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STRATEGIC MINERAL OCCURRENCES IN INTERIOR ALASKA

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C O N T E N T S

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STRATEGIC MINERAL OCCURRENCES IN INTERIOR ALASKA

INTRODUCTION

This report has been prepared to furnish information concerning occurrences of the more important of those minerals, the prices of which are sufficiently high to permit mining them in interior Alaska. It was found convenient to limit it for the most part to interior Alaska, or more specifically to the Yukon River watershed, because this region may be considered as a geographic and geologic unit, with similar problems in mining and transportation and with, in many respects, similar types of ore deposition.

Discussed here are occurrences of minerals that supply the following metals: antimony, chromium, mercury, molybdenum, nickel, platinum, tin, and tungsten. Also discussed briefly are occurrences of a few non-metallic minerals, certain grades of which command high prices. They are: asbestos, mica, and quartz crystal. Most of these are classed as strategic minerals, although nearly all of the important metallic minerals may be so classed if an insufficient supply is the main criterion.

Excluded because prices are too low to permit profitable mining in interior Alaska are occurrences of aluminum, magnesium, iron, and manganese. Also excluded, although in many cases they could be mined profitably under present conditions, are occurrences of copper, lead, zinc, and many minor metals. To assemble data on all of these materials would unduly delay publication of this report.

The deposits of each material are described according to the localities in which they occur. Preceding the descriptions of the deposits is a brief geological discussion. Information on past production, prices, and objectionable impurities is also included when it is considered to be pertinent. In order to avoid repetition, information already available in U. S. Geological Survey publications is as a rule omitted, but reference is made to the original publication.

This report is admittedly incomplete; it is presented at this time because of the urgent need for increased production of minerals. To collect data on all known prospects, and on those now being discovered, would delay it indefinitely. Consequently, it was considered advisable to present the information now available, in the hope that it will be immediately useful.

ACKNOWLEDGMENTS

In addition to notes made by the writer while on field trips for the Department of Mines, sources of information include communications from miners and prospectors and records of the Territorial Assay Office at College, Alaska. Much information was also obtained from publications of the U. S. Geological Survey. Reference is made to the sources of information obtained outside the Department of Mines.

Deserving of special thanks are: J. B. Mertie, Jr., of the Alaska Branch of the U. S. Geological Survey, who in 1939 made available 62 samples of placer concentrates, mostly from the Fairbanks District; and also R. C. Wells and Charles Milton, of the Chemical Laboratory of the U. S. Geological Survey, who furnished both laboratory facilities and advice in connection with a mineralogical study of these and other samples. Acknowledgment is also made of the assistance of Eskil Anderson of the Department of Mines, in gathering data used here and in describing 57 samples of placer concentrates that were collected during 1941.

Unless otherwise stated, all quantitative analyses were made by A. E. Glover, Territorial Assayer at College, Alaska.

DEVELOPMENT OF PROSPECTS

In many respects the procedure followed in developing base metal prospects follows the same general pattern, although this pattern is naturally modified by individual conditions. The following remarks are directed mainly to those who have hitherto prospected and developed gold lodes.

Identifications and analyses of ores are made in Territorial Assay Offices at College, Anchorage, Nome, and Ketchikan. These services are free to residents of Alaska, and nominal charges are made to others. Analyses to determine the metal content as well as the presence of objectionable impurities should be made soon after the discovery of a base metal prospect.

After the discovery is made and the prospect has been opened so that ore in place may be observed, the prospector may request an examination by a Territorial Mining Engineer for the purpose of determining if additional development is worthwhile. Development should be carried out with the idea in mind of making an estimate, as soon as possible, of the approximate extent and tenor of the ore.

Since in addition to mining the ore, it is necessary to find a purchaser for it, it is generally advisable to submit a suitable sample to a smelter handling that type of ore, to determine if it contains objectionable impurities or is otherwise undesirable. This procedure involves correspondence with smelters or other buyers of ore and is often necessary whether the owner plans to sell the prospect or develop it himself.

In some cases, usually after preliminary prospecting is completed, various agencies of the Federal Government, such as the Bureau of Mines, the Geological Survey, or the Reconstruction Finance Corporation, may extend aid in various ways in developing deposits of strategic minerals. In addition, the Metals Reserve Company, a subsidiary of the RFC, will guarantee prices of certain ores. L. C. Doheny, of Fairbanks is the RFC supervising engineer for Alaska.

ANTIMONY DEPOSITS

Production

As a consequence of record high prices, active exploitation of Alaskan antimony deposits began in 1914. In 1915, a total of 833 tons of ore averaging about 58 per cent antimony was shipped[1] and production between 1916 and 1918 amounted to 2492 tons[2], practically all from the Fairbanks district. Shipments ceased at the end of the war, although sporadic development work continued for several years in the Fairbanks and Kantishna districts. In 1937 production was started from a large stibnite deposit on Stampede Creek in the Kantishna district. Except for a period during 1941, operations at this deposit have been carried on continuously. In the spring of 1942, a carload of high-grade ore was shipped from another deposit in the Kantishna district, on Slate Creek. As far as is known, no other shipments have been made, although small amounts of stibnite have been mined and stacked at a number of operations.

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[1] Brooks, Alfred H., The Alaska Mining Industry in 1916: U. S. Geol. Survey Bull. 662, 1916, p. 20.

[2] Brooks, Alfred H., The Future of Alaska Mining: U. S. Geol. Survey Bull. 714-A, 1921, p. 39.

Ore Prices and Tenor

Pure stibnite contains 71.4 per cent antimony, but 60-65 per cent ore is considered to be unusually high-grade. Ordinarily, smelters do not accept ores with an antimony content of less than 50 per cent, but recently the minimum has been placed at 40 per cent because of the extraordinary demand for ore. Because of high costs in interior Alaska, however, it would as a rule pay to concentrate low-grade ores to at least 50 per cent before shipping.

During 1941, the price of 50 per cent ore advanced from about $1.50 to $1.80 per 20-pound unit for contained antimony, and from about $1.93 to $2.20 for 65 per cent ore. Prices on April 2, 1942, ranged from $2.10 per unit for 50 per cent ore, to $2.35 for 65 per cent ore. The price per ton on April 2 was therefore, $105 for 50 per cent ore and $152.75 for 65 per cent ore.[1] These prices are for carload lots. Deducted from the quoted price are shipping and smelting charges, as well as penalties.

Objectionable Impurities

Objectionable impurities in antimony ore vary with different smelters and with different projected uses for the antimony. As a rule it is necessary to submit a sample of the ore to a smelter before its suitability can be determined.

At the Laredo, Texas, smelter of the Texas Mining and Smelting Company the maximum combined impurity tolerance of arsenic, copper, lead, and zinc is 0.04 per cent, that is, a penalty is charged against ores containing more than 0.04 per cent of these metals combined. In addition, ores containing over 0.01 per cent selenium are not acceptable.[2] At other smelters there are no penalties for lead, or zinc, and the presence of selenium is not listed as objectionable.

Most of the high-grade ores in interior Alaska contain relatively small amounts of metallic impurities and would therefore meet most requirements. As far as is known, no custom smelters are at present able to recover gold or silver contained in stibnite ore. However, since few of the high-grade stibnite ores in Alaska contain much gold, this loss is unimportant.

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[1]E. & M. J., Metal and Mineral Markets.

[2]From a letter dated October 28, 1941, to L. C. Doheny, RFC Supervising Engineer, Fairbanks, Alaska.

Modes of Occurrence

Stibnite is the only economically important antimony mineral found in Alaska. It is found in quartz lodes in nearly all of the gold mining districts of interior Alaska, where it occurs either as the chief ore mineral or in minor amounts with other sulfide minerals and with gold. Only those deposits in which stibnite is the chief ore mineral will be discussed here. Their distribution in Alaska is shown in Fig. 1.

Stibnite usually occurs either in simple fissure veins or in shear zones, depending on whether the country rock is hard or soft. There is no line of demarcation between the two types; one may grade into the other. The higher grade ore is commonly found in bunches, lenses, or kidneys within a zone of stibnite and quartz gangue. The country rock may be sedimentary, igneous, or metamorphic.

Deposits in which stibnite is the chief ore mineral have been as a rule formed at moderately low temperatures. As far as is known, the greatest depth at which high-grade stibnite has been found in interior Alaska is 500 feet. This is believed to be merely because no deep mining has been done; it probably occurs at much greater depths. Deposits in which stibnite is associated with cinnabar, and which are mined chiefly for the latter mineral, are believed to have been formed at relatively shallow depths. They ordinarily have a smaller vertical range than stibnite deposits proper, although they may grade into true stibnite deposits at depth.

Although stibnite and gold are closely associated in many deposits, most of the high-grade ores examined by the writer contained relatively little gold, silver or metallic minerals other than stibnite. In many cases the nearly pure stibnite occurs in lenses or shoots, in fissures or zones that also contain gold-quartz veins; in these the stibnite is usually later than the main gold deposition, although it is possibly from the same igneous source. The occurrence of stibnite lenses alongside gold-bearing veins merely indicates that the same fissures or zones of weakness in the country rock were favorable loci of ore deposition during at least two different periods.

According to the observations of Brooks[1], however, most of the antimony ores contain more or less gold, as well as galena and pyrite. Whether or not these ores represent a distinct type of mineralization is not known to the writer. It is probable that they are merely mineralogical variations and that numerous gradations exist between the nearly pure stibnite ores and those containing sulfides and gold in addition to stibnite.

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[1]Brooks, Alfred H., Antimony Deposits of Alaska: U. S. Geol. Survey Bull. 649, 1916, p. 11.

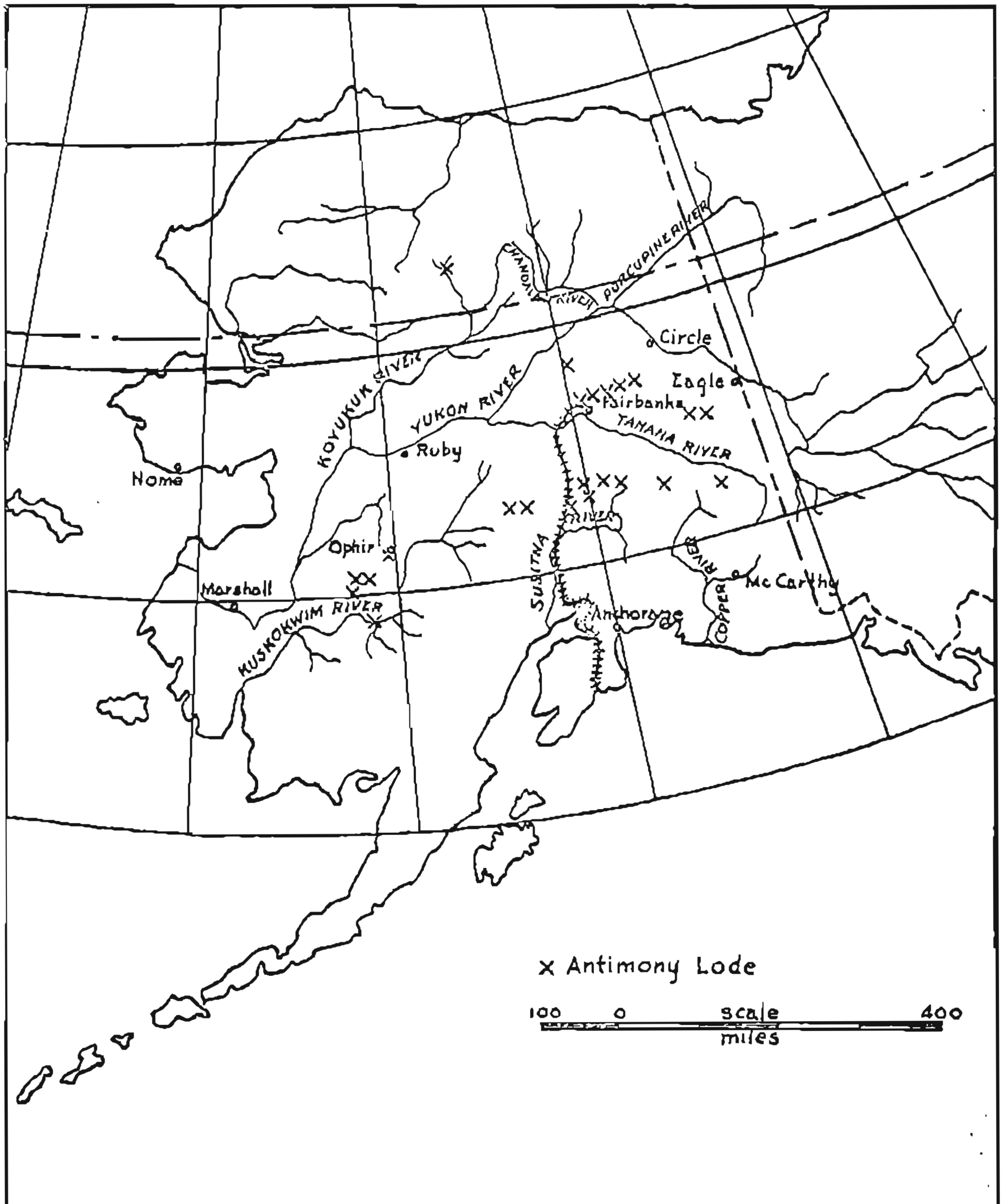

Fig. 1 · Map showing distribution of antimony deposits in interior alaska
From U S Geol. Survey Bull. 649. Plate 1. with additions

Most of the antimony deposits of Alaska are more or less closely associated with granitic rocks, such as monzonite and quartz diorite[1]. In the Fairbanks[2], Kantishna and adjacent districts, these rocks were intruded principally during the Mesozoic, whereas in the Kuskokwim and the lower Yukon regions they were intruded during the Tertiary period[3].

Oxidation products of stibnite include the soft, pale yellow oxides, cervantite and stibiconite, which are not readily interdistinguishable, and the bright red sulfoxide, kermesite. In some deposits these minerals form encrustations an inch or more thick on exposed parts and in cracks in the ore, but ordinarily there has been little weathering, especially where the ground is permanently frozen.

Localities

Fairbanks District:

Stibnite deposits in the Fairbanks District occur in two well-defined zones. The first zone, barely a mile wide, runs about N. 70° E. from Treasure Creek to lower Fairbanks Creek, a distance of 20 miles (Fig. 2). It is generally parallel to the strike of the schist country rock and also to the long axis of the quartz diorite intrusion that runs southeast from Pedro Dome. Numerous light-colored dikes, aligned roughly parallel to the strike of the schist, are also found in this zone[4].

The second zone in which stibnite lodes have been found is in the Ester Dome area (Fig. 2). Here the mineralized area is roughly circular and is about 6 miles across. Only a few granitic rocks outcrop in this area. Their alignment is north to northeast, following structural zones in the schist.

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[1]Brooks, Alfred H., op. cit., p. 9

[2]Mertie, J. B. Jr., The Yukon-Tanana Region: U. S. Geol. Survey Bull. 872, 1937, pp. 241-242.

[3]Mertie, J. B. Jr., and Harrington, G. L., Mineral Resources of the Ruby-Kuskokwim Region: U. S. Geol. Survey Bull. 642, 1915, pp. 262-263.

[4]U. S. Geol. Survey Bull. 849-B, 1933, Plate 3, Geological map of Fairbanks District.

Both zones are much more important for their gold than for their stibnite mineralization. Numerous gold quartz veins are found in them and some of the richest placers in the Fairbanks District are in these zones or adjacent to them.

Between the two zones is a third mineralized zone or area that includes the valleys of Pedro, Gilmore, Engineer and Goldstream creeks. No stibnite deposits are known to occur in this area, the mineralization appears to be of a distinct and higher temperature type that has produced gold, scheelite and small amounts of cassiterite. Although a number of rich and extensive placers have been deposited in this area, few lodes have been found. Some overlapping with the stibnite zone to the north is indicated by the occurrence of placer scheelite and cassiterite in Cleary Creek, near where stibnite lodes have been found.

Stibnite deposits described elsewhere are only mentioned here unless additional information is available, while those about which there is no previously published information will be described in some detail. Little work has been done on these deposits since about 1918, consequently, most of the old workings are now inaccessible.

In the narrow mineralized zone north of Pedro Dome, the most important occurrences described by Brooks[1] are: The Scrafford property on Treasure Creek, the Gilmer and Fredericks properties on Vault Creek, the Tolovana mine on Willow Creek, the Rhoads and Hall (now Cleary Hill) mine on Bedrock Creek, the Chatham or Burns mine on upper Chatham Creek, the Homestake or Nordale mine at the head of Wolf Creek, and the Crites and Feldman (now Hi Yu) mine on Fairbanks Creek. Excepting the first two listed, most of these properties have been worked chiefly for gold, but occasional bunches or kidneys of high-grade stibnite are found with the gold quartz veins. Also described are several gold-quartz veins which carry minor amounts of stibnite.

In the Ester Dome mineralized zone only one occurrence of importance is described by Brooks, this is the so-called Stibnite Lode near the head of Eva Creek (Fig. 2). Also mentioned are two other prospects near the head of Eva Creek, two near the summit of Ester Dome and the presence of antimony ore in the basin of St. Patricks Creek. Several gold-quartz veins in which stibnite occurs sparingly are also listed.

The Gilmer property on Vault Creek, now owned by H. G. Wilcox, was visited by the writer in 1941. The workings, which included open cuts, adits and a shaft, had all caved. About two tons of sacked high-grade ore was stacked on the surface and some lower grade stibnite

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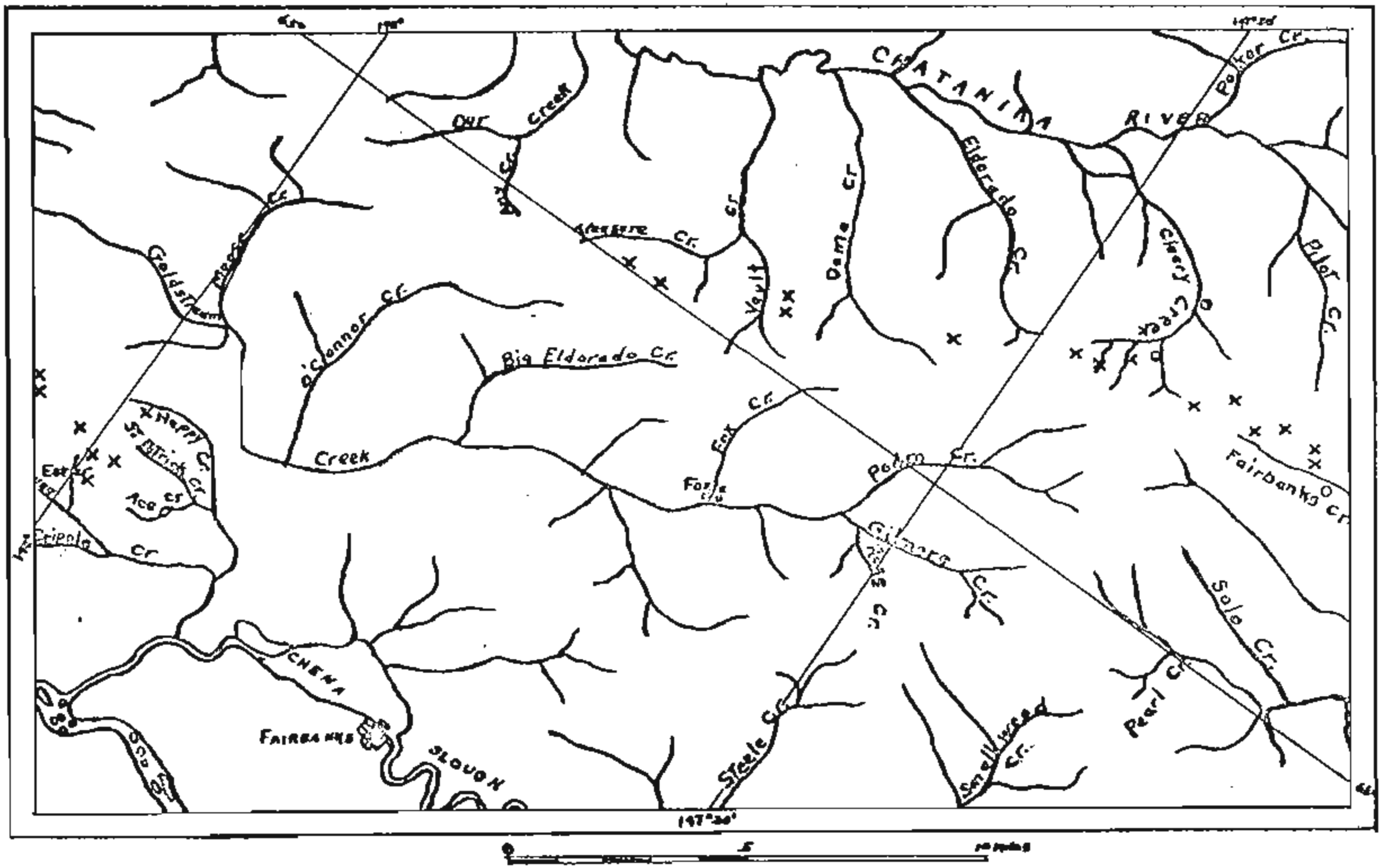
[1]Brooks, op. cit., pp. 28-41.



× Lode Stibnite o Placer Stibnite

Fig. 2. - Map showing antimony occurrences in the Fairbanks district.

was observed on two waste dumps. Most of the high-grade ore was relatively fine grained. The ore was considerably oxidized; yellow encrustations covered some of it to depths of an inch or more.

Samples of the sacked ore contained from 38 to 42 per cent antimony and an average of 0.75 ounces of gold per ton. Picked samples from the dumps contained from 25 to 28 per cent antimony and from 0.2 to 0.74 ounces of gold per ton. The silver content was relatively low and varied between a trace and 1.96 ounces per ton. Only traces of arsenic and lead were found. Noteworthy is the high gold content of this ore; in addition it is more massive than most of the high-grade antimony ore in the Fairbanks District.

Some large lenses of stibnite have been found with the gold-quartz vein in the Soo mine, near the head of Dome Creek. Several large specimens containing over 60 per cent antimony were given to the writer by Otto Geist of College, Alaska. The crystals are curved and bladed; some of them are several inches long. High-grade stibnite was also found on the dump of the old Markovich mine, at the head of Spruce Creek, about a mile northwest of the Soo mine.

High-grade stibnite is found in the McCarty gold mine at the head of Fairbanks Creek. As in other mines in this mineralized zone, the stibnite occurs in separate lenses or bunches that are definitely later than the gold mineralization. A sample taken from a large lens on the 235 foot level contained 60.66 per cent antimony and traces of arsenic, lead, and gold. The gold vein here is made up of coarsely crystalline quartz containing free gold and small amounts of jamesonite, stibnite, arsenopyrite, and sphalerite[1].

Farther down Fairbanks Creek on the Hi Yu property (formerly Crites and Feldman) about a quarter mile northwest from the mine portal, a stibnite vein was uncovered in the fall of 1941. This occurrence is believed to have been originally discovered during the last war, but no development work was done and its location was forgotten. Where exposed in the bottom of a small prospect pit the vein is about 20 inches wide and is composed of coarsely crystalline, bladed stibnite and a small amount of fine-grained vitreous quartz. A thin encrustation of yellow oxides covers the exposed surfaces. Analyses of this ore show an antimony content of from about 60 to 66 per cent, traces of arsenic and lead, and no copper or selenium. The gold and silver contents were 0.01 and 1.00 ounces per ton, respectively.

Placer stibnite has been found in several streams in the mineralized zone north of Pedro Dome. Since the mineral is readily disintegrated it would not ordinarily be found far from its bedrock source. On Cleary Creek, placer stibnite has been found as far downstream as No. 2 above Discovery, bench claim, more than a mile below the nearest known bedrock occurrence. Near the mouth of Chatham Creek, Otto Geist,

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[1] Joesting, H. R., The McCarty Mine, 1941. Unpublished report on file at the Territorial Dept. of Mines, Juneau.

of College found a large piece of fairly high-grade ore which consists of both coarse and fine grained stibnite. This specimen was also over a mile below the nearest known bedrock occurrence on Chatham Creek.

Other placer occurrences are at a number of localities on Fairbanks Creek from claim No. 6 above Discovery, downstream to near the mouth of Deep Creek. On 10 above Discovery, Fish Creek, a piece of fine-grained stibnite was found containing a small gold nugget about one-sixteenth inch in diameter. The bedrock sources of these placer occurrences are probably mostly on the north side of Fairbanks Creek, where there are known to be a number of stibnite lodes.

Placer cassiterite and scheelite are also found with the stibnite on Cleary, Fairbanks, and Fish creeks, thereby indicating an overlapping of the zone of stibnite mineralization with the area of higher temperature mineralization to the south.

In the Ester Dome area occurrences of stibnite are less numerous than in the zone north of Pedro Dome. Aside from those listed on page 8, only a few more occurrences are known. One is in the Ryan Lode near the head of St. Patricks Creek, where lenses of stibnite have been found; another is in a vein near the south end of the McDonald Lode Claim, close to a limestone-aplite contact. A third occurrence is on the steep south slope of Happy Creek valley about half a mile west of the road. In 1940, Gus Krutsch and Ross Cosgrove found here a number of pieces of stibnite float, some of them 2 feet across. The ore was of the coarse, bladed variety, with an antimony content of about 62 per cent. Several prospect trenches were bulldozed and the float was traced uphill several hundred feet, but its bedrock source was not discovered.

Bonnifield and Wood River Districts:

Several previously unreported occurrences of stibnite were seen by the writer during a field trip made in 1941 along the north side of the Alaska Range, between Mt. Hayes and Ferry[1]. With one exception little work has been done on them.

A large amount of high-grade stibnite float was found at an altitude of about 5,000 feet, near the head of Kansas Creek, tributary to Wood River. Although the vein is covered by talus, according to the amount of float it is about 5 feet wide and appears to strike northeast. The ore consists mainly of stibnite with a small content of lead and zinc, but no gold or silver. The country rock is dark quartzite schist, much of which is iron-stained. Numerous small intrusions of granite were found nearby. Because of its remote location it is doubtful if this occurrence of antimony could be successfully worked.

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[1] U. S. Geol. Survey Bull. 907, 1940, Plate 3: Geologic map of the Bonnifield region.

Antimony prospects have been reported in the vicinity of California Creek. Several are on Martin and Eagle creeks, small tributaries to McAdams Creek, which in turn runs into California Creek. Apparently no work has been done on them. On Caribou Creek, which runs into California Creek several miles below McAdams Creek, is a large stibnite vein that has been staked several times, but has been little developed. It is at present owned by Valentine Diebold of Ferry.

On upper Cody Creek, about 6 miles northeast of Ferry, is a stibnite prospect owned by Albert Barlow and Joseph Koska of Ferry. The ore occurs in small, discontinuous bunches in black, slaty schist that forms a small cliff on the north side of Cody Creek. Only a few feet back from the face of the cliff it is cut off by a large fault that extends several miles toward the head of Eva Creek.

Three tunnels, one 90 feet long, were driven into the cliff, but no solid ore was found after the fault zone was reached. About two tons of high grade stibnite was mined and sacked during the prospecting. A sample contained 47 per cent antimony and traces of gold, silver, arsenic and lead. It is unlikely that any worthwhile amounts of ore remain underground.

A stibnite lode has been reported on Rex Creek, about 2 miles northeast of the Cody Creek prospect, and two others on Lignite Creek, tributary to the Nenana River. No information is available as to their exact locations.

Farther down the Alaska Railroad, about 5 miles south of Colorado, is an antimony lode described by Capps[1]. This deposit, on Antimony Creek, was prospected a number of years ago by a tunnel said to be 100 feet long. Samples from the dump contained 30 to 40 per cent antimony. The tunnel is now caved, but is being reopened by Howard Sparks of Livengood.

Donnelly District:

A gold bearing stibnite prospect is reported on Gunnysack Creek, about half a mile south of the Rapids Roadhouse and the same distance upstream from the road. A tunnel was driven there in 1916. The ore is said to carry from $1.50 to $15 per ton in gold and the stibnite is apparently low grade.

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[1]Capps, S. R., Mineral Resources of the Upper Chulitna Region: U. S. Geol. Survey Bull. 692, pp. 229-230, 1919.

Tok District:

On Boulder Creek, a small stream that enters the Tok River about 7 miles above the Dry Tok, is a large stibnite vein said to have been discovered about 1901. It was examined by Moffit[1] in 1936 and by Joesting[2] in 1941, after some development work had been done.

Where exposed by prospecting the deposit consists of banded quartz and stibnite toward the walls and 2 to 3 feet of higher grade ore near the center. The total width of the mineralized zone is about 11 feet. In the higher grade parts the stibnite is both massive and coarsely crystalline. A considerable proportion of fine-grained, vitreous quartz is also present. The antimony content of the higher grade ore averages about 20 per cent, while that of the outer zones is much less. The ore also contains about $1.00 in gold per ton, as well as traces of silver and arsenic, but no lead. Although the deposit is relatively low-grade where exposed, it is not unlikely that higher grade lenses will be encountered. It is owned by Sam Gamblin and George Morhoffer of Fairbanks.

Fortymile and Goodpaster Districts:

A large stibnite prospect owned by Paul Glasgow of Fairbanks is reported on upper Kechumstuk Creek, tributary to the Mosquito Fork in the Fortymile district. It is said to have been first prospected many years ago. Only a single analysis is available; this shows an antimony content of 31 per cent.

East of the Glasgow prospect, in the Middle Fork drainage, is another large prospect reported by Quentin Harris. A considerable tonnage of ore, containing about 48 per cent antimony and about $3.50 in gold per ton, is said to be in sight here.

Although these prospects are remote from transportation, it would be entirely feasible to work them under present conditions provided a moderate tonnage of fairly high-grade ore could be developed. Shipping the ore would necessitate a tractor-sled haul to the Tanana, from where it could be transported by river boats to Big Delta and thence by truck to seaboard at Valdez.

1Moffit, F. H., Geology of the Slana-Tok District: U. S. Geol. Survey Bull. 904, pp. 43-45, 1938.

2Joesting, H. R., The Stibnite Deposit on Boulder Creek, Tok River District. Unpublished report on file at the Territorial Dept. of Mines, Juneau.

In the Goodpaster district antimony occurs in jamesonite, a lead antimony sulfide which is associated with the gold-quartz veins at the head of Tibbs Creek. Although some of the veins contain considerable jamesonite, it is doubtful if the antimony or lead could be recovered profitably unless large-scale mining operations were initiated.

Circle District:

Stibnite is comparatively rare in the Circle district. A number of small pieces, the largest of which was about two inches across, were found in placer concentrates on upper Sourdough Creek, indicating a nearby bedrock source. Occurrences of stibnite have been reported in the Crazy Mountains and on the South Fork of Birch Creek, but they have not been confirmed.

Tolovana District:

During the last war stibnite is said to have been shipped by parcel post from a vein on claim No. 16 above Discovery, on Livengood Creek. This vein was apparently discovered while drift mining for placer gold.

A mineralized zone containing thin seams of stibnite and traces of cinnabar and gold is exposed in a cut bank on the north side of Lillian Creek, just across the highway crossing. According to the results of assays, however, the metallic mineral content of the zone is too low to permit profitable mining.

Placer stibnite occurs on both Lillian and Amy Creeks, and Mertie[1] reports that in 1916 a vein of stibnite was uncovered on Lillian Creek during placer mining operations.

Koyukuk Region:

The only known lode occurrence of stibnite in the Koyukuk region is one reported by Shorty Herbert on the John River near Hunts Fork. A sample submitted by Herbert from this lode contained 42 per cent antimony. Schrader[2] reports that stibnite pebbles were found in the gravel of Gold Creek, a tributary to the Middle Fork of the Koyukuk River above Wiseman.

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[1]Mertie, J. B. Jr., The Gold Placers of the Tolovana District: U. S. Geol. Survey Bull. 662, 1918, pp. 270-271.

[2]Schrader, F. C., U. S. Geol. Survey Prof. Paper 20, p. 105, 1914.

Other Districts:

In the Kantishna and adjacent districts, the antimony deposits are generally similar to those in the Fairbanks district. In the Innoko, Iditarod, McGrath, and Sleitmut districts the stibnite is associated with cinnabar and the deposits have been mined principally for mercury

Descriptions of the antimony deposits of these districts are omitted because little new information is available. Most of the known deposits have been described by Brooks and others[1].

CHROMIUM DEPOSITS

Ore Prices and Tenor

Early in 1942 chrome ore was quoted at about $40 a long ton for ore containing 48 per cent chromic oxide, delivered at Atlantic coast ports. In March 1942, the Metals Reserve Company, an RFC subsidiary, announced that truckload lots of chrome ore would be purchased at depots in northern California and Oregon. The stated base price for high-grade ore containing 45 per cent Cr_2O_3 was $40.50 a long ton, with an increase of $0.90 per ton for each 1 per cent Cr_2O_3 in excess of 45 per cent. Specifications called for maximum contents of silica, phosphorus and sulfur, of 11, 0.2 and 0.5 per cent, respectively, and a minimum chrome-iron ratio of 2.5 to 1.

Modes of Occurrence

Chromite is the only ore mineral of chromium. Deposits of chromite nearly always occur as segregations in basic, generally dark-colored igneous rocks such as peridotite, dunite, or serpentine, and in placers derived from these rocks. The mineral is hard and chemically stable, consequently it seldom shows weathering effects and often stands out in relief from the enclosing rock.

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[1]Brooks, op. cit.

Mertie, J. B. Jr., Mineral Deposits of the Ruby-Kuskokwim Region: U. S. Geol. Survey Bull. 864-C, 1936, pp. 225, 228.

Capps, S. R., Geology of the Alaska Railroad Region: U. S. Geol. Survey Bull. 907, 1940, pp. 179, 183, 187, 188, 191.

Dunites and related rocks are composed chiefly of olivine, which has a high magnesium content. Soil from these rocks is not favorable to plant growth, hence they may often be recognized at a distance by their barren appearance.

Since the prices of chromite are comparatively low, only large and high-grade deposits of this mineral could be successfully exploited in interior Alaska. None has been found so far, although it should be pointed out that no special search has been made.

Localities

Salcha District:

Chromite has been found in two large areas of basic rocks northeast of the Splits of the Salcha River.[1, 2] These deposits are of the disseminated type, where grains and small crystal aggregates are distributed rather uniformly throughout the rock. Found in a few places were small segregations of high-grade chromite a foot or so thick and a few feet long, but for the most part the chromite content was not over about one per cent.

The chromite-bearing rocks are peridotite and dunite, in part altered to serpentine. They are intruded as laccoliths into Paleozoic quartz-mica schists and calcareous schists. Many other basic intrusives, varying in size from a few square miles to several hundred square miles, occur in the same area. Most of them are well exposed and weathered to a characteristic brown color.

Tolovana District:

A chromite prospect was found over 25 years ago near the town of Livengood. The prospect pit is now caved, but the chromite is believed to be associated with serpentine rocks in the vicinity.[3] Analyses of samples indicate that the ore is not high-grade.

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[1]Mertie, J. B. Jr., The Yukon-Tanana Region: U. S. Geol. Survey Bull. 872, 1937, Plate 1.

[2]Joesting, H. R. and Anderson, E., report in preparation.

[3]Mertie, J. B. Jr., Gold Placers in the Tolovana District: U. S. Geol. Survey Bull. 662, 1918, p. 275.

Chromite and chrome spinels are found in many placers in the vicinity of Livengood, notably in Lucky Gulch and in Livengood, Amy, Lucille, Ruth and Olive creeks. It is especially abundant in samples from Lucky Gulch and from claims 5 to 8 above Discovery on Livengood Creek. Mertie[1] reports that chrome spinel occurs in the bench channel of Livengood Creek from the Red Claim, opposite Lucky Gulch, to Discovery Claim, below Ruth Creek, a distance of nearly 4 miles

Both the chromite and chrome spinel are believed to be derived from serpentine in Middle Devonian basic volcanic rocks that outcrop at Livengood and may be traced northeast and southwest for long distances. Segregations of chromite doubtless exist in these rocks, but finding them would be a difficult task because of the thick alluvial overburden in much of the district.

Other Districts:

Chromite has been found, generally in small amounts, in practically all the basic igneous rocks in interior Alaska. It is also found in placer concentrates from the Circle, Eagle, Bonnifield, Ruby, Iditarod, and Marshall districts. Waters[2] found picotite or chromite in the majority of 38 samples from the Rampart and Hot Springs districts. So far as is known, however, no commercial deposits are likely to occur in any of these localities.

NICKEL DEPOSITS

Ore Prices and Tenor

Nickel ores are generally complex, and prices depend on methods of treatment necessary. The price of the metal has been 35 cents a pound for a number of years. Most of the nickel produced in the western hemisphere is from the Sudbury district in Ontario, from mines controlled by the International Nickel Company.

At Sudbury, where the nickel occurs in pentlandite associated with pyrrhotite and chalcopyrite, the average nickel content is about 2.5 per cent. In addition, the ore contains about 3 per cent copper and 0.05 oz. ~~per cent~~ platinum per ton. In the New Caledonia deposits, where the nickel occurs in garnierite and related nickel silicates, the average nickel content is about 5 per cent. In interior Alaska a nickel content of at least 5 per cent would probably be necessary before a fair sized deposit could be profitably mined.

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[1]Mertie, op. cit., p. 265.

[2]Waters, A. E., Jr., Placer Concentrates of the Rampart and Hot Springs Districts: U. S. Geol. Survey Bull. 844, 1934, pp. 231-242

Modes of Occurrence

Nickel and platinum are usually associated with the same rock-types as chromium and are often found in the same regions. Nickel occurs in two main types of deposits, as segregations of nickel-bearing pyrrhotite in basic rocks, and in superficial veins and cracks in serpentines. In the first type the principal nickel mineral is pentlandite; in the second it is garnierite. In interior Alaska nickel occurs in garnierite in most of the known prospects. Nickel deposits of the garnierite type are not uncommon, but significant production has been attained only in New Caledonia.

Localities

Salcha District:

Considerable areas of serpentine rocks in the Salcha District have been found to contain up to 0.6 per cent of nickel, as well as traces of platinum, and small amounts of chromium. Traces of nickel are also found at the head of Nickel Creek in dolomite in contact with peridotite. Localities that have been investigated[1] include a large basic intrusion at the head of Nickel Creek, northeast of the Splits and an intrusion on the north side of Gold Creek, about 8 miles north of the Butte. Other nickel prospects have been reported east of the Salcha River, but they have not been confirmed. Although it is unlikely that rich deposits will be found, these areas of basic rocks are considered to be worth prospecting for nickel and platinum, as well as for chromium.

Tolovana District:

In the Tolovana district small amounts of nickel have also been found in serpentine. One sample from upper Lillian Creek contained both nickel sulfides and nickel silicates, but both were present in small amounts. The highest nickel content reported in serpentine near Livengood was about 0.3 per cent.

Hot Springs District:

Nickeliferous pyrrhotite and cobalt bloom have been found in a basalt dike south of Hot Springs Dome. The highest analysis showed 0.8 per cent cobalt; no quantitative nickel analyses are available.

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[1]Joesting, H. R. and Anderson, E., report in preparation.

This prospect and others on Hot Springs Dome have been described by Mertie[1].

Other Districts:

Little is known of nickel prospects in other districts in interior Alaska. Pentlandite and millerite have been found in the Mt. Eilson district, but all the samples were low-grade. What proved on analysis to be a nickel-bearing alum was collected in 1941 by members of a U. S. Geological Survey field party, from a seep on the Porcupine River, opposite the mouth of the Salmontrout River. This information was given by Fred Rich of College, who was a member of the field party headed by J. B. Mertie, Jr.

PLATINUM DEPOSITS

Price

During 1940 the price of crude domestic platinum varied between $21.92 and $37.67 an ounce, according to the Minerals Yearbook of 1940. Refined platinum sold for $36 an ounce during 1941, and up to date in 1942.

Modes of Occurrence

Platinum occurs chiefly in basic igneous rocks associated with chromite, pyrrhotite and chalcopyrite; and in placers. Much of it is found native, with a purity of about 60 to 90 per cent. Alloyed with it are other platinum group metals, chiefly iridium and osmium, and also iron.

Localities

The most productive platinum deposits in the United States or its possessions are the placers in the Goodnews district. They have been described by Reed[2] and by Mertie[3].

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[1]Mertie, J. B. Jr., Mineral Deposits of the Rampart and Hot Springs Districts: U. S. Geol. Survey Bull. 844-D, 1934, p. 215.

[2]Reed, Irving, Report on Mining Investigations in Alaska, pp. 103-126, Juneau, Territory of Alaska, 1933.

[3]Mertie, J. B. Jr., The Goodnews Platinum Deposits, Alaska: U. S. Geol. Survey Bull. 918, 1940.

Small amounts of platinum and platinum group metals have been produced intermittently for a number of years from placers on Boob Creek in the Tolstoi district, Granite Creek in the Ruby district, Slate Creek in the Chistochina district, Cache and Peters creeks in the Talkeetna district and from the Kahiltna River in the Yentna district[1]. In all of these localities the placers are worked primarily for gold; platinum occurs in relatively small proportions.

Platinum has also been found in placers on Willow and Wilson creeks in the Marshall district, Moose and California creeks in the Bonnifield district, Lucky Gulch in the Seventymile district, and on several creeks in the Tolovana district. So far as is known, however, in none of these localities have significant amounts been reported.

Traces of platinum have been found in serpentines and peridotites in the Salcha-Chena region and also near Livengood. It is unlikely that commercially important lodes will be found in these areas, but placers derived from the basic rocks may contain platinum in addition to gold.

MERCURY DEPOSITS

Price and Tenor

Late in 1941 mercury was quoted at the record price of nearly $200 for a 76-pound flask. Subsequently, the price declined slightly, but it was still about $197 early in 1942 and is likely to remain relatively high as long as the strong demand for mercury continues. Current domestic production, however, is probably at record levels, since mercury production reacts quickly to price changes. No prices are quoted for mercury ores; their reduction is simple and inexpensive and consequently they are usually treated at the mines.

As long as mercury sells for over $2.50 a pound, the minimum grade of ore that can be profitably mined in Alaska will probably be as low as 0.5 per cent, although this, of course, will depend partly on local conditions.

Modes of Occurrence

Cinnabar is the only commercially important mercury mineral. It is found in irregular fissure veins, in networks and stockworks of small veins, and as disseminations in more or less porous rocks. In many deposits an impervious shale roof has apparently served to localize the ore shoots.

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[1]Mineral Industry of Alaska in 1936: U. S. Geol. Survey Bull. 897-A, 1938, p. 83.

Cinnabar deposits occur in all kinds of rocks, but generally in regions of volcanic activity. They are, as a rule, near-surface deposits that decrease in tenor at relatively shallow depths. For this reason the rich deposits are almost always found in Tertiary or younger rocks; those in older rocks have long since been eroded away.

Pyrite, marcasite and stibnite are usually associated with cinnabar. Stibnite often becomes more abundant at greater depths. Common gangue minerals are opal, chalcedony, quartz, calcite and dolomite.

Localities

Cinnabar is found widespread in the Kuskokwim region and in the Iditarod and Innoko districts. It is also found, generally in small amounts, in the Marshall, Kantishna, Bonnifield, Tolovana, Rampart, Hot Springs, Circle, Fortymile and Seventymile districts. The distribution of cinnabar deposits in Alaska is shown in Fig. 3. According to Mertie[1], cinnabar is a characteristic product of Tertiary mineralization in both the Yukon-Tanana region and in southwestern Alaska, furthermore, it has been found only in lodes of Tertiary age and in placers derived from them.

Kuskokwim Region:

Most of the known cinnabar occurrences in Alaska are in the Kuskokwim region. The deposits occur in veins and shear zones in Cretaceous sandstones and shales, and are closely associated with dikes and other small masses of Tertiary rhyolites and granites. Descriptions of many of them appear in various Geological Survey publications[2].

The Red Devil mine, on the south side of the Kuskokwim River about 8 miles below Sleitmut, is at present the only property in Alaska producing mercury in significant amounts. According to Picotte[3], the 1940 production was 167 flasks, while the 1941 production to September 15 was 80 flasks, with a production rate of two flasks a day. Oil-fired retorts are used to reduce the ore.

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[1]Mertie, J. B. Jr., The Yukon-Tanana Region: U. S. Geol. Survey Bull. 872, pp. 248, 249-250.

[2]U. S. Geol. Survey Bulletins 622, 642, 754, 864, and others.

[3]Picotte, Gordon, University of Alaska mining extension instructor: oral communication, 1941.

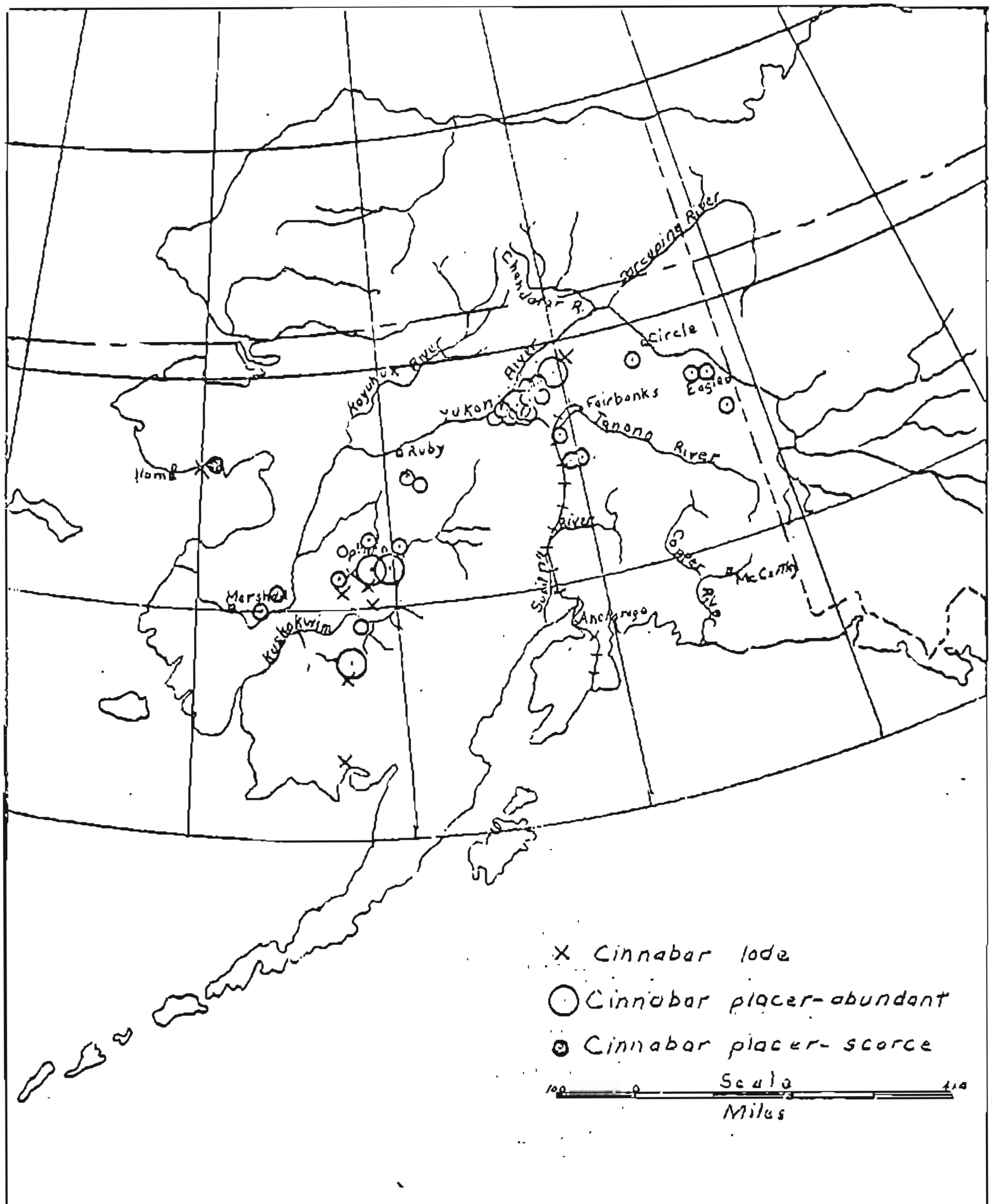

Fig. 3. - Map showing distribution of mercury deposits in Alaska.

The cinnabar occurs as stringers in large lenses said to average a foot wide and 100 feet long, and which occupy a shear zone in sand stone and shale. Metacinnabarite, the black mercuric sulfide, is abundant at the surface of the deposit. Stibnite occurs with the cinnabar in amounts that are believed to increase at greater depths. Gangue minerals are calcite and quartz. Rhyolite dikes are apparently associated with the cinnabar mineralization. The average mercury content of the ore as retorted is reported to have been about five per cent.

Near the Kuskokwim River, a quarter mile below Sleitmut, is a cinnabar prospect owned by Herschell and Hortense Landru. Considerable rich float, containing both cinnabar and metacinnabarite, has been found, but it has not yet been traced to its source. The country rock and dikes are said to be similar to those on the Red Devil property.

A recent discovery of cinnabar was made by Russel Schaeffer and Harvey Winchell on the upper Swift River, tributary to the Holitna River. By river from Sleitmut the distance is said to be about 150 miles, but by air it is probably less than 75 miles. Several low grade lode occurrences were found, as well as a rich placer deposit. The placer cinnabar was found in a creek named Cinnabar Gulch, its extent is unknown, but the pay gravel is said to be about a foot thick. It lies on shale bedrock and is covered by 4 to 10 feet of overburden. Recently a small shipment of cinnabar concentrates was made from this prospect, down the Aniak River. The concentrates were produced by sluicing the placer cinnabar through boxes.

Summarized in the following table is the available information concerning known lode occurrences of cinnabar in the Kuskokwim region. Although a few of them are listed, placers and residual deposits containing cinnabar are found near many of the lodes.

Table I. - Cinnabar Deposits in the Kuskokwim Region

Name and Location	Type of Occurrence	Source of Information
Parks, near Sleitmut	Lode	Bull. 655, pp. 139-144[1]
Willis and Fuller, near Sleitmut	Lode	Bull. 655, p. 144
Red Devil (Halverson and Mellick), near Sleitmut	Lode	Picotte, ibid.
Barometer Group, near Sleitmut	Lode	Wilcox, H. G., oral communication
Cinnabar Chief	Lode	Bull. 797, p. 41
Landru Prospect, near Sleitmut	Placer and Lode	Doheny, L. C., and Landru, Herschell, oral communication
Schaeffer and Winchell, upper Holitna River	Placer and Lode	Doheny, L. C. and Landru, Herschell, oral communication
Prospect near Napamute	Lode	Bull. 792, p. 33
Prospect near Kolmakof	Lode	Bull. 622, p. 272

Nushagak District:

An occurrence of cinnabar on the Wood River, above Dillingham, was reported to the writer by H. G. Wilcox, dean of the School of Mines, University of Alaska. No details are known concerning this occurrence.

Iditarod, Innoko and McGrath Districts:

The Brink property on the upper Iditarod River, about 40 miles southwest of Flat and 25 miles northwest of Crooked Creek post office, is the only lode occurrence in the Iditarod district known to have produced mercury. A total of about 157 flasks was produced prior to 1927; since then the property has lain idle except for a small amount of intermittent prospecting. It is reported, however, that development has recently been resumed. All of the ore was taken from

[1]Bulletins are U. S. Geological Survey bulletins.

open cuts. It was reduced in two Hendy 6-tube retorts that are still on the property.[1]

The cinnabar is associated with light-colored porphyry dikes of varying widths. It occurs in stringers in the dikes, in the adjacent sedimentary rocks and along the contacts of the dikes and country rock. Surface mineralization is said to have been traced for half a mile along the dike system. Some of the ore is high-grade.

Cinnabar in considerable amounts has been found in some of the placers in the Iditarod and McGrath districts, notably on Happy and Candle creeks. Mercury for local use has been recovered from some of them. Several lode occurrences are also known, but no production has been reported from them.

Known lode and placer occurrences in the Iditarod, Innoko, and McGrath districts are listed in Table II. Since no exact data are available concerning tenor of the deposits, the terms abundant, common, scarce, and rare are qualitative.

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[1]Lyman, R. F., University of Alaska mining extension instructor, oral communication, 1941.

Table II - Occurrences of Cinnabar in the Iditarod, Innoko, and McGrath Districts

Name and Location	Type of Occurrence & Relative Abundance	Source of Information
Brink (DeCoursey) Mine, head of Iditarod River	Lode	Lyman, R. F., ibid. and Bull. 864, p. 243
Head of Glen Gulch	Lode	Bull. 655, p. 145
Head of Flat Creek	Lode	Bull. 754, p. 116
Glen Gulch	Placer - common	Bull. 655, p. 145
Happy Creek	Placer - abundant	Bull. 864, p. 212
Black Creek	Placer - abundant	Bull. 655, p. 145
Flat Creek	Placer - common	Dept. of Mines
Otter Creek	Placer - abundant	Bull. 739, p. 157 and Doheny, L. C.
Moore Creek	Placer - abundant	Bull. 754, p. 108
Head of Wyoming Creek, Cripple Creek Mts.	Lode	Bull. 754, p. 116
Boob Creek	Placer - scarce	Bull. 754, p. 108
Candle Creek	Placer - abundant	Bull. 754, pp. 107-108
Creeks on north slope of Apple Mtn near McGrath	Placer - scarce	Doheny, L. C.

Tolovana District:

Large amounts of placer cinnabar have been found on Olive Creek and smaller amounts on Lillian and Ruth creeks. These creeks all head in the same area, near the town of Livengood. One lode occurrence - the Hudson cinnabar prospect - was discovered on upper Olive Creek in 1917. Considerable underground development was done and a small amount of mercury was produced. During 1940 and 1941 the prospect was re-opened and extended by Fred Crane; subsequently, an examination was made by Joesting[1], who found that the deposit is too low-grade to be of commercial importance, and that it probably becomes leaner at greater depths.

[1]Joesting, H. R., The Hudson Cinnabar Prospect, Tolovana District, 1941, Unpublished report on file at the Territorial Dept. of Mines, Juneau.

Other Districts:

Little lode prospecting for cinnabar has been done in regions other than southwestern Alaska. A few occurrences are known, but the lodes are small and low-grade, and none appears promising. Many placer occurrences are known, but in few of them is cinnabar present in commercial quantities. In the following table available information concerning placer cinnabar in several districts is summarized.

Table III - Occurrences of Placer Cinnabar in the Yukon and Tanana Regions

District	Location of Occurrence	Relative Abundance	Source of Information
Marshall	Bobtail Cr. trib. Kako Cr.	Rare	Dept. of Mines
	Flat Cr. trib. Stuyahok R.	Scarce	Dept. of Mines
Bonnifield	Moose Creek	Common	Dept. of Mines
	Grubstake Creek	Scarce	Dept. of Mines
	California Creek	Scarce	Dept. of Mines
Rampart	Hunter Creek	Scarce	Bull. 844-D, p. 232
	Little Minook Creek	Rare	Bull. 844-D, p. 233
	Hoosier Creek	Rare	Bull. 844-D, p. 234
	Quail Creek	Rare	Bull. 844-D, p. 235
	Troublesome Creek	Scarce	Bull. 844-D, p. 236
Hot Springs (Eureka Area)	Pioneer Creek	Rare	Bull. 844-D, p. 237
	McCaskey Bar	Rare	Bull. 844-D, p. 238
	Shirley Bar	Common	Bull. 844-D, p. 238
	Omega Creek	Rare	Bull. 844-D, p. 238
Circle	Deadwood Creek	Scarce	Dept. of Mines
Seventymile	Seventymile R. below the Falls	Scarce	Bull. 897-C, p. 192
	Canyon Creek	Scarce	Bull. 872, p. 245
	Mogul Creek	Scarce	Dept. of Mines
Fortymile	Wade Creek	Scarce	Bull. 897, p. 160

MOLYBDENUM DEPOSITS

Price and Tenor

Throughout 1940 and 1941 the price of molybdenite concentrates containing 90 per cent MoS_2 was quoted nominally by the Engineering and Mining Journal at 45 cents per pound of contained MoS_2; this is equivalent to 75 cents per pound of contained Mo.

Molybdenite deposits are often rich locally, but few of the known large deposits average more than 1 per cent molybdenite. The deposit at Climax, Colorado, the world's largest producer, carries only about 0.9 per cent molybdenite. Smaller deposits carry 5 per cent or more of the mineral. In interior Alaska, unless the deposit was exceptionally large, a tenor of at least 5 per cent would be necessary before molybdenite could be mined under present conditions.

Modes of Occurrence

Molybdenite is the only ore mineral of molybdenum. It is found principally in pegmatite dikes, quartz veins, contact deposits, and disseminated in porphyries. Deposits of molybdenite are generally closely associated with granitic intrusive rocks.

Most of the molybdenite deposits in Alaska are found in the southeastern part, where the mineral is also a fairly common accessory in some of the gold and copper ores. In interior Alaska the few known occurrences are apparently not of commercial grade.

Localities

Donnelly District:

In a canyon of Ptarmigan Creek, in the foothills of the Alaska Range north of Mt. Hayes, several molybdenum prospects have been developed over a period of several years by A. W. Conradt of Fairbanks. They were examined in 1941 by Joesting[1]. Molybdenite occurs scattered sparsely through a large number of quartz stringers in granodiorite. Gold quartz veins are also found in the granodiorite. In several places the stringers constitute small stockworks and it is in these stockworks that most of the prospecting has been done. Four adits were driven into the canyon walls. One is 106 feet long; the others are from 24 to 34 feet long. No commercial ore was encountered.

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[1]Joesting, H. R., The Geology and Ore Deposits of Ptarmigan Creek, Mt. Hayes District, Unpublished report on file at Territorial Dept. of Mines, Juneau.

Upper Tanana Region:

A small number of molybdenite prospects are known or have been reported in the upper Tanana region; among them are the Johnson prospect at the head of the Healy River, several occurrences near the head of the South Fork of the Goodpaster River, and the Hajdukovitch prospect, said to be near Tetlin.

The Johnson prospect, on a divide between the heads of the Healy River and the South Fork of the Goodpaster River, was described briefly by Chapin[1]. Molybdenite occurs scattered through a white quartz vein in granite. A picked sample from this prospect contained 1.2 per cent molybdenite, but the average content is much less. Except for casual sampling, no work is known to have been done on it for many years.

Several miles west of the Johnson prospect, at the head of Boulder Creek, molybdenite occurs sparingly in small quartz veins in granite. It has also been found in the adjacent area at the head of Tibbs Creek, although most of the mineralized veins in the Tibbs Creek area carry gold and jamesonite, and represent a mineralization distinct from that which deposited the molybdenite. So far as is known, high-grade molybdenite ore has been found in none of the prospects in the Goodpaster-Healy River district; but on the other hand, little prospecting has been done.

The Hajdukovitch prospect is said to be in the vicinity of Tetlin, but its exact location is unknown to the writer. Some high-grade specimens are reported to have come from this prospect.

Other Districts:

Molybdenum deposits have been reported on the Indian River below Hughes and also in the vicinity of Kaltag. The Indian River prospect was apparently discovered during placer mining operations. It is said to contain ore of high grade but has not been systematically sampled.

Molybdenite also occurs in scheelite deposits at the head of Engineer Creek in the Fairbanks district. Small flakes of the mineral are associated with scheelite in limestone near a granite contact. The molybdenite is of no commercial importance.

A relatively large number of molybdenite prospects have been found in the copper River region and development work has been done on some of them. Since deposits of other minerals in the Copper River region are not described in this report, specific mention will be made of only two that are potentially important.

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[1]Chapin, Theodore, A Molybdenite Vein on Healy River; U. S. Geol. Survey Bull. 692, 1919, p. 329.

A prospect owned by Fram, Horn and Todd, on Rock Creek in the Slana district has been described by Roehm[1] and by Moffit[2].

Several prospects containing high-grade molybdenite have been reported in the vicinity of McCarthy. One of these on Canyon Creek, in the upper Chitina River Valley, has been described by Moffit[3].

TIN DEPOSITS

Price and Tenor

During 1941 metallic tin sold for about 52 cents a pound landed at New York; this was for tin mined and smelted in Malaya. Most of the small domestic production of tin concentrates is now refined in the United States[4]. For this production the producer receives the quoted price of metallic tin, from which smelting charges are subtracted. Smelting charges for Alaskan concentrates have been about $50 a ton, but they are said to have increased considerably in 1941. Costs of sacking and shipping are also paid by the producer, so that total marketing costs, including sacking, freight, and smelting may be from about $75 to over $100 a ton, depending on the locality.

Most of the tin mined in North America is from placers in the York district in the Seward Peninsula, where average mining costs are about $2 a cubic yard. They are comparatively high because the mining season is short and the small size of most of the deposits necessitates the use of small-scale methods. In the York district an average tenor of eight pounds of 70 per cent concentrates per cubic yard is necessary for profitable operation. By way of comparison, on the Malay Peninsula where operations are on a large scale and labor costs are low, most of the production has come from gravel averaging 0.5 pound of cassiterite per cubic yard.

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[1]Roehm, J. C., Preliminary Report of Rock Creek Molybdenum Group of Claims, Slana Mining District, 1936. Unpublished report on file at the Territorial Dept. of Mines, Juneau.

[2]Moffit, F. H., Geology of the Upper Tetling River District: U. S. Geol. Survey Bull. 917-A, 1941, pp. 150-153.

[3]Moffit, F. H., Mineral Resources of the Upper Chitina Valley: U. S. Geol. Survey Bull. 642, p. 135.

[4]Minerals Yearbook, Review of 1940, p. 674.

In the tin-producing districts of interior Alaska, where larger scale placer mining methods are practicable and where the mining season is longer, costs are generally somewhat lower than in the York district. Furthermore, the tin is recovered from placers mined primarily for gold; the value of the tin is in most cases far less than the cost of mining it.

Modes of Occurrence

Cassiterite, the oxide of tin, is the most abundant tin mineral and the only one of economic importance in Alaska. Cassiterite lodes are found in quartz veins, pegmatite dikes, and contact metamorphic deposits. Tin-bearing veins are usually found in or near granites. Tungsten minerals and molybdenite are commonly associated with cassiterite. The lodes are seldom rich.

Because cassiterite is heavy and resistant to weathering, it readily concentrates in placers. About three-fourths of the worlds tin production - over 230,000 long tons in 1940[1] - is from placers. About 60 per cent of the total production has come from the tinfields of Malaya, Burma, and the Dutch East Indies. During the five-year period 1936 to 1940, the United States produced a total of 442 long tons of tin, of which about 440 tons came from Alaska[2].

Localities

The Seward Peninsula tin deposits have been described in other publications and will not be discussed here. A brief description, together with a bibliography, appears in a publication of the Alaska Planning Council entitled, "Preliminary Economic Survey of the Seward Peninsula Area." The following U. S. Geological Survey publications describing Seward Peninsula tin deposits are listed in the bibliography: Bulletins 213, 225, 229, 259, 284, 345, 358, 480-C, 520-B, 622-B, 692-C, 712-G, 714-F, and 733; also Mineral Resources of Alaska for 1906, 1907 and 1909-1911.

In interior Alaska, placer tin is found in almost every mining district, although it is generally scarce or absent in the Kuskokwim region and in the Iditarod and Innoko districts. It has been produced from the following districts: Hot Springs, Ruby, Long, Gold Hill and Talkeetna. Despite the widespread distribution of placer tin, however,

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[1]ibid., p. 683.

[2]ibid., p. 674.

there appear to be no deposits sufficiently large or rich to mine for their tin content alone. In addition, the few known lode deposits are of very low grade.

Although it is unlikely that any important deposits will be discovered in interior Alaska, the production of placer tin could be increased considerably by more effective methods of recovery. In almost all the placers where tin production has been incidental to gold, a large proportion of the cassiterite has been lost in the tailings.

In Fig. 4 the distribution of placer tin in interior Alaska is shown. Following is a tabulation by districts of known placer tin occurrences. Where information is available, the approximate amount of cassiterite is stated as abundant, common, scarce or rare. These terms are not intended to be quantitative, nor does "abundant" necessarily indicate that tin is present in commercial quantities. Principal sources of information are bulletins of the U. S. Geological Survey and files in the College office of the Territorial Department of Mines.

Table IV - Occurrences of Placer Cassiterite in Interior Alaska

District	Location of Occurrence	Relative Abundance	Source of Information
Seventymile	Fox Creek	Scarce	Dept. of Mines
Fortymile	Wade Creek	Scarce	Bull. 897-C, p. 166
Circle	Portage Creek	Common	Dept. of Mines
	Deadwood Creek	Abundant	Bull. 442, p. 246
	Mastodon Creek	Scarce	Dept. of Mines
	North Fork, Harrison Cr.	Scarce	" " "
Fairbanks	Bedrock Creek	Common	" " "
	Cleary Creek	Common	" " "
	Chatham Creek	Common	" " "
	Dome Creek	Scarce	" " "
	Eldorado Creek	Common	Bull. 379, p. 188
	Fairbanks Creek	Common	Dept. of Mines
	Fish Creek	Rare	" " "
	First Chance Creek	Rare	" " "
	Pedro Creek	Rare	" " "
	Twin Creek	Common	" " "
	Goldstream Creek	Scarce	Doheny, L. C.
	Cripple Creek	Rare	Dept. of Mines
	Nome Creek	Scarce	" " "
	Sourdough Creek	Scarce	" " "

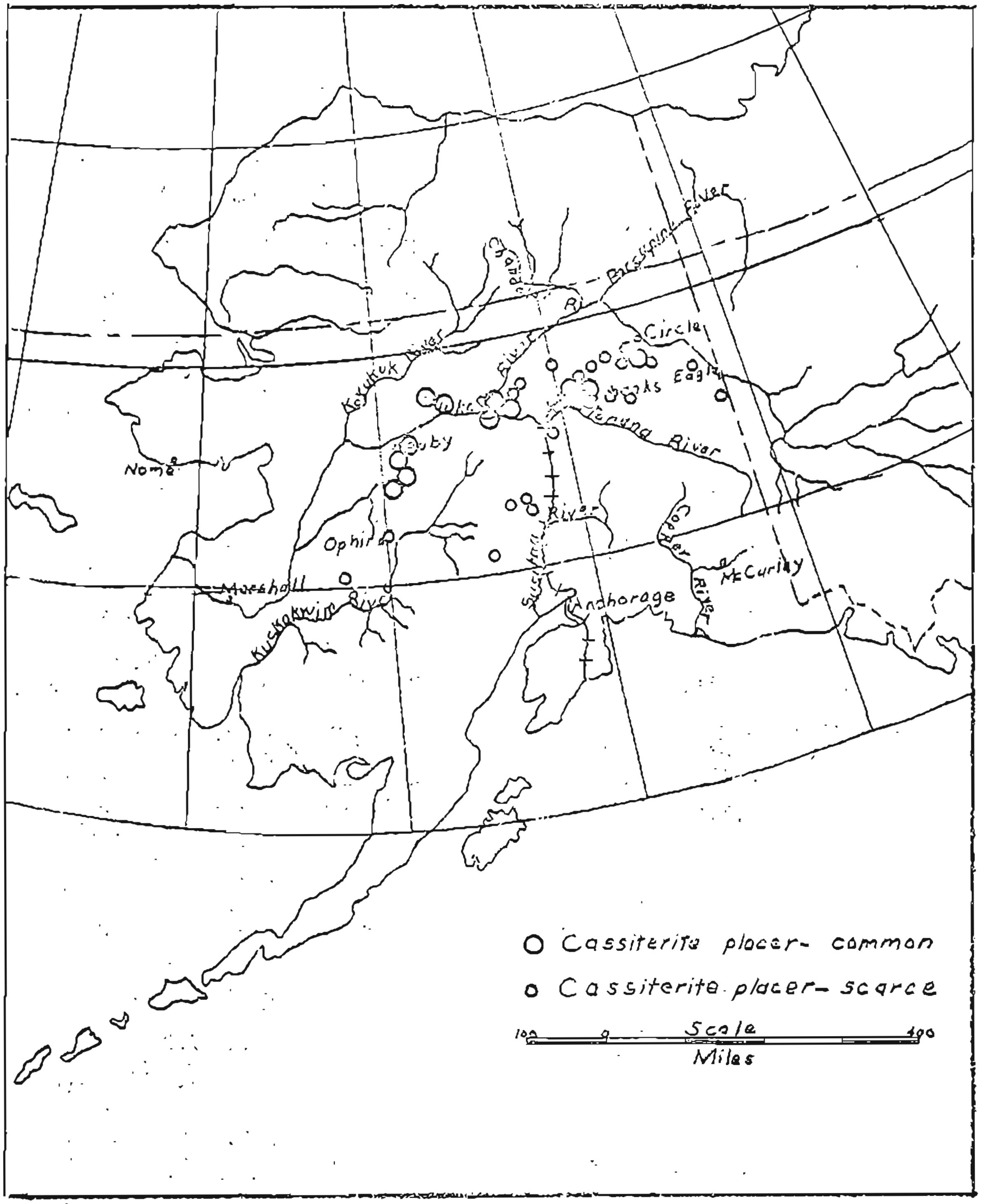

Fig. 4. - Map showing distribution of placer cassiterite in interior Alaska.

Table IV (Continued)

District	Location of Occurrence	Relative Abundance	Source of Information
Salcha	Caribou Creek	Scarce	Doheny, L. C.
Chena	Beaver Creek, trib. S. Fork of Chena River	Scarce	Fowler, C.
	Pyne Creek, trib. S. Fork of Chena River	Scarce	Fowler, C.
Bonnifield	Moose Creek	Scarce	Dept. of Mines
Kantishna	Vicinity of Eureka	Scarce	Bull. 849-F, p. 359
Talkeetna	Cache Creek and head-water tributaries	Scarce	Bull. 755, p. 129
	Peters Creek and head-water tributaries	Scarce	Bull. 755, p. 129
	Yentna River	Scarce	Bull. 714-A, p. 71
Livengood	Livengood Creek	Rare	Dept. of Mines
Rampart	Hunter Creek	Rare	Bull. 844-D, p. 232
	Quail Creek	Common	Bull. 844-D, p. 235
Hot Springs (Tofty area)	Deep Creek	Abundant	Bull. 844-D, p. 238
	Woodchopper Creek	Abundant	Bull. 813-A, p. 59
	Sullivan Creek	Abundant	Bull. 844-D, p. 239
	Tofty Creek	Abundant	Bull. 813-A, p. 59
	Miller Creek	Abundant	Bull. 824, p. 67
	Patterson Creek	Abundant	Bull. 480, pp. 88-90
	Cache Creek	Scarce	Bull. 844-D, p. 240
Gold Hill	Moran Creek, trib. Melozi River	Abundant	Bull. 712-A, p. 22
	Mason Creek	Abundant	Bull. 712-A, p. 22
	Grant Creek	Abundant	Bull. 824, p. 67
Ruby	Cox Gulch	Abundant	Bull. 810, p. 54
	Big Creek	Abundant	Bull. 813-A, p. 62
	Ruby Creek	Common	Bull. 754, pp. 117-118
Long	Long Creek	Common	Bull. 754, pp. 117-118
	Midnight Creek	Abundant	" " " " "
	Short Creek	Common	" " " " "
	Greenstone Creek	Common	" " " " "
	Monument Creek	Common	" " " " "
	Trail Creek	Common	" " " " "
	Birch Creek	Common	" " " " "

Table IV (Concluded)

District	Location of Occurrence	Relative Abundance	Source of Information
Poorman	Poorman Creek	Common	Bull. 754, pp. 117-118
	Flat Creek	Common	" " " " "
	Spruce Creek	Common	" " " " "
	Tamarack Creek	Common	" " " " "
Innoko	Boob Creek	Scarce	Bull. 754, pp. 117-118
Iditarod	Black Creek	Rare	Dept. of Mines

TUNGSTEN DEPOSITS

Production

During the period of high wartime prices, from 1916 to 1918, about 86½ tons of tungsten concentrates were shipped from Alaska. Most of the production was from the Fairbanks district; small amounts also came from the Nome, Iditarod and Circle districts. Production ceased in 1918, following a sharp decline in price[1]. In 1941 one small shipment of concentrates is reported to have been made from the Fairbanks district.

Price and Tenor

Tungsten prices have fluctuated considerably during the past 30 years. In 1916, during the first world war, 60 per cent concentrates sold for a maximum price of \$93.50 a short ton unit of WO_3, while the average for the year was \$33.97. In 1919, immediately after the war, the average price declined to \$8.69. The decline continued until 1921, when the price reached a minimum of \$1.50 a unit. Since 1921 there has been a more or less continuous increase in price[2]. Early in 1942 domestic concentrates were quoted at \$26 a short ton unit of WO_3; thus the standard minimum grade of concentrates containing 60 per cent WO_3 sold for \$1560 a ton. Prices for small lots are generally several dollars less per unit.

In interior Alaska, tungsten ore at present prices should contain at least two per cent WO_3 to pay for mining, concentrating and marketing costs, although the size of the deposit and local conditions must, of course, be taken into consideration. Placer tungsten deposits of considerably lower tenor are workable, especially those mined primarily or partly for gold.

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[1] Brooks, Alfred H., The Future of Alaska Mining: U. S. Geol. Survey Bull. 714-A, p. 39.

[2] Wilson, E. D., Tungsten Deposits of Arizona: Ariz. Bur. Mines, Geol. Series No. 14, Bull. No. 148, p. 8.

In many gold placers that carry appreciable amounts of tungsten, the use of special recovery methods is necessary. These may be elaborate or simple - in some cases the use of jigs or tables is necessary to concentrate the finer material; in others two sets of boxes used alternately may be effective; while in many small operations cleaning up the boxes at frequent intervals may save a good part of the tungsten.

Specifications for Tungsten Concentrates

Penalties of 25 cents are commonly charged for each 0.1 per cent excess of the following allowable impurities:[1]

	Per cent		Per cent
Copper...........	0.05	Molybdenum.........	0.25
Phosphorous......	0.05	Tin................	0.10
Arsenic..........	0.10	Sulfur.............	0.50
Antimony.........	0.10	Lead...............	0.10
Bismuth..........	0.10	Manganese..........	1.00

The standard minimum grade of tungsten concentrates is 60 per cent WO_3. No penalties are imposed if the grade is 70 per cent or more WO_3.

Modes of Occurrence

Tungsten minerals of commercial importance are scheelite, and the minerals of the wolframite group - ferberite, wolframite and hubnerite. Most of the Alaskan production of tungsten has been from scheelite, but the greater part of the world production has probably been from wolframite deposits.

Scheelite occurs in moderate temperature gold-quartz veins, in high temperature veins with cassiterite, and in replacement deposits in contact metamorphic zones in limestone. Wolframite is found in igneous rocks, in pegmatites, and in veins allied to tin veins. While it typically occurs in high temperature veins, it is also found in veins formed at moderate temperatures and pressures.

Tungsten deposits are almost always found in or near granitic rocks. They are genetically connected with the upper and outer portions of granitic intrusions. Associated ore minerals are cassiterite, molybdenite, chalcopyrite and sometimes gold and silver. Common gangue minerals are calcite, epidote, garnet, fluorite and quartz.

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[1] Op. cit., p. 8.

Scheelite and wolframite are often found in stream placers and in residual deposits. Since both minerals are brittle and easily comminuted, however, commercial placer deposits would ordinarily be anticipated close to the bedrock source of the tungsten. For this reason it is often feasible to trace tungsten lodes by panning stream gravel and overburden.

When activated by ultraviolet rays with a wave length of about 2537 Angstrom units, scheelite fluoresces, or gives off light of a characteristic light blue color. Within the past few years portable lamps that emit the correct wave length have been generally available. Since they greatly increase the rapidity with which rocks may be tested, the value of these lamps to the scheelite prospector can hardly be exaggerated. Confirmatory tests for tungsten should always be made, however, because a few other substances fluoresce similarly to scheelite.

Localities

Occurrences of Placer Tungsten:

Placer scheelite is widely distributed in Alaska as shown in Fig. 5, but most of the lodes are apparently small or of low grade. Placer wolframite appears to be much less common than scheelite, which may be interpreted as indicating that it occurs less widely distributed in lodes. In Table V are listed the known occurrences of placer tungsten. Principal sources of information are the files of the College office of the Territorial Department of Mines and bulletins of the U. S. Geological Survey. The terms abundant, common, scarce and rare indicate approximate amounts of tungsten minerals. The more important lode and placer occurrences of tungsten will be discussed separately, according to locality.

Table V. - Occurrences of Placer Tungsten in Interior Alaska

District	Location of Occurrence	Relative Abundance	Source of Information
Circle	Deadwood Creek	S - scarce[1]	Dept. of Mines
		W - abundant	Bull. 442, p. 246
	Switch Creek	S - scarce	Dept. of Mines
Fairbanks	Bedrock Creek	S - scarce	Dept. of Mines
	Chatham Creek	S - common	" " "
	Cleary Creek	S - common	" " "
	Dome Creek	S - scarce	" " "
	Little Eldorado Cr.	W - scarce	Bull. 442, p. 246
	Fairbanks Creek	S - common	Dept. of Mines
		W - scarce	Bull. 442, p. 246

[1]S - scheelite; W - wolframite group.

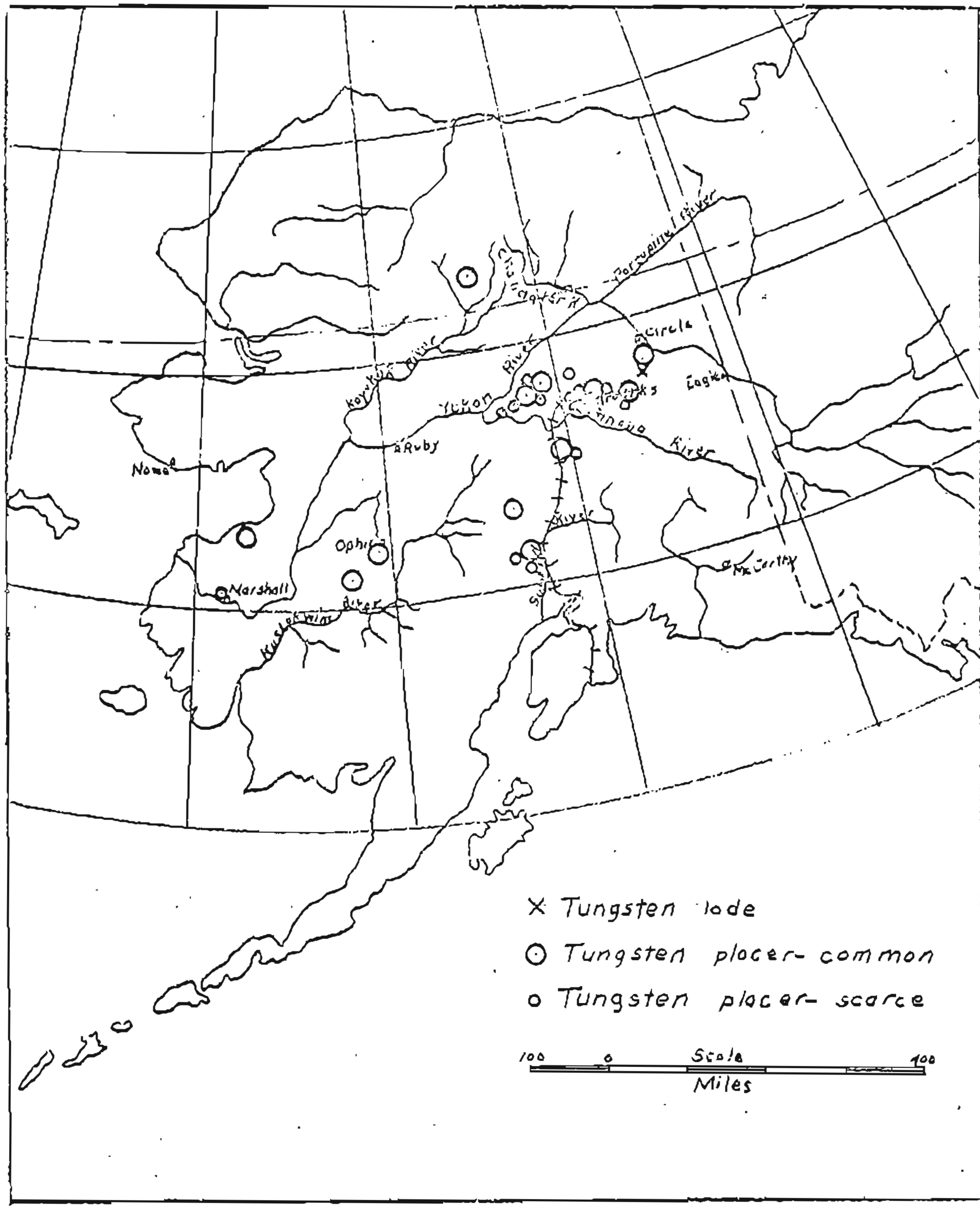

Fig. 5. - Map showing distribution of tungsten deposits in interior Alaska

Table V (Continued)

District	Location of Occurrence	Relative Abundance	Source of Information
Fairbanks (Cont'd)	Pearl Creek	S - abundant W - abundant	Dept. of Mines
	First Chance Creek	S - abundant	Dept. of Mines
	Gilmore Creek	S - common	" " "
	Goldstream Creek	S - scarce	" " "
	Ester Creek	S - scarce	" " "
Salcha	Caribou Creek	S - rare	Dept. of Mines
Chena	Palmer Creek	S - abundant	Dept. of Mines
Bonnifield	Moose Creek	S - common	Dept. of Mines
	Eva Creek	W - scarce S - rare	" " "
	Grubstake Creek	S - rare	Dept. of Mines
	Cold King Creek	S - rare	" " "
Kantishna	Stampede Creek	S - common	Quentin Harris
	Little Moose	S - common	Quentin Harris
Talkeetna	Cache Creek	S - scarce	Bull. 755, p. 129
	Peters Creek	S - scarce	Bull. 755, p. 129
	Windy Creek	S - scarce	Bull. 755, p. 129
	Bird Creek	S - abundant	Sample from Gordon Picotte
Livengood	Livengood Creek	S - scarce	Dept. of Mines
	Ruth Creek	S - common	" " "
	Lillian Creek	S - scarce	" " "
	Olive Creek	S - rare	" " "
Rampart	Little Minook Creek	S - rare	Bull. 844-D, p. 233
	Hoosier Creek	S - scarce	Bull. 844-D, p. 234
	Troublesome Creek	S - common	Bull. 844-D, p. 235
	Gunnison Creek	S - common	Bull. 844-D, p. 235
Hot Springs (Eureka area)	Pioneer Creek	S - scarce	Bull. 844-D, p. 235
	Omega Creek	S - rare	Bull. 844-D, p. 235
Koyukuk	Lake Creek, trib. to Wild River	S - abundant	Bull. 815, p. 333
Innoko	No. 6 Pup, trib. to Little Creek	S - abundant	Dept. of Mines

Table V (Concluded)

District	Location of Occurrence	Relative Abundance	Source of Information
Iditarod	Otter Creek	S - common	Bull. 642, p. 238
Wade Hampton	Elephant Creek	S - rare	Dept. of Mines
St. Michael	Bonanza Creek	S - abundant	Bull. 712-A, p. 22

Fairbanks District:

In the Fairbanks district, in the area at the heads of Engineer, First Chance, Gilmore and Pearl creeks, scheelite occurs as disseminated deposits in contact metamorphosed limestone and in gold-bearing quartz veins, close to a large intrusion of porphyritic granite[1,2].

Associated with the scheelite are the minerals diopside, hornblende, vesuvianite, garnet, epidote and wollastonite. Locally fluorite and titanite are common. A few small flakes of molybdenite are also occasionally found. Although other ore minerals might be anticipated, none was found in the specimens examined.

From 1915 to 1918 scheelite was mined from several deposits at the heads of Gilmore Creek and of First Chance and Steele creeks. Some of the concentrates were shipped out by parcel post during the winter of 1915-16; later shipments were made by boat[3]. Early in 1942, after lying idle for many years, development work on some of the tungsten claims in this area was initiated by Cleary Hill Mines, Inc.

Placer scheelite is found in a number of creeks in the Fairbanks district, as listed in Table V. It is especially abundant in Pearl, Gilmore and First Chance creeks, which drain the principal areas of tungsten mineralization. Scheelite doubtless occurs in other creeks in this area, but complete data are lacking. Wolframite is found in the placers of Pearl and Fairbanks creeks, but its bedrock source is unknown to the writer.

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[1]U. S. Geol. Survey Bull. 849-B, Plate 3: Geologic map of Fairbanks district.

[2]Mertie, J. B., Jr., Lode Mining in the Fairbanks District: U. S. Geol. Survey Bull. 662, pp. 419-424.

[3]Brooks, Alfred H., The Alaskan Mining Industry in 1916: U. S. Geol. Survey Bull. 662, p. 21.

On lower First Chance Creek scheelite apparently constitutes the main part of the placer concentrates. For several years it has hindered gold mining operations by clogging the riffles of the sluice boxes. The mineral was identified only recently, when a sample of concentrates was sent to the Department of Mines.

Scheelite in minute amounts occurs in many of the gold-quartz veins in the Fairbanks district. Ordinarily it is so sparsely distributed that it may be found only in placer concentrates, or in concentrates obtained when the ore is milled.

Chena District:

Scheelite is relatively abundant in the placers of Palmer Creek, tributary to the Chena River, about 70 miles east of Fairbanks. During the 1941 gold mining operations most of the concentrates consisted of scheelite. While the size and tenor of the deposit are unknown, it is unlikely that the scheelite can be profitably recovered except as a by-product of gold mining. The mineral probably occurs in quartz stringers in the schist country rock, which are especially numerous in the bedrock uncovered in 1941. No granitic rocks are known to outcrop in the Palmer Creek drainage area and no igneous rocks were found in the stream gravel.

Circle District:

Considerable wolframite, together with cassiterite, has been recovered from the placers on Deadwood Creek, in the Circle district. Most of these minerals have come from Discovery Claim, about a mile above where Switch Creek enters Deadwood Creek. The principal site of both the tungsten and tin mineralization is said to be south of a granite intrusion that crosses Deadwood Creek near Discovery Gulch. A small vein of wolframite has been reported on the west side of Deadwood Creek, near Discovery Gulch[1]. Small amounts of scheelite are also found on Deadwood Creek, and some wolframite on lower Switch Creek.

Bonnifield District:

Ferberite, the iron-rich member of the wolframite series, has been found in placer concentrates from Eva Creek near the Liberty Bell mine, and in float near Caribou Creek, tributary to California Creek, according to identifications of specimens made by A. E. Glover, Territorial Assayer. These finds are given special mention because the occurrence of wolframite minerals was hitherto unreported in the Bonnifield district.

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[1]Mertie, J. B. Jr., Gold Placers of the Fortymile, Eagle and Circle Districts: U. S. Geol. Survey Bull. 897-C, pp. 237-238.

Innoko District:

On No. 6 Pup, tributary to Little Creek about five miles south of Ophir, placer scheelite is found in what may prove to be commercial quantities. During the 1941 placer mining season abundant scheelite was found in the lower 700 feet of the creek, in ground worked by C. McFarland. About 1,000 feet above the upper end of the open cut a large dike, with which the scheelite may be associated, is said to cross No. 6 Pup.

Smaller amounts of scheelite are found on Little Creek below the mouth of No. 6 Pup, but apparently none is found above it. Scheelite is also said to be absent, or of rare occurrence, in other placers in the vicinity.

NON-METALLIC MINERAL DEPOSITS

Relatively little search has been made in interior Alaska for deposits of non-metallic minerals. Most of these materials are abundant and cheap, and are produced close to where they are used. On the other hand, workable deposits of certain special grades of asbestos, mica and quartz are relatively rare; these materials command sufficiently high prices to permit commercial production in interior Alaska.

Little information is available concerning deposits of high-grade asbestos, mica or quartz crystals in interior Alaska. The following discussion is as much for the purpose of calling the attention of the prospector to specifications, prices and modes of occurrence as for describing localities where deposits have been found. More complete information may be found in Industrial Minerals and Rocks, published in 1937 by the American Institute of Mining and Metallurgical Engineers, and in Minerals Yearbook, Review of 1940, published by the U. S. Bureau of Mines. Also published by the Bureau of Mines are several Information Circulars dealing with these minerals.

Asbestos

Specifications and Prices:

There are two general types of asbestos: amphibole and serpentine. Included under each type are fibrous varieties of several minerals. Any mineral that is easily separated into fibers may be classified under the commercial term "asbestos".

Some varieties of asbestos separate into long, silky fibers of good tensile strength; these are suitable for spinning into yarn and bring the highest prices. In general the more brittle, coarse or short-fibered grades sell for lower prices, although other factors such as resistance to fire or acids have a bearing on the value. The highest priced grade of asbestos is known as Crude No. 1.

Prices of the various grades of asbestos cover a wide range. The following quotations, taken from E & M J Metal and Mineral Markets for April 30, 1942, serve only as a general guide:

> "Asbestos, per ton, f.o.b. Quebec mines, tax and bags included: Crude No. 1, $650 to $750; crude No. 2 and sundry crudes, $165 to $385; spinning fibers, $124 to $146.50; various grades shingle stock, $62.50 to $85; various grades paper stock, $44 to $49; cement stock, $28.50 to $33; floats, $19.50 to $21; shorts, $14.50 to $26.50."

Prices of high-grade asbestos have fluctuated widely. In 1921 quotations for No. 1 crude reached a high of about $3,000 a ton; three years later they had dropped to $300. Prices have in general increased during the past few years. Although the prices of high-grade asbestos are comparatively high, it is usually necessary to handle many tons of rock to produce a single ton of asbestos, consequently only the best grades could be mined in interior Alaska.

Modes of Occurrence:

Over 90 per cent of the world's asbestos is from deposits in serpentine, an alteration product of dunite and peridotite. The most important variety of serpentine asbestos is the highly fibrous mineral called chrysotile. Chrysotile generally occupies veinlets along fractures in serpentinized dunite. Frequently the veinlets form a network, or may lie in closely spaced parallel planes. Chrysotile veins are also found in limestone and dolomite, associated with serpentine. In other cases the veins occur as layers in serpentine, parallel to the bedding of the limestone.

Amphibole asbestos commonly occurs in interbedded veins in ironstone, a silicified, iron-bearing slate. Several varieties are also found in basic igneous rocks, and in gneissic and schistose rocks of high magnesia content.

Asbestos has long been known to occur near Shungnak in the Kobuk region. It is found associated with greenstone intrusive rocks. According to Smith[1], attempts have been made to mine this asbestos. but the price was not sufficiently high to pay for the transportation According to other reports, some high-grade asbestos has been found, but samples have not been seen by the writer. The Shungnak asbestos deposits were examined in 1931 for the Territorial Department of Mines by Irving McK. Reed, Associate Mining Engineer, and were found to include high-grade chrysotile. The occurrences have been described at pp. 21 22 of a report on Mining Investigations and Mine Inspection in Alaska, Biennium ending March 31, 1933.

Serpentine asbestos occurs in dunite and serpentine in several localities in the Salcha and Tolovana districts, but so far as is known, no commercial deposits have been found. Asbestos has also been reported near Timber Creek, tributary to the Tok River, by Sam Gamblin, of Fairbanks, but no information is available as to its quality

In the Kuskokwim region, asbestos and also graphite were dredged from the bedrock of the Tuluksak River during the mining operations of the New York Alaska Gold Dredging Company, according to A. E. Glover, Territorial Assayer. In the Marshall district small stringers of rather coarse amphibole asbestos have been found in rocks of greenstone habit Chrysotile asbestos has also been reported in this district.

Asbestos probably occurs in nearly all of the areas of basic igneous rocks that outcrop in many areas in interior Alaska, as well as in other types of rocks Whether or not any of it is of commercial quality can be determined only by prospecting.

Mica

Specifications and Prices:

Prices of mica depend largely on grade and size. They range from less than a cent a pound to over $20 Prices of domestic mica have increased considerably during the past few years. In 1940 the average sale values of domestic uncut sheet mica ranged from $10.284 for 8 x 10 inch sheets, to 8.7 cents a pound for punch mica, which yields circles $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in diameter[2]

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[1]Smith, P. S., The Noatak-Kobuk Region: U. S. Geol. Survey Bull 536, 1913, p. 155.

[2]Minerals Yearbook, Review of 1940, p. 1363.

Modes of Occurrence:

Muscovite, the so-called white mica, is the most valuable industrial mica and is the most extensively used. Phlogopite, or amber mica, is next in importance. The other industrial micas - biotite, vermiculite and lepidolite - are of minor importance.

Muscovite and biotite are widely distributed in the form of small flakes in granites, gneisses, schists and similar rocks. The valuable occurrences of sheet muscovite, however, are confined to pegmatites with the same composition as ordinary granite and containing essentially quartz, feldspar and mica. In pegmatites the individual mineral constituents attain great size; occasionally sheets or so-called books of muscovite several feet in diameter have been found in them, although sheets a foot in diameter are considered large.

Phlogopite is restricted to basic pegmatites composed chiefly of the mineral pyroxene. These dikes are confined to areas underlain by large masses of basic, pyroxene-bearing rocks. The most important of such areas are in southwestern Quebec, in eastern Madagascar and in Russia.

Localities:

Mica is found in all parts of Alaska, but the pegmatite dikes in which the large sheets occur have been little prospected for this mineral. Frequently the exposed parts of these dikes are weathered and cracked by frost, so that it is difficult to obtain representative samples from the surface.

According to reports of Indians, large mica sheets have been found in the Nabesna district near the Nabesna mine, and also near the village of Mentasta. Some of the sheets are said to be a foot square. An occurrence of sheet mica in a pegmatite dike about 25 miles from Gulkana is reported by Sam Gamblin of Fairbanks. The exact location is not known to the writer.

Recently a large body of lepidolite, a lithium-bearing mica, was uncovered on upper Wade Creek during mining operations by the Wade Creek Dredging Company.

Quartz Crystals

Specifications and Prices:

Quartz in the form of sand, gravel or crushed stone sells for a maximum of $2 a ton in the United States. Quartz in the form of crystals suitable for use in radio frequency control, on the other hand, sells for $2 to $20 a pound. Considering the abundance of quartz crystals it is obvious that only a small proportion of them can be used for this purpose. They must be clear and have at least two crystal faces; in addition they must be free from strain, cracks, needles, bubbles, clouds and twinning. Most of these imperfections, except some types of twinning, may be seen with the naked eye. As to size, some users specify crystals weighing from 3 to 8 pounds, but since they are costly and difficult to obtain, others use crystals as small as half a pound.

Quartz crystals suitable for use in optical instruments also bring high prices. Their specifications are about the same as for those used for radio frequency control. Some grades of crystals are used in jewelry, but as a rule the cost of cutting and polishing is greater than that of the raw material. Quartz crystal suitable for the manufacture of fused silica ware sells for $100 to $150 a ton.

Modes of Occurrence:

Next to feldspar, quartz is the most abundant mineral in the earth's crust. It occurs in a great number of forms and varieties. Quartz crystals suitable for radio use occur principally in pegmatite dikes. Practically all of the world's supply comes from Brazil.

Localities:

During the past year several specimens of quartz crystal have come from the upper Koyukuk region. One reported occurrence is near Wild Lake; another is on the Bettles River near Big Lake. None of the samples were suitable for use in radio frequency control, but in view of the reported abundance of crystals in some localities, it would seem that additional search would be worthwhile.