek might be worked by hydraulicking or by scraping as on Shungnak River. Upper Dahl Creek might be worked by hydraulicking as there is fair ditching ground on the east side of the valley, enough water for a small plant and a fairly

good grade. The tailings could be stacked with a nozzle or by means of a small Sauerman scraper as at Monument Creek on Seward Peninsula

Ownership of Claims on Dahl Creek

Lewis Lloyd - - - - - - - - - -	No. 1 and 2 Below Discovery Association
	Lloyd Bench Association (right limit)
	Orline Bench (20 acres right limit)
	(Total approximately 140 acres)
Michael J. Tuohy - - - - - -	Lucky Three Group (160 acres on Creek)
	Ptarmigan Group (80 acres on left limit alongside Ptarmigan Group and No. 1 and 2 Below Discovery Association) (Total approximately 240 acres)
"Yukon Charley" Coffin - - -	Discovery Claim
	No. 1 Above Discovery
Kotzebue Fur and Trading Co. (E. E. Patterson) - - -	Bean Fraction
	No. 2 Above Discovery
	No. 3 Above Discovery
	No. 4 Above Discovery

RILEY CREEK

This is a large creek heading in two forks against the east-south turn in Dahl Creek and flowing northeast to Kogoluktuk River. Only the head of the right or west fork of Riley Creek has been mined or is known to carry gold. Riley Creek is a post-glacial stream which has eroded a narrow secondary valley through glacial topography. When the intermontane

lowland was filled with ice, the valley of Riley Creek also was completely filled. At its greatest extent an ice-tongue extended over the pase at the head of Riley Creek and joined the ice at the head of Dahl Creek. The main movement of the ice was down Kogoluktuk River. The ice in Riley Creek must have been relatively stagnant. However there was enough movement up the creek to bring many basic igneous erratics from some point to the north. The ice must have surmounted the mountains enclosing Riley Creek on the north as they show smoothed and rounded forms. As both mass and movement are the factors in glacial erosion, the glacial valley of the Kogoluktuk was cut down much farther than Riley Creek. The valley of the creek starts as a comparatively narrow trough in a wide, flat, U-shaped depression which probably represents a remnant of some pre-glacial drainage basin. The trough merges into a wide flat just before the confluence of the creek with Ryan Creek. The combined creeks then cut into the flat about a mile below their junction, in a canyon leading down to Kogoluktuk River.

At the head of the Right Fork of Riley Creek, the bedrock is a black, finely laminated (schistose) slate. The depth to bedrock averages about 7 feet in the workings. The gravel is composed of finely broken slate mingled with a great many subangular boulders of quartz and limestone. A few waterworn erratics of an altered basic intrusive rock resembling a greenstone also occur with the other boulders. Probably more than 40 per cent of the gravel is made up of the above boulders. None of them seen were over 2 feet in diameter. They mostly

lie in a 2-foot stratum about 3 feet from the surface of the ground. It would seem as though the creek, a swiftly flowing torrent, had excavated its channel to about the present depth when it undercut a large deposit of till (or through soil-flow, a deposit of till slid into the creek), whose boulders were deposited in a layer or stratum throughout the creekbed.

The gold is fairly coarse though no large nuggets are found. It is very rough and dendritic. The value is about $15.00 an ounce. The gold undoubtedly originated in the numerous quartz leads at the head of the creek. These will be dealt with later.

Where mining has been done is just below a small left limit tributary or fork heading into a very low pass into Ruby Creek, and about 1/2 mile from the extreme head of the main creek (or left-hand fork of the Right Fork of Riley Creek). The width of the creek valley at this place is about 150 feet. The grade of the creek is about 5 per cent. The amount of water available for mining varies from none to a maximum of 80 miners' inches. Probably an average would be about 30 miners' inches. Many men have attempted to work on the creek since early days, but no one, it is said, has made more than wages. An area 50 feet wide by 700 feet long has been mined, mostly on the right limit.

K-28-'32 Wm. D. Dugan, in the summer of 1931 was ground sluicing and running a bedrock drain on the Right Fork of Riley Creek on the left limit opposite the lower end of the old workings. He was also splashing and shovellin-in in a small cut about 500 feet above this place in the stream-bed. He expected by the end of the season, to have worked about 1000 square feet of bedrock.

Below the turn of the Right Fork from north-east to east

and the junction with the Left Fork, the depth to bedrock increases rapidly. So far as known no one has sunk a shaft to bedrock on the Left Fork or on Riley Creek below the forks. It was Dugan's intention to sink a shaft in this last place in the winter of 1931-1932.

RYAN CREEK KK 28-34

This creek is a large right limit tributary of Riley Creek heading in Asbestos Mountain and flowing northeast. It is said to have been named after a man called Ryan who did some desultory prospecting on it in early days. No one, so far as known, has sunk a shaft to bedrock on this creek. The ground is thawed and probably deep.

Ryan Creek heads into and runs for some distance in a greenstone and serpentine formation, so far as could be seen from the head. It does not seem likely that gold in paying quantities will ever be found on the creek.

RADIO CREEK KK 28-35

This creek was not visited. It is a right limit tributary of Kogoluktuk River heading against the head of Stockley Creek south of Asbestos Mountain.

The ground in the creek valley is all thawed. The depth to bedrock is unknown.

In the winter of 1930-1931, Wm. D. Dugan sank 3 shafts on Radio. In one shaft on the left limit, bedrock was reached at 13 feet. The other shafts were 20 and 11 feet deep respectively. He was unable to reach bedrock because of water in both of these 2 shafts. As well as could be understood from Dugan's description, the creek deposits found in all these shafts were

much disturbed and misplaced, probably due to some effect of regional glaciation.

Radio Creek is in a very favorable location. If not too much effected by past glaciation, it should be a good place for prospecting.

GLACIER CREEK KT 26-35

This creek is a right limit tributary of Kogoluktuk River heading against Harry Creek, and parallel to and south of Radio Creek.

Warren Ferguson is the only person, so far as could be ascertained, who had attempted to sink a shaft on Glacier Creek. As the ground is thawed, water prevented him from reaching bedrock.

Like Radio Creek, Glacier Creek is favorably situated. It should also, if not disturbed too much by glaciation, be a good place to prospect.

CALIFORNIA CREEK KT 31-7

This creek is a large left limit tributary of Kogoluktuk River about 5 miles above the confluence of that river and Kobuk River. California Creek is known to the natives as Conieksivik (caribou round-up place) Creek. It heads in a broad low divide and runs south in a wide U-shaped valley for about 1 mile to its confluence with Wonder Creek. It then turns and runs in a narrower valley in a south-westerly direction about 2½ miles to its confluence with Little Creek. The valley then narrows abruptly about 1000 feet below Little Creek to a canyon about 1½ miles long. Below the canyon the creek takes a more westerly direction, flowing for about 2 miles in a shallow valley cut into outwash and morainic deposits to Kogoluktuk River.

The bedrock is a greenstone schist in the canyon and on lower California Creek. The bedrock is smooth and has a slight transverse pitch from the right to the left limit. The downstream grade of the bedrock at the workings is about 2 per cent. The depth to bedrock averages about 14 feet deep from the canyon to the mouth of Little Creek. 1800 feet above the mouth of Little Creek the depth to bedrock is 20 feet. At the mouth of Clara Creek, in the creek-bed, the depth to bedrock is about 8 feet. In the canyon the depth to bedrock ranges from 14 feet at the upper end to practically zero in the lower half. The average grade of the creek from the mouth of Wonder Creek to the mouth of Clara Creek is about 1.56 per cent. From the mouth of Clara Creek to the head of the canyon the grade is about 2.25%. From the head of the canyon to the foot of the canyon the grade is about 3.81%. From the foot of the canyon to the mouth of the creek, the grade is about 1.9%. The canyon is about 100 ft. wide at the upper end, narrows to about 30 ft. in the middle and is about 500 ft. wide at the lower end. Lower California Creek, from the mouth of Clara Creek to the head of the canyon, is about 200 ft. wide from rim to rim. The north side of the valley is quire steep while the south side rises on a more gentle slope. The section of the valley is in the shape of an unsymetrical "U".

The maximum amount of water in California Creek is about 2500 miners' inches, the minimum amount about 500 miners' inches, and an average amount about 1500 miners inches.

There is only about 1 foot of moss, sod and soil over the gravel. The gravel is fairly coarse (pieces up to 3 inches in diameter), and waterworn with a few large subangular boulders up to 3 feet in diameter.

The gold is in smooth flat pieces but very coarse, about one-half being of the size of nuggets. It occurs in the lower 5 ft. of gravel but not down into the bedrock. The gold is worth about $17.20 an ounce. The size of the gold would indicate a nearby source. Greenstone, so far as the writer knows, has not been considered a favorable source for placer gold. However there seems to be quartz veins in the greenstone on the right limit of the creek. It is thought that these veins and also the contact between the greenstone and other formations on the left limit have been the source of the gold. The mineralization is undoubtedly connected in some way with the granitic intrusion outcropping on lower Lynx Creek.

(A31)1 F. R. Ferguson has mined on California Creek since he discovered gold in the canyon in 1918. He is holding 8 claims, or approximately 160 acres from the head of the canyon upstream. From the head of the canyon to the mouth of Little Creek, he has hydraulicked a pit approximately 1000 feet long by 50 feet wide. He then moved upstream about 800 feet and hydraulicked another pit approximately 1000 feet long by 60 feet wide. Ferguson stopped work in August, 1931, and skipping another strip of ground, was moving upstream 1200 feet so as to open up another pit in the summer of 1932. All but 6 to 10 feet of the lower gravels are hydraulicked to one side of the creekbed. The lower 6 to 10 feet are then hydraulicked to the elevator. Water is furnished by a 2½-mile ditch, 12 feet wide on top, 6 feet wide at the bottom and 5 feet deep. The grade of the ditch is 8 feet

to the mile or about 0.1512%. About 3000 feet of 24-inch pipe is used, tapering to 8 inches for the nozzles. The head is from 160 to 225 feet, according to the location of the elevator. Three No. 1 giants are used with 2-inch to 3½-inch nozzles, according to the amount of water available. No. 1, 14-inch Campbell elevator is used, lifting 14 feet. 36 feet of 14 inches by 26 inches sluice boxes with wooden block riffles are used, set on a grade of 11 inches to 12 feet or 7.65 per cent. The ground is said to have averaged approximately $0.49 a bedrock-foot or about 81 cents a cubic yard up to and including 1930. In 1931, the ground is said to have averaged approximately $0.29 a bedrock-foot or about 38.5 cents a cubic yard.

Three or four men (Eskimos) are employed. Wages are $5 a day with board. Board costs approximately $2 a day. The working season is about 100 days.

California Creek, from a placer standpoint, seems to have had an analogous history to that of Dahl Creek. At the closing of the period of glaciation during the time of the Kogoluktuk glacier, a rather stagnant tongue of ice extended down the creek as far as the canyon. This ice tongue even may have been augmented by a small glacier down Wonder Creek. On the retreat and shrinking of the Kogoluktuk glacier to the mouth of Kogoluktuk River, and then to the falls (rapids) above the mouth of Lynx Creek, the ice-tongue was cut off by the divide at the head of the creek. The stream has had enough grade and sufficient volume of water to remove the outwash filling from its valley to above the mouth of Clara Creek and to reconcentrate what must have been goldbearing glacial and preglacial deposits.

It is thought that this reconcentration will not extend much further up the creek and that the depth to bedrock will probably rapidly increase so that the life of mining by the present method will not least over 4 or 5 years.

The present method of working the creek is probably the best if more consistently followed out. However, as the creek has a rather steep grade, affording natural drainage to the pit, and as the equipment has to be frequently moved, a rubble elevator might be used to advantage. On the other hand, the advantage in ease of changing location possessed by the rubble elevator is partially overcome by mounting the standard equipment and part of the sluice boxes on skids. They are then moved forward by a whim. Also the standard elevator has an advantage in not requiring such skilled handling of the giants as the rubble elevator. The efficiency of the present method might be increased and deeper ground mined by handling the tailings with a small scaper.

LYNX CREEK K 38-39

This creek is a small left limit tributary of Kogoluktuk River about 1 mile upstream from California Creek. Lynx Creek heads in the same low pass as California Creek and flows southwest about 5 miles to its confluence with Kogoluktuk River. The creek flows in a rather narrow valley, partially cut in postglacial times, into a small glacial trough. About 2 miles from its head, Lynx Creek is joined by a comparatively large left limit tributary known as Kit Creek.

The bedrock of upper Lynx Creek to about 1/2 mile below the mouth of Kit Creek appears to be a mica-schist. From this point to within about 1 mile of Kogoluktuk River, the bedrock

is a granite gniss.

The grade of the upper end of the creek to the mouth of Kit Creek is about 2.5 per cent. From the mouth of Kit Creek to a point 1/2 mile below, at about the gneiss-schist contact, the grade is about 2.75 per cent. From the above contact for about 2 miles, Lynx Creek runs on an average grade of about 3 per cent in a very narrow canyon in the gneiss, incised into the lower end of the original glacial hanging-valley. This canyon is known as the "drop-off" of Lynx Creek.

On the upper end of the creek, the width of the floor of the valley from rim to rim is about 300 feet. The depth to bedrock at the workings is about 8 feet, of which 2 feet is sod and soil, the rest gravel. The gravel is comparatively fine (up to 1 inch in diameter). There are many small boulders, but rocks as large as 2 feet in diameter are rare. The ground is all thawed. The bedrock is soft and decomposed. One to two feet of bedrock are taken up in mining.

The gold lies mostly on the bedrock. About 1/2 of the gold is in small nuggets, the rest in fine, rounded ("shotty") grains. It is worth about $17.20 an ounce. It is derived undoubtedly from a bedrock source and from reconcentrated glacial deposits.

xx 28-24 Herman Pohl is mining on claim No. 1 Above Discovery on Lynx Creek. He ground-sluices off about 7 feet of overburden and gravel, then shovels-in the remaining gravel and one or 2 feet of bedrock. He uses from 72 to 240 feet of 12-inch by 12-inch sluice boxes with pole riffles, set on a grade of 10 inches to 12 feet or 6.95 per cent. The maximum amount of water available in the creek for mining is about 500 miners inches. The minimum is zero and an average is about 80 miners inches.

Pohl started work in 1912. He has mined over about 65,000 square feet of bedrock in a narrow cut about 3500 feet long. The width of the cut ranged from 25 feet at the lower end to 10 feet at the upper. Up to and including 1930, the ground yielded about 9.1 cents to the bedrock foot or about 27.3 cents to the cubic yard. In 1931, the ground yielded about 12.5 cents to thebedrock foot or about 37.5 cents to the cubic yard.

About 3/4 mile above Pohl, there is about 500 feet of old workings. Other attempts to work the creek were noticed 1/2 mile above the last.

The creek is about worked out by present methods. Pohl does not intend mining on it more than one more year. No money has ever been found in the lower part of the creek where the bedrock is granite gneiss.

Lynx Creek has had practically the same late Pleiocene and Recent history (placer geological history) as California Creek. At the time of the Kogoluktuk glacier, ice over-rode the mountain to the north of Lynx Creek and filled the valley completely. As the ice diminished, stagnant lobes were left in Lynx Creek and upper California Creek. This was cut off, on the retreat of the Kogoluktuk glacier to where the rapids are at present, by the divide at the head of the creek. The creek has had sufficient grade to remove the slight amount of outwash material and erode down into the bedrock.

The creek should be subjected to a more thorough prospecting. It might be possible to bring water from the head of Canyon Creek over the low divide at the head of Lynx Creek, and hydraulic the creek at a much less cost. However, the amount of money so far

recovered would not lead one to expect any justification of very expensive or extensive operations.

LOUISE CREEK 14 28-36

This is a small gulch, the only left limit tributary to Kogoluktuk River between Lynx Creek and Canyon Creek. Louise Creek flows through a very favorable formation. If there has been enough post-glacial erosion, the creek should have a placer deposit workable by a small operator. No one, so far as could be ascertained, has ever prospected on the creek.

CANYON CREEK 14 28-37

This creek is a large left limit tributary of Kogoluktuk River above Louise Creek. Canyon Creek heads in the same low pass as California and Lynx Creek, a short headwaters gulch draining from the mountain to the east of the pass. The creek then flows northwest to Kogoluktuk River about 8 miles above Lynx Creek. Canyon Creek has a large flat at its upper end thought to be a partially dissected part of an outwash filling in the original pre-glacial valley. Farther downstream the valley contacts into a canyon, the stream flowing at a steep gradient down to the level of the valley of Kogoluktuk River.

The late Pleistocene and Recent history of Canyon Creek is closely interwoven with and parallel to the histories of California and Lynx Creeks. From reports on the one shaft attempted sunk on upper Canyon Creek, a stagnant ice tongue may have overridden and subsequently buried under outwash material the original gravels in the creek as old land surfaces and wood were reported found in the above shaft. Or there might have been an aggrading of the surface due to the blocking of the stream outlet by outwash filling in the Kogouktuk valley.

Warren Ferguson sank a shaft 40 feet deep on upper Canyon Creek. No bedrock was reached. The ground was all thawed. Prospects of fine gold were said to have been found in the shaft.

Herman Pohl intended, in the late fall of 1931 and spring of 1932, to prospect in the canyon of Canyon Creek.

TRINITY CREEK

K-37-8

This creek, also known to the miners as Montana Creek, is a right limit tributary of Kobuk River at or near Kalla. It heads against Clara and Juanita Creeks, left limit tributaries of California Creek, and flows southwestward to Kobuk River. The creek was not visited.

Warren Ferguson attempted sinking a shaft on Trinity Creek but was drowned out as the ground is all thawed.

Ed Polson was intending to prospect on this creek in the winter of 1931-1932.

AGNES CREEK

K-38-16

This creek is a right limit tributary of lower Ambler River, flowing from the Baird Mountains. The creek was not visited.

Jas. C. Cross was intending to prospect on Agnes Creek in the winter of 1931-1932, as he had done for several years previous.

LODE MINING

GOLD

K-36-21

No further development of gold lode prospects has taken place since the U.S.G.S. expedition under P. S. Smith in 1910. The lodes at the head of Riley Creek were visited by the writer in 1931. Most of the lenses and small veins seemed to have a north-south strike, although one vein traced for about 1/4 mile

into the mountain to the north of the head of Dahl Creek, appeared to have a northeast-southwest strike. There seems to be no system of veining though future work may uncover some such system. Apparently the veins dip at a high angle, though again, so little work has been done (and what little that has been done obscured by sloughing), that it is almost impossible to determine the dip. The leads are from a few inches to 1½ feet wide. One lense appeared to be about 3 feet wide. The quartz was unshattered and probably "the veins from which this quartz was derived belong to a series formed later than the maximum period of regional metamorphism". The work that has been done on these veins consists of a few shallow pits and trenches now sloughed in and practically obliterated.

On the divide between California Creek and Kit and lower Lynx Creeks, there is a quartz lead which was traced for over a mile. The approximate strike is east-west along the top of the ridge. The width of the vein appears to be about 3 feet. The dip is apparently nearly vertical. The walls are both of greenstone. The quartz itself is white and glassy, and, in the specimens examined, showed no mineralization. However, in view of the placers in both California and Lynx Creeks, this lead should have some attention paid to it.

The leads on Riley Creek should be uncovered by systematic prospecting with trenches and pits. From the appearance of the previous work, nothing was done that would show the extent of the veins. If surface work justified it, an adit could be easily driven from Dahl Creek to intersect the veins. An adit also could be driven from the steep slope on the north side of California Creek to intersect the vein at that place.

The writer considers that the Upper Kobuk Goldfields have been much neglected by the quartz miners. Though remote, the region has fairly cheap transportation in the summer and should be more thoroughly prospected.

COPPER

Nothing has been done on the copper prospects of Ruby Creek and Aurora Mountain since the U.S.G.S. expedition in 1910. Even at that time work seems to have been suspended so long that the shafts and other workings had caved in many instances. These prospects were not visited in 1931. At the present price of copper, even the most attractive copper prospect would not pay to develop in such a remote region.

ASBESTOS

About 3/8 mile north of and about 250 feet in elevation above the mouth of Stockley Creek, and on the left limit of Dahl Creek, is a prominent outcropping of greenstone and serpentine. This rock weathers out along both vertical and horizontal joint planes into rectangular blocks. Parallel to the horizontal joint planes are three thin parallel seams of asbestos. The largest was about 3 inches wide and was uncovered for about 2 feet. The dip was about $25\frac{1}{2}°$ to the east. The asbestos fibers lay longitudinally in the direction of the dip and parallel to the walls of the seam. Fibers over a foot long could be pulled from the seam. Specimens of this asbestos are reported to have been submitted to the Bureau of Mines at Washington, D. C., where it was said to be of the very highest grade.

On the Dahl Creek slope near the top of Asbestos Mountain, and about one mile east of and at least 1000 feet in elevation

above the first mentioned outcrop, is another large outcrop of serpentine and nephrite. Here, also, three thin seams of asbestos were seen, the largest 3 or 4 inches in width. These seams were traced for approximately 1/4 mile, and may be longer. The dip is about 25° to the east. The asbestos lies longitudinally with the dip as in the seams first described. Fibers at least 18 inches long could be pulled from these seams. Specimens of this asbestos submitted to the Bureau of Mines Station at College, Alaska, were pronounced to be amphibole asbestos of the very best quality. These asbestos seams were discovered in 1930 and 1931 by Michael Garland.

Y+ 32-13-

About 1/2 mile east of the last described outcrop, and near the "monument" on the highest peak of Asbestos Mountain, is a surface deposit of a short-fibered asbestos. The fibers, as lying weathered out on the ground, were about 1 inch long. This deposit is undoubtedly weathered from the serpentine and may consist of chrysotile. Its value is very problematical.

Similar deposits of low grade asbestos, occur associated with greenstone and serpentine above the canyon on Cosmos Creek and about one-half way up the canyon near the base of Shungnak Mountain on Shungnak River.

The asbestos field in the Upper Kobuk Goldfields needs more thorough prospecting. Other deposits of high-grade asbestos, besides those on Dahl Creek, may be uncovered, which may be large enough to work.

JADE (NEPHRITE)

Quoting P. S. Smith in page 154, U. S. G. S. Bulletin 563,

"In almost all the streams of the Shungnak region north of the Kobuk, boulders of a hard, green, slightly translucent rock are plentiful.....most of the pieces are undoubtedly serpentine, others are green quartzite, and still others are probably neprhite." According to Iddings, neprhite, which is a variety of actinolite or tremolite, occurs only as an alteration product in metamorphosed peridotite, pyroxenite or horneblendite. Actionolite itself may be altered to serpentine with which it is associated.

Many boulders of nephrite of a clear, dark green color occur in the gravels of Dahl Creek. Some of this material approaches gem quality.

On the east side of the summit of Asbestos Mountain, is a large deposit of dark to clear green, translucent nephrite. This stone would approach gem quality if it were not for numerous inclusions of magnetite scattered thickly through it. However, if cheap transportation were available, it might be used for interior decorating. It is also possible that parts of this deposit may be without the disfiguring inclusions.

On Shungnak Mountain adjacent to the asbestos deposit, is also a deposit of nephrite. This is not of such good quality as on Asbestos Mountain, as it grades into serpentine, and also is marred by inclusions. However a good quality of nephrite is occasionally picked up on Shungnak River. Nephrite of good quality is found, through rather rarely, in the placers of (?) Creek.

The nephrite deposits of Jade Mountain were not visited. The source of the fine gem material found there has not been located. This gem material is apple green in color.

PRODUCTION

It is doubtful if the Upper Kobuk Goldfields have produced the discovery of the placers up to the year 1931, more than approximately $175,000. In 1931, the production is estimated at approximately $3,400.00.

FUTURE DEVELOPMENTS

Except rather doubtfully in the superficial reconcentrated glacial deposits of Shungnak and Kogoluktuk Rivers, no possible chance for dredging was seen in the Upper Kobuk Goldfields. If the method of mechanical scraping being developed by the Kobuk Alaska Mines Company is a success, several projects similar to the one on Shungnak River could be developed. These could all be worked as different units by one central management. The future of the area otherwise lies in small hydraulic or scraping plants owned and run by individual operators. Up to the present, lack of capital and initiative among the miners in the area has held back mining developments. Also, with more prospecting, it is quite likely new creeks workable with modern methods will be found.

The gold quartz leads on Riley Creek, and possibly on California Creek, may, with sufficient prospecting work, develop into workable mines. With more prospecting the asbestos on Dahl Creek may be found in sufficient quantities to justify mining and shipping.

Waterpower from both the Shungnak and Kogoluktuk Rivers could be secured without difficulty. Besides having fairly cheap water transportation during the summer, the Kobuk Valley is,

compared to other parts of Alaska, a very easy country in which to build roads.

/s/ IRVING REED

Juneau, Alaska
December 9, 1932

Note of Irving Reed on Kobuk asbestos deposit developments during season of 1932, as given to him by MIKE GARLAND during fall of 1932:

About one mile west from the lower outcrop or first discovery made by Garland, and across Dahl Creek, near the contact of the serpentine and limestone, Garland claims to have found in 1932 another much larger outcropping of asbestos. He took some old powder that was 20 years old and tried to blast out the face of the outcrop. He says that apparently the asbestos is in vertical columns with plates of serpentine between the columns. This would make known exposures two miles apart in the greenstone, and the greenstone extends at least a mile farther to the west from the exposure on top of Asbestos Mountain, with a probable extent of three miles of asbestos-bearing rock.

Reference to my report on the upper Kobuk and maps accompanying.

IRVING M. REED