SOUTHEASTERN ALASKA'S MINERAL INDUSTRY

By Alvin Kaufman

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Alvin Kaufman[2/]

SUMMARY AND INTRODUCTION

Increased exploration in Alaska has resulted in many requests to the Bureau of Mines for facts about the mineral resources and mining conditions in the Territory. This report presents information about the minerals of Southeastern Alaska and the factors that affect development of a mining industry in that area.

Southeastern Alaska is a narrow coastal strip of rugged mountains and many islands. The climate is mild, with an average annual temperature of 40° and heavy rainfall. Geologically, the region is favorable for deposition of ore; geographically, it is difficult to prospect and to develop, except along areas immediately adjacent to the coastline.

The Federal Bureau of Mines and the Federal Geological Survey have investigated and issued reports on many mineral deposits in the region - gold, silver, iron, zinc, copper, and lead, as well as garnet, gypsum, barite, limestone, and marble. From 1906 to 1955, the mines of Southeastern Alaska produced over 6 million ounces of gold, 3 million ounces of silver, 14 thousand ounces of the platinum-group metals (principally palladium), 37 million pounds of copper, 48 million pounds of lead, and 111 thousand pounds of zinc.

Environmental conditions that affect the development of an industry to exploit Southeastern Alaska's minerals are generally favorable. An adequate labor supply can be developed but will be expensive because of the high cost of living. Only high-grade ores, (State standards) and concentrates can be economically transported to market by present services, but costs may be reduced by larger back-hauls or the use of barges and tugs. The water supply is ample for most purposes; in many places waterpower may be developed. Taxes are no higher than those in many States.

Development of the Northwestern United States has resulted in increased possible markets for Southeastern Alaska ores, particularly iron and uranium. Several base-metal smelters are at tidewater or relatively close to ports on the Pacific coast. Direct ocean shipment of ore to Japan also may offer an outlet, as it is within economic shipping distance of Alaska.

The mineral resources of Alaska have long been studied by the Bureau of Mines, which maintains stations and offices at Juneau and Anchorage.

1/ Work on manuscript completed February 1958.

2/ Supervising commodity-industry analyst, Bureau of Mines, Alaska District, Region I, Juneau, Alaska.

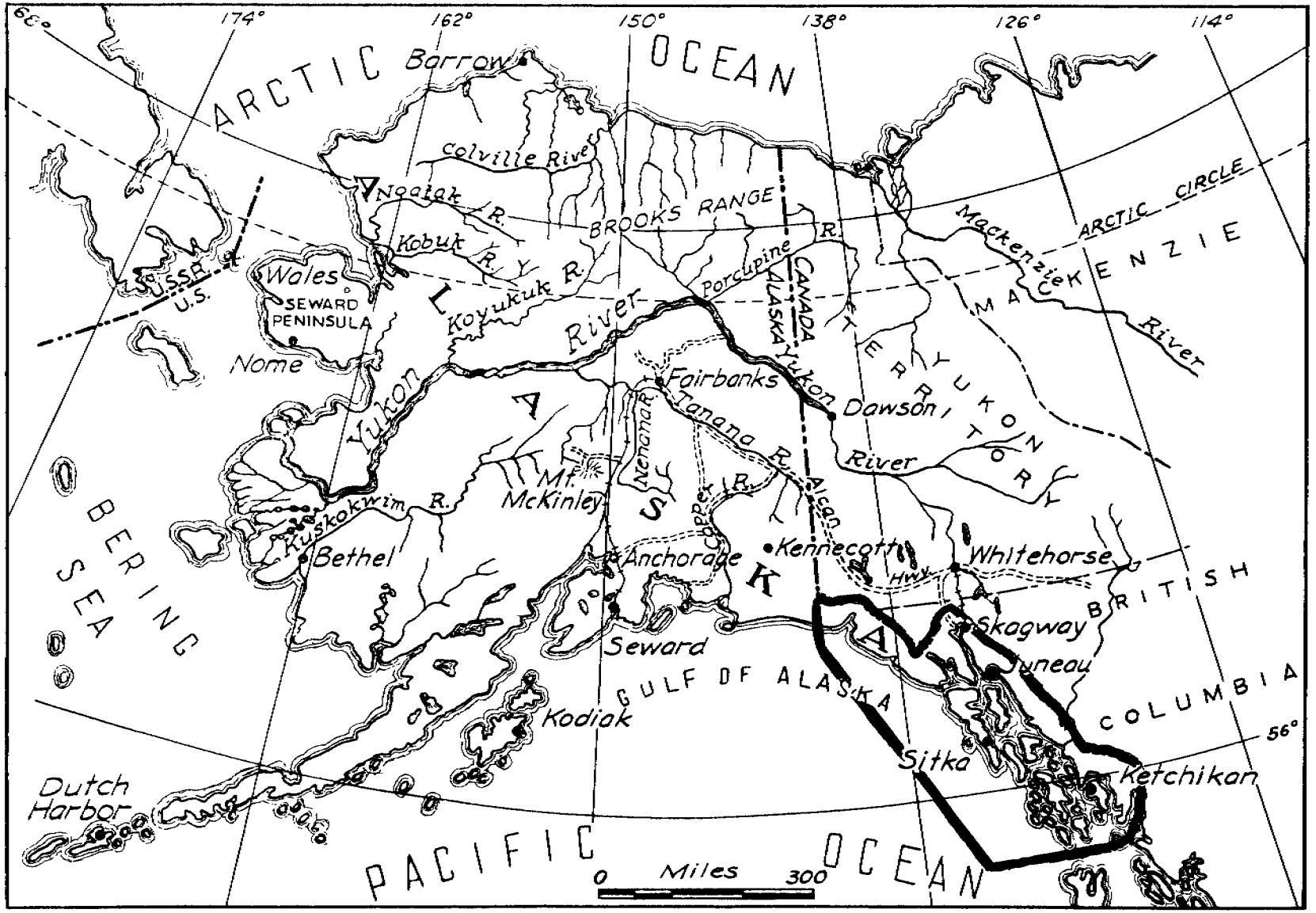

FIGURE 1. - Index Map of Alaska.

The Alaska Mining Experiment Station at Juneau and the Anchorage Experiment Station are concerned chiefly with pioneering investigations of mineral deposits, primary treatment processes and utilization of ores and fuels, and studies of mining and processing techniques used commercially in the Territory. Field and laboratory projects are principally reconnaissance and preliminary investigations on a Territory-wide basis. Certain selected areas, which appear to offer exceptional promise, are investigated further to obtain preliminary evaluation as to possible commercial reserves.

The Bureau station at Juneau has petrographic, ore-dressing, and chemical laboratories for examining and treating prospectors' samples and those specimens submitted by the Bureau's own field parties.

In another field of activity, health and safety, the Bureau of Mines maintains a small staff at Anchorage.

The Bureau of Mines regularly conducts statistical surveys of mineral production in Alaska and issues periodic reports showing values and quantities in volume III of its annual publication, Minerals Yearbook.

All work of the Bureau of Mines is done in close cooperation with the Geological Survey also Department of the Interior and the Territorial Department of Mines. The Territorial Department of Mines has headquarters in Juneau and maintains an assay office at Ketchikan. At its Juneau offices are land records of ownership of mineral claims and a bibliographic file on each property.

PHYSICAL FEATURES

Location and Size

The Southeastern Alaska region is a 40,000-square-mile area between parallels (latitude) 54° 30' to 60° 30' and meridians (longitude) 130° to 141°. The region extends from the St. Elias Mountains on the north to Dixon Entrance on the south; it is bordered on the north by the Yukon Territory and British Columbia; and on the south and east by British Columbia; the Pacific Ocean is the western boundary.

Southeastern Alaska is a coastal belt with contiguous islands. The main body of the region, including the islands, is 400 miles long and 100 to 150 miles wide; a narrow extension northwest of Mount Fairweather is 100 miles long and 25 to 50 miles wide.

Climate

The average annual temperature in Southeastern Alaska, as indicated by figure 2, is comparable with that of the Northern United States; the climate is characterized by heavy precipitation and moderate temperatures throughout the year. Rainfall, as measured at Juneau over an 11-year period, occurs on an average of 224 days per year.3/ Snowfall is heavy in the mountains and inland areas, particularly at the heads of the fiords, but is relatively light at sea level near the larger bodies of water.

Average climatic conditions from 1950 to 1955 in various sections of Southeastern Alaska are shown in table 1.

3/ U. S. Department of Commerce, Statistical Abstract of the United States: Table 208, 1956, p. 172.

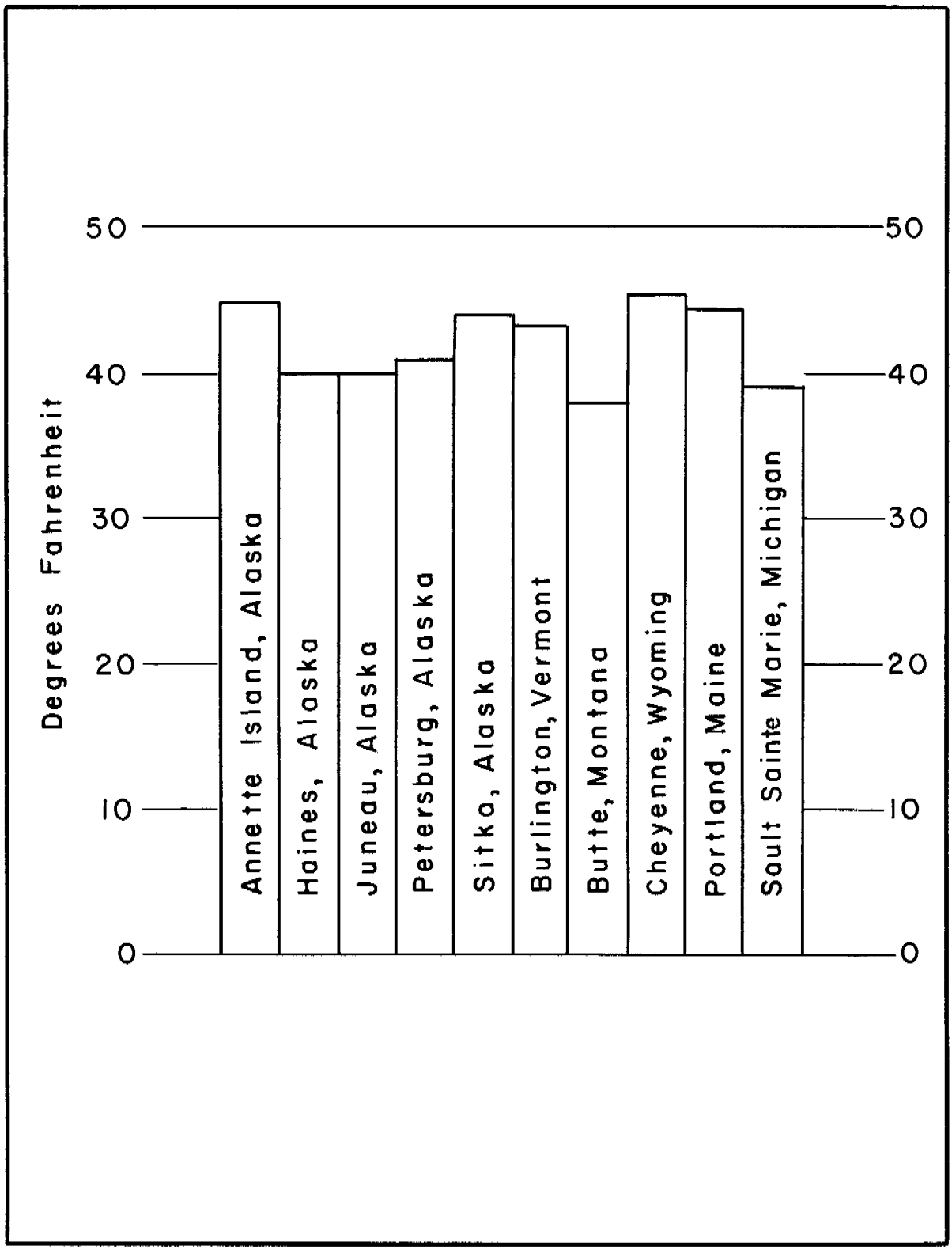

FIGURE 2. - Average Annual Temperature, Selected Cities, the United States and Alaska.

TABLE 1. - Climatic data, selected cities, 1950-55 average[1/]

City	Average temperature °F.			Total annual precipitation, inches	Total annual snowfall, inches	Length of growing season, days
	High	Low	Annual			
Annette Island	82	5	45	107	47	202
Haines	84	2/-9	3/40	3/65	3/212	4/160
Juneau (airport)	80	-11	40	48	82	124
Petersburg	76	-5	41	98	121	146
Sitka	79	2	43	78	45	174

1/ U. S. Weather Bureau, Climatological Data, Alaska: Annual Summaries, 1950-55.
2/ 1951-55 average.
3/ 4-year average.
4/ 5-year average.

Topography

Southeastern Alaska is essentially a mountainous northern jungle with thick forests on the lower mountain slopes and in the larger valleys. A substantial part of the region (possibly half or more) is covered by scrub timber, brush, grass, muskeg, and loose rock. In most areas the undergrowth is so dense it conceals the underlying rock; this results in difficult and expensive prospecting.

The region may properly be considered to consist of the mainland and the Alexander Archipelago. The latter, embracing more than 1,000 islands, comprises at least one-third of the land surface of Southeastern Alaska. Many islands of the archipelago are composed entirely or partly of flat, low-lying land, but most of the island surfaces consist of smooth, rolling mountains several thousand feet high. The largest islands, such as Prince of Wales, Admiralty, Chichagof, Baranof, Revillagigedo, and Kupreanof, contain rugged mountain ranges gouged by cirques and further characterized by bare serrate peaks with talus slopes.

The dominating structural features of the Southeastern Alaska mainland is the Coast Range, which extends northward along the shoreline from the British Columbia boundary for approximately 350 miles until it passes inland behind the St. Elias Range near the head of Lynn Canal. This group of mountains has no well-defined crestline but is a complex of irregular mountain masses occupying the coastal strip between the Pacific Ocean on the west and the Central Plateau region to the east.

The foothills of the Coast Range rise abruptly from the sea to altitudes of 2,000 to 3,000 feet and are penetrated by spectacular fiords. The crests of the Coast Range itself rise as high as 10,000 feet; to the north, Mount Fairweather in the St. Elias Range, rises to 15,300 feet.

GENERAL GEOLOGY

The general geology of Southeastern Alaska and that of specific areas or mineral deposits has been described in the numerous reports by the Geological Survey and the Bureau of Mines. (For detailed information see reports listed in bibliography.) The following brief description of the general geology of Southeastern

Alaska is summarized from the works of Buddington and Chapin,[4] Spencer,[5] and Wright.[6]

The oldest rocks of the region are Paleozoic; they consist primarily of metamorphosed limestone, schists, cherts, and greenstones, overlain (in limited areas of Admiralty, Kupreanof, Kuiu, and Prince of Wales Islands) by metamorphosed conglomerates, sandstones, and shales of the Mesozoic and Cenozoic (Tertiary) eras. The bedded rocks, with the exception of the more recent strata, are highly tilted or intricately folded; usually they show a high degree of metamorphism. The southern part of Admiralty Island, the northwestern side of Kuiu Island, the southern shore of Kupreanof Island, and a small area on the southern end of Prince of Wales Island are covered by a Tertiary basaltic lava. Much of the rock strata of Southeastern Alaska is overlain by beds of clays and gravel, as well as by recent volcanics exposed at various points along the mainland and at Mount Edgecombe on Kruzof Island.

The Paleozoic strata are intruded by coarse granular igneous rocks with composition from granodiorite to quartz diorite to hornblende diorite to pyroxenite and dunite. These intrusives form most of the Coast Range and occupy wide areas in the central parts of many of the islands. The structure of the bedded rocks has a direct relation to the intrusives, shown by the parallelism between the strike of the bedding and that of the longitudinal axes and lines of contact with the intrusives. Igneous dikes of andesite, diabase, basalt, and melaphyr often cut both the older and younger formations.

The sedimentary formations on the mainland and adjacent islands strike northwest. The sedimentary formations of the outer islands are deformed by two separate systems of large and small folds. The axes of the larger (and younger) folds trend northwesterly; the folds are most pronounced adjacent to wide intrusive areas. The axes of the minor folds trend northeasterly; the minor folds are in the less disturbed and less metamorphosed areas. In many places both trend directions have been observed. The northeast-trending minor folds often are combined in much broader anticlines or synclines trending northwest.

Mineralization usually is found in sedimentary roof pendants in the larger intrusive masses or in close association with small intrusive stocks, chiefly at the sharp angles of intrusive contacts. However, the largest bodies of low-grade iron ore and the nickel-copper ore bodies appear as primary constituents of intrusive magmas of basic or ultrabasic composition.

MINING HISTORY AND PRODUCTION

The following brief discussion of the mining history of Southeastern Alaska is summarized from the works of Buddington and Chapin,[7] Spencer,[8] and Bancroft.[9]

4/ Buddington, A. F., and Chapin, T., Geology and Mineral Deposits of Southeastern Alaska: Geol. Survey Bull. 800, 1959, pp. 18-23.

5/ Spencer, Arthur C., The Juneau Gold Belt, Alaska: Geol. Survey Bull. 287, 1906, pp. 9-11.

6/ Wright, C. W., Lode Mining in Southeastern Alaska: Geol. Survey Bull. 314, 1907, pp. 47-51.

7/ Work cited in footnote 4.

8/ Work cited in footnote 5.

9/ Bancroft, H. H., History of Alaska: Bancroft & Co., San Francisco, Calif., 1886, pp. 697, 741, 742.

The mining history of Southeastern Alaska illustrates the potential wealth of the region. In 50 years (1906-56) the lode mines of the area yielded 6.2 million ounces of gold, 3.3 million ounces of silver, 37 million pounds of copper, 48.3 million pounds of lead, 111 thousand pounds of zinc, and 14 thousand ounces of platinum-group metals, principally palladium. This output represents, at 1955 prices, approximately a quarter billion dollars in metals. Lode-mine output, by years, is shown in table 2.

The first mineral location was recorded in 1867 by Charles V. Baranovich, a Russian trader, on a copper deposit near New Kasaan, Prince of Wales Island. This was followed in 1869 by the discovery of placer-gold deposits at Windham Bay and Powers Creek (Holkam Bay) by Mix Sylva and other disgruntled miners from the Cassiar district in Canada. In the next 2 years approximately $40,000 in gold was extracted from the Windham Bay-Powers Creek area; this was the first large quantity of gold produced in Alaska.

Eight years after the Windham Bay - Powers Creek discovery, mining was begun at the Stewart mine on the west coast of Baranof Island, 14 miles southeast of Sitka. A 10-stamp waterpower mill was built on the property, but not enough water was available for operations.

In 1880 Joe Juneau and Richard Harris discovered placer gravels near the mouth of Gold Creek in the vicinity of the present city of Juneau. Their findings led to the lode discoveries that became the nucleus of the highly productive Alaska-Juneau Gold Mining Co. Approximately $80.8 million in gold, silver, and lead was recovered from this mine from 1893 to its closing in 1944. In the year following the Juneau-Harris discovery the Paris lode (subsequently known as the Treadwell mine) on Douglas Island was sold by "French Pete," the original locator, to John Treadwell for $5. Treadwell and his associates spent over $400,000 for development from 1882 until the mine began producing in 1885. This lode mine, with adjacent claims, yielded more than $67.5 million in gold and silver during its 37 years of production.

The years from 1892 to 1906 were noted for considerable prospecting and many discoveries; activity was stimulated by the rich placer-gold discoveries in the Yukon and interior Alaska. In 1898 the Porcupine area was discovered, and more than $1 million in gold was produced by the placer mines of this district from the time of its discovery to 1930 (the last year production was recorded). In 1905 the Chichagof gold lode on Chichagof Island was found; during the next 33 years it yielded more than $13.5 million in gold.

The mines in the Ketchikan area, where copper first was discovered in 1881, yielded their first large shipment (30,400 tons) of copper ore (containing 3 percent copper) in 1905. This material was shipped to smelters at Hadley and at Copper Mount on Prince of Wales Island. The smelters were operated by the Alaska Smelting & Refining Co. and the Alaska Copper Co., respectively. Ore was shipped also to the Tacoma smelter of the American Smelting & Refining Co., as well as to the Granby smelter, Anyox, British Columbia.

In addition to the foregoing a substantial quantity of nonmetallics has come from Southeastern Alaska; marble has been shipped from Calder and Tokeen at various times, and over 500,000 tons of gypsum has been produced on Chichagof Island.

From 1928 to 1931 the Pacific Coast Cement Co. operated a limestone quarry on Dall Island. In 1931 the properties were leased to the Superior Portland Cement Co., Inc. Except for 1933-34, the quarry was active for 6 months each year until 1940.

TABLE 2. - Mineral production from lode mines, 1906-56, by years[1/]

Year	Fine ounces			Short tons		
	Gold	Silver	Platinum-group metals	Copper	Lead	Zinc
1906	162,675	50,684	-	2,175	-	-
1907	135,684	66,358	-	2,379	-	-
1908	164,215	56,482	-	1,630	-	-
1909	199,171	42,079	-	1,353	-	-
1910	187,245	43,702	-	1,127	-	-
1911	189,480	31,826	-	489	-	-
1912	214,820	38,173	-	617	-	-
1913	202,336	28,887	-	300	-	-
1914	202,814	33,892	-	254	-	-
1915	260,286	98,891	-	864	-	-
1916	263,399	126,708	-	1,763	820	-
1917	207,445	150,191	-	1,323	845	-
1918	154,120	97,798	224	686	561	-
1919	202,611	112,620	540	315	687	-
1920	211,448	119,934	1,447	324	759	-
1921	176,914	105,975	-	234	510	-
1922	125,377	71,197	-	219	338	-
1923	95,818	58,756	-	229	388	-
1924	111,681	72,528	1,636	237	630	-
1925	123,593	70,995	3,760	511	788	-
1926	122,050	71,188	3,566	473	778	-
1927	128,727	76,720	-	-	1,008	-
1928	157,575	78,900	-	-	1,019	-
1929	169,312	92,560	-	35	1,315	-
1930	164,427	98,996	-	3	1,320	-
1931	186,680	121,428	-	-	1,660	-
1932	169,506	100,790	-	-	1,248	-
1933	163,749	2/111,800	-	-	1,152	-
1934	139,343	89,477	-	2/17	747	-
1935	134,200	82,856		72	656	-
1936	163,105	107,518		191	937	-
1937	169,998	124,587	3,115	226	815	-
1938	172,127	135,090		154	967	-
1939	145,397	118,003		115	918	-
1940	138,057	102,798		48	774	-
1941	130,451	103,275		49	657	-
1942	82,533	61,920	-	19	414	-
1943	40,813	35,924	-	20	200	-
1944	10,360	8,664	-	2	44	-
1945	4,112	1,793	-	-	11	-
1946	1,916	7,342	-	2	115	-
1947	955	22,518	-	12	264	25
1948	4,372	26,563	-	16	329	22
1949	2,917	4,747	-	4	51	2
1950	3,103	13,429	-	6	149	6
1951	601	1,971	-	1	21	1
1952	254	97	-	-	(3/)	-
1953	203	123	-	-	1	-
1954	492	112	-	2	-	-
1955	1,908	303	-	1	(3/)	-
1956	834	200	-	(3/)	1	-

1/ Data for 1906-35 based on Geol. Survey records. 2/ Partly estimated.
3/ Less than 1 ton.

MINERAL RESOURCES

General

In 1955 minerals valued at $230 thousand were produced in Southeastern Alaska; $66 thousand represented the gold, silver, and lead output from a mill cleanup; and the remaining $164 thousand, sand and gravel, stone, and gem stones. The output of sand and gravel and stone was primarily for paving and other roadbuilding purposes; because these are contingent upon the changing requirements of the roadbuilding agencies, the production of sand and gravel and stone cannot be considered a stable factor in the mineral industry.

The mineral industry of Southeastern Alaska, declined some years ago owing to exhaustion of early bonanzas and a drop in the purchasing value of gold; activity has been low for the past 14 years, and interest in the mineral resources of the region has only just begun to revive.

The region contains an abundance and variety of potential mineral resources, which in recent years have not been explored and developed because of unfavorable economic conditions and because the topography and luxuriant vegetation of the area make prospecting extremely difficult; in some sections prospecting by traditional methods has been impracticable. Development of the helicopter, with coincident improvement of geophysical-geochemical prospecting methods, will permit more thorough investigation of the mineral wealth that appears to be concentrated in this area. To illustrate the possibilities, some of the known occurrences of the various minerals are discussed in alphabetical order; figure 3 indicates their approximate location.

By Minerals[10/]

Antimony

Stibnite is found in a fissure vein and as disseminations in limestone at Camaano Point (4) at the south end of Cleveland Peninsula. Native antimony constitutes a substantial part of the metal content of a gold quartz vein at Sunset Cove on the mainland southeast of Juneau. Stibnite, in relatively small deposits, has been found at a few other places in Southeastern Alaska.

Barite

Small fissure veins containing barite occur in limestone, conglomerate, and volcanic rock along the north side of Cornwallis Bay and the south side of Saginaw Bay (both on Kuiu Island), and at the northeast end of St. Ignace Island near Ketchikan.

Barite replacement deposits in limestone occur on the Castle Islands, Kupreanof Island, and at Lime Point on Prince of Wales Island. The Geological Survey estimates that 60,000 tons of ore, averaging 93 percent barium sulfate, is exposed on Castle Island.[11/] At Lime Point the country rock is limestone interbedded with schist. The Survey made a 100-foot opening in the deposit which exposed a roughly tabular, nearly vertical, barite body, 30 feet in width. The full extent of the deposit is unknown.

10/ Underlined numbers in parentheses refer to items in the bibliography at the end of this report.

11/ Work cited in footnote 4, p. 6.

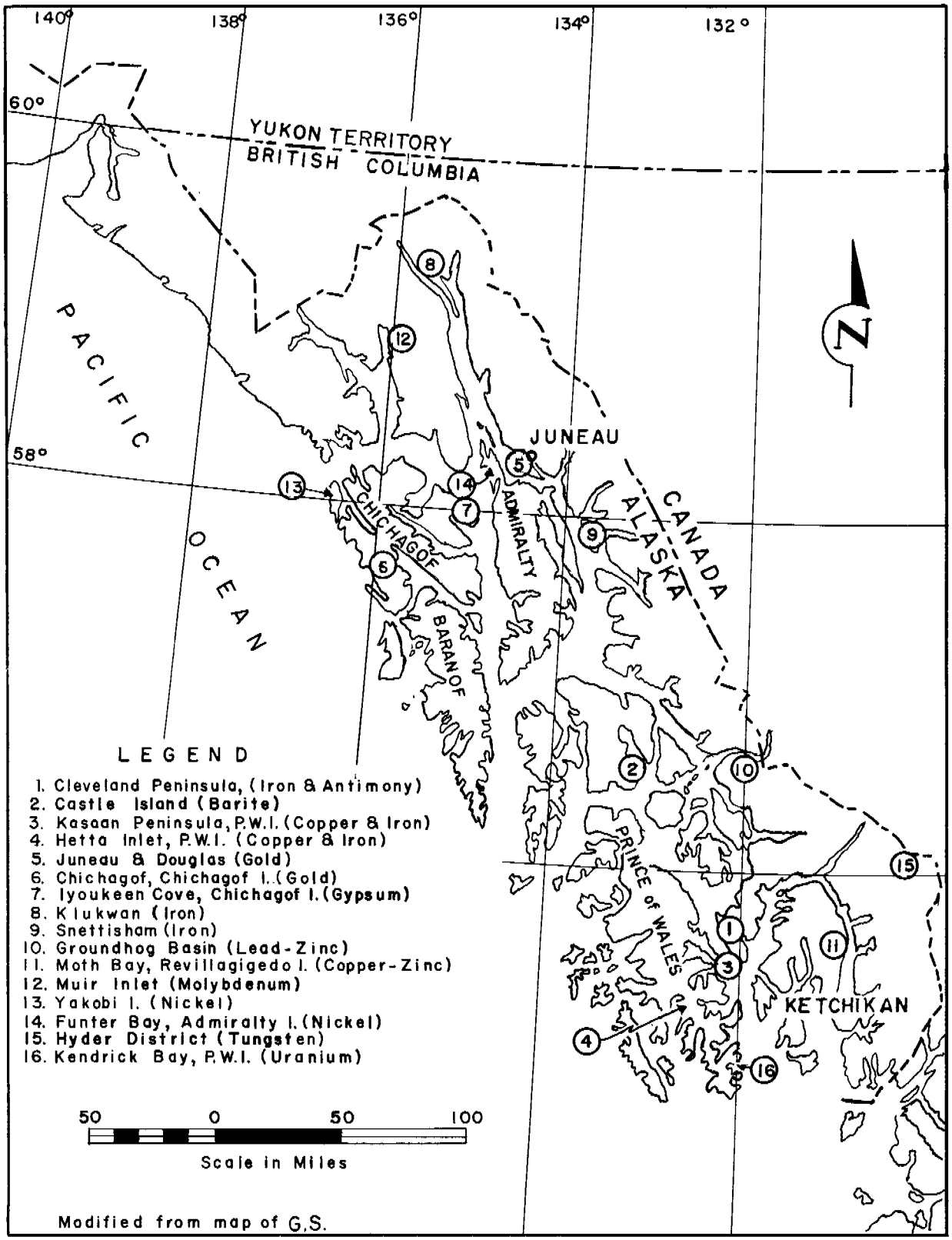

FIGURE 3. - Selected Mineral Occurrences in Southeastern Alaska.

Copper

Most of the known copper deposits of Southeastern Alaska are in the Ketchikan area; many of them are lenticular or irregular deposits in limestone adjacent to contacts with igneous intrusives; others are in wide shear zones in greenstone or schist. The copper deposits on Prince of Wales Island have been mined extensively in the past, particularly at Kasaan Peninsula (12, 13, 14, 31), Skowl Arm (8), and Hetta Inlet (30). Copper-bearing deposits also have been mined or partly developed at North Arm and Niblack Anchorage on Prince of Wales Island; and copper minerals have been reported at Seal Bay and Dall Head on Gravina Island, at the head of Duncan Canal on Kupreanof Island, and on Woewodski Island.12/

Garnet

Garnet is found in Southeastern Alaska as massive aggregates in contact-metamorphic deposits and as disseminated crystals in rock. Garnet in a crystalline schist has been mined 7-1/2 miles north of Wrangell (2); other occurrences have been reported at Port Houghton and Copper Mountain.

Gold

Gold has been the principal mineral product of the region. It occurs in quartz veins, in sulfide impregnation zones, in dikes, and in lodes that are composed of quartz stringer zones in sheared slate. The gold deposits are not limited to any particular formation; their distribution apparently is governed by structural conditions related to intrusive bodies. The largest lode-gold deposits have been found in the Juneau area; these have been low-grade ore bodies whose profitable exploitation has depended on large-scale operation. On the other hand, the mines of Chichagof Island were relatively small but high grade. Gold also has been found in a few placers, notably in Gold Creek near Juneau; however, the steep gradients and recent glaciation have prevented accumulation of important placer deposits.

Gypsum

Gypsum occurs at a few places in this region. It has been mined successfully at Iyoukeen Cove (7, 15), on the east side of Chichagof Island. It is possible that gypsum occurs elsewhere in similar deposits.

Iron

Iron-ore bodies in Southeastern Alaska occur principally in association with contact-metamorphic copper deposits and as disseminations or nearly massive segregations in basic rocks such as pyroxenite and hornblendite. The contact-metamorphic ore bodies are represented by relatively small, irregularly shaped magnetite deposits on Kasaan Peninsula (6, 12, 27, 30, 31), and at Copper Mountain on Prince of Wales Island; the iron content of these deposits is between 40 and 50 percent; pyrite and chalcopyrite are conspicuous accessory minerals disseminated in the magnetite. Magnetite-bearing pyroxenite deposits have been discovered at Klukwan (26) near Haines, on the Snettisham Peninsula (24), and at Union Bay on Cleveland Peninsula. These magnetite ores contain 15 to 35 percent total iron, with approximately 1 percent of titania for each 10 percent of iron; metallurgical tests indicate that beneficiation would produce a concentrate suitable for electro-furnace use. Further testing is required to determine the amenability of these ores to blast-furnace practices.

12/ Work cited in footnote 4, p. 6.

The very large size of the titaniferous magnetite deposits, their favorable location near deep water and apparent amenability to ore-dressing techniques, coupled to expansion of the steel industry on the west coast of the United States and a growing need by Japanese steel mills, has resulted in greatly increased interest in the iron-ore deposits of Southeastern Alaska.

Prospect locations, aside from those noted above, based upon local magnetic disturbances, are in the vicinity of East Island, Shakan Strait, and in Peril Strait.

Lead-Zinc

Despite the relatively small historic output of lead and zinc from Southeastern Alaska mines, mainly as a byproduct of gold production, known occurrences of these metals in the form of the minerals galena and sphalerite are widespread.

Galena and sphalerite usually are associated, in differing amounts, with the gold in gold lodes and veins; they also occur in complex sulfide deposits throughout the area.

Lead-zinc deposits occur at Groundhog (10) and Glacier Basins east of Wrangell, at Taylor Creek (17) on Kupreanof Island, in replacement deposits on Cholmondeley Sound, Prince of Wales Island, and in the Salmon-River area. Lead-silver ore bodies also have been reported in the latter area, as well as along the Whiting River. Copper zinc deposits have been recorded at Moth Bay (21) on Revillagigedo Island and at Tracy Arm (9), southeast of Juneau.

Limestone

The Southeastern Alaska area contains numerous deposits of high-grade limestones, many of which appear to be suitable for chemical-grade material. The most promising of these are on Dall, Heceta, Kuiu, Kupreanof, Long, Prince of Wales, Shrubby, and Wadleigh Islands. The limestone deposits on these islands have a calcium carbonate content ranging from 93 to 97 percent. However, the sale of limestones is essentially the movement of a low-cost commodity with prices very rarely exceeding $3 to $5 a ton and most often selling for about $1 a ton; consequently, further exploitation of Alaskan limestone deposits may have to await development of local markets.

Molybdenum

Molybdenum prospects have been found on Lemesurier Island in Icy Strait, at Shakan, at the north end of Noyes Island, on the north side of Adams Inlet, on the Chickamin River, and near the head of Muir Inlet (22, 26). It occurs disseminated in contact-metamorphic deposits, in pegmatitic quartz veins, in quartz fissure veins, in aplite and pegmatite veins, and as fracture facings.

Nickel

Nickel-copper deposits have been found on Yakobi Island (3, 16), Fleming and Chichagof Islands (16, 25), Admiralty Island (11, 19), and Snipe Bay (Baranof Island) (20). These consist mainly of pyrrhotite with some pentlandite and chalcopyrite in genetic connection with gabbroic or noritic intrusive masses or dikes. It appears highly probable that there are other nickel deposits in the region.

Titanium

Ilmenite occurs in segregations and in association with magnetite in the ultrabasic intrusives, and has been reported as a constitutent of some of the beach sands in the region.

Tungsten

Small scheelite ore bodies have been found at the Apex-El-Nido mine (23) on Chichagof Island, and at the Mountain View (5, 23) and Riverside (23) properties in the Hyder district; tungsten-bearing minerals have been found at many other places in Southeastern Alaska.

Uranium and Other Radioactive Minerals

Radioactivity has been reported from several areas in Southeastern Alaska, but commercial exploitation has been announced only for uranium from Bokan Mountain (18) near Kendrick Bay, Prince of Wales Island. This area was discovered by airborne survey, but very little detailed ground prospecting has been done. Additional deposits may be found.

On northern Prince of Wales Island, in the Salmon Bay area, radioactive veins have been discovered in an area north of Exchange Cove and extending to Point Colpoys. These radioactive formations probably extend to the adjacent islands.

Radioactivity also has been reported in the Taku Harbor - Point Astley area near Hyder on Annette Island and near William Henry Bay on Lynn Canal. The uranium possibilities of Southeastern Alaska have not been prospected enough to present data on the potential value of the region as a uranium-producing area.

ELEMENTS IN DEVELOPMENT

Labor

No experienced mine labor exists in Southeastern Alaska, because no mines have been operated since early in World War II. However, during the active period (1890 to 1943) a good indigenous supply was developed. Reestablishment of a stable mining industry undoubtedly would encourage the evolution of a new generation of skilled miners.

Figures published by the Employment Security Commission (table 3) for September 1956 indicate that only 3 percent of the labor force was unemployed at that time. The September period, however, is one of peak employment, as shown in figure 4. A study of this graph indicates that unemployment (measured by unemployment-benefit payments at the three local offices of the Employment Security Commission) reaches a peak in March, then rapidly declines to a low point in August. As a result of the seasonal nature of employment in the area, wages (table 4) are high compared with those in the continental United States. However, an operation capable of offering year-round or regular seasonal employment probably would be able to obtain personnel at wage rates lower than those shown in the table. Nevertheless, remuneration would still be above the $2.19 average hourly wage earned in the national metal-mining industry in 1955 because of the substantially higher cost of living in Alaska. Table 5 shows the cost of food in three Southeastern Alaska cities and Seattle, Wash. It will be noted that, in December 1956, the cost of a typical market basket of food in Southeastern Alaska ranged from 22 to 25 percent above that for the same food basket in Seattle.

TABLE 3. - Labor-force data[1/], by cities, July 1 and September 1, 1956

	Juneau		Petersburg		Ketchikan	
	July 1	September 1	July 1	September 1	July 1	September 1
Total labor force ..	5,450	5,525	2,250	2,325	3,750	3,750
Unemployed	397	150	50	50	200	175
Employed	5,053	5,375	2,200	2,275	3,550	3,575

1/ Alaska Employment Security Commission, local office bimonthly labor-market summaries, Juneau, Alaska, July 1-Aug. 31, 1956, inclusive.

TABLE 4. - Wage rates, union scale, 1956[1/]

Occupation	Rate per hour[2/]
Brakeman	$3.29
Jackhammer operator	3.46
Maintenance man	3.57
Miner	3.62
Miner, shafts, and raises	3.67
Muckers and laborers	3.36
Pneumatic and power-tool operator	3.39
Powderman	3.77
Powderman's helper	3.36

1/ Adapted from Schedule B, Alaska General Contractor-AFL-CIO Alaska Master Labor Agreement, effective March 1956.

2/ Rates are applicable in First Judicial Division to 138° west longitude. Room and board must be provided employees at a maximum charge of $5.75 per day. If room-and-board charge exceeds $5.75, pay rates will be adjusted accordingly. The employer is required also to contribute 10¢ per hour worked to the union health and security fund.

TABLE 5. - Cost of food, selected cities and Seattle, 1954-56[1/]

City	Cost of food basket		
	1954	1955	1956
Seattle	$10.21	$10.38	$10.65
Ketchikan	12.81	12.84	13.02
Sitka	14.62	13.21	(2/)
Juneau	13.41	12.79	13.31

1/ Univ. of Alaska, Agricultural Exp. Sta., Cost of Living Survey, Jan. 31, 1956, and Jan. 31, 1957.

2/ Not available.

Transportation

Water Transport

Southeastern Alaska is fortunate in having been endowed by nature with an inland water route extending from Puget Sound on the south to Skagway on the north. This "Inside Passage," a series of deep water channels and straits, provides easy access to tidewater for every part of the region.

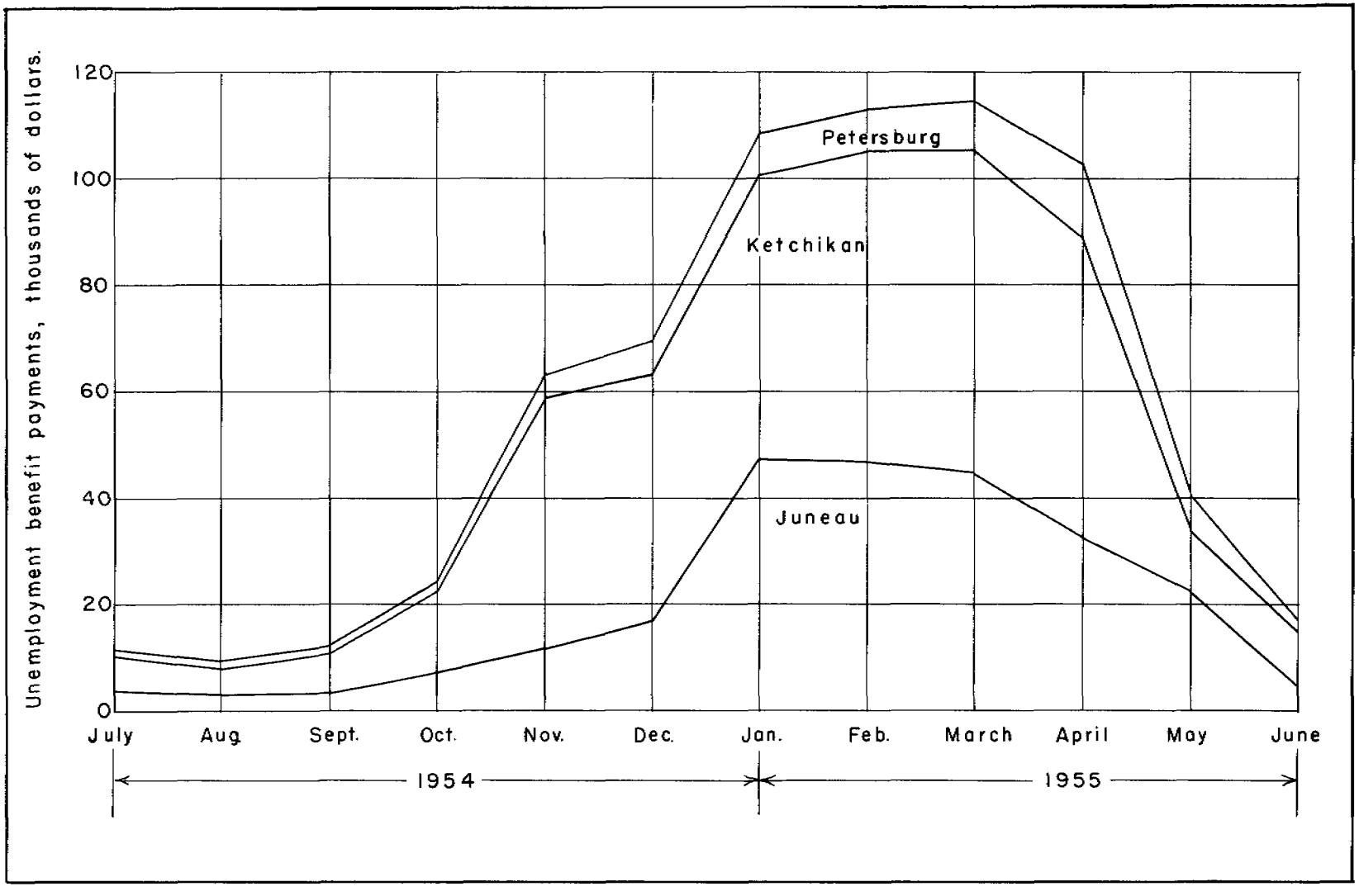

FIGURE 4. - Alaska Employment Security Commission, Local Office Unemployment Benefit Payments, Fiscal Year 1955, by Months.

At present only one American shipping company offers service to Southeastern Alaska on a regular schedule throughout the year. Several Canadian lines operate tourist and freight services during the summer months, but the legal restrictions of the Jones Act prevent foreign ships from hauling cargo between two American ports. It is doubtful, therefore, if Canadian ships could be utilized by Southeastern Alaska miners.

Under present conditions existing shipping facilities appear adequate for transporting supplies and equipment from the United States to various Alaskan ports. Tables 6 and 7 show the commercial freight rates and wharfage and handling charges for selected commodities or cities. The steamship company has the option of charging either by weight or volume, whichever provides the greater revenue. Motorships could be used to haul supplies and equipment from the main ports to the mine docks where direct service by large shippers is not available. The capacity of the motorships and the rates charged for their use vary widely according to the area served, the length of haul, and the terms of the individual contract.

TABLE 6. - Freight rates, selected commodities, Alaska Steamship Co., 1956[1/], cents

From Seattle to -	Ketchikan		Wrangell-Petersburg		Juneau		Skagway, Sitka, Haines	
Commodity	Per 100 lb.	Per cu. ft.	Per 100 lb.	Per cu. ft.	Per 100 lb.	Per cu. ft.	Per 100 lb.	Per cu. ft.
Machinery	83	41-1/2	89	44-1/2	94	47	101	50-1/2
Oil, petroleum, and petroleum products	95	-	102	-	111	-	117	-
Ores and concentrates[2/]	56	-	56	-	62	-	62	-
Blasting powder, dynamite	286	-	293	-	299	-	306	-
Sacks: Burlap, gunny, or jute ...	-	38	-	39	-	40	-	41

1/ Alaska Steamship Co., Local, Joint, and Proportional Freight Tariff, Tariff No. 766, July 5, 1955, as revised Mar. 18, 1957.

2/ Value not exceeding $60 per ton. Rate increases 25 percent each additional $60 or fraction thereof.

TABLE 7. - Wharfage and handling charges, freight n.o.s. general merchandise, selected cities, 1957, cents

City	Wharfage		Handling	
	Per 100 lb.	Per cu. ft.	Per 100 lb.	Per cu. ft.
Haines[1/]	7-1/2	3-3/4	26-1/2	13-1/4
Juneau[2/]	9	4-1/2	20	10
Ketchikan[3/]	9	4-1/2	18	9
Seattle[4/]	3-1/2	1-3/4	10-1/4	5-1/8
Sitka[5/]	9	4-1/2	23	11-1/2

1/ Haines Terminal and Highway Co., Tariff No. 7, Oct. 1, 1955.
2/ Ketchikan Wharf Co., Tariff No. 7, Feb. 2, 1955.
3/ Ketchikan Wharf Co., Tariff No. 16, Feb. 2, 1955.
4/ Alaska Steamship Co., Tariff No. 732, supp. 8, Aug. 13, 1956.
5/ Conway Dock Co., Tariff No. 8, July 1, 1957.

The steamship method of transport could also be used to ship ore or concentrate to market. The ton-mile cost of transporting ore from Southeastern Alaska to Seattle-Tacoma via scheduled service is estimated to be 11.2 mills, based on a 1,000-mile haul at 56 cents per 100 pounds. This figure does not include wharfage, handling, or the cost of sacking. The latter would be necessary because the steamers are not equipped to handle ore and concentrates in bulk.

An alternate method of hauling ore from Southeastern Alaska mines to the Seattle-Tacoma area, as well as equipment and supplies north to the mine, would be by chartered tug and barge. Several towing companies quote a monthly charter fee of $40,000 for one tug and one 2,500-ton barge. The estimated ton-mile cost of hauling ore by chartered tug and barge would be 8 mills, excluding wharfage and handling and assuming that two round trips were made each month. This ton-mile cost could be halved by a year-round mining operation capable of shipping on a sustained basis. Such an operation would be able to obtain, by special contract with the tugboat companies, a monthly rate as low as $17,000 for the tug and $1,200 for each 2,500-ton barge.

In those instances where the mine output would not be enough to warrant chartering a tug and barge for a full month, it is possible to charter on a 1-round-trip basis at a cost of $1,500 per day. Enough ore for a shipment would have to be stockpiled at the mine. The shipper, in all cases, is required to load and discharge, as well as insure his own cargo.

Air Transport

No scheduled commercial air-freight lines operate between the United States and Southeastern Alaska. The regular, scheduled passenger flights from Seattle to Annette Island and Juneau however, do, carry some freight. One leading airline quoted a rate for all commodities as follows:

	Cents per pound
Lots less than 100 pounds	30
Lots 100 pounds or over	15
Single items weighing 45 pounds or more	15

Despite the lack of air-freight service from Seattle, the availability of large bodies of water has led to development of an excellent seaplane-transportation network in Southeastern Alaska. Communities of all sizes are served on a regular schedule from Juneau by Alaska Coastal Airlines and from Ketchikan by Ellis Airlines. Alaska Coastal Airline rates are listed in table 8; Ellis-Airline rates are comparable. Both companies, as well as other "bush" operations, also offer charter service to all points in the region at rates ranging from $30 per hour for a Piper seaplane to $100 per hour for a Grumman amphibian.

Air transportation is widely utilized for hauling equipment, groceries, and personnel. The cargo capacity of the different aircraft varies downward according to the number of passengers and the quantity of fuel aboard, but in most instances is less than 1 ton. The seaplanes generally require a minimum of 1 mile of open water for landing and takeoff and a draft ranging from 12 to 18 inches. The amphibians, on land, require a runway 2,500 to 4,100 feet long, depending on the type of airplane, weight of cargo, wind, and other factors.

TABLE 8. - General commodity rates, selected cities, Alaska Coastal Airlines, cents per pound, 1957[1/]

From	To -					
	Haines	Juneau	Ketchikan	Petersburg	Sitka	Wrangell
Haines	-	0.09	0.23	0.17	0.16	0.18
Juneau	0.09	-	.17	.10	.09	.11
Ketchikan	.23	.17	-	.10	.17	.09
Petersburg	.17	.10	.10	-	.10	.06
Sitka	.16	.09	.17	.10	-	.11
Wrangell	.18	.11	.09	.06	.11	-

1/ Adapted from local air-cargo rates, tariff No. 1, CAB No. 19, Alaska Coastal Airlines, effective Apr. 1, 1957.

The helicopter, capable of landing and taking off on a level space 10 by 10 feet, provided no overhanging obstructions prevent free movement of the rotor blades, is being advanced rapidly as a means of transporting exploration parties and supplies in areas where airplane-landing facilities are not available. Because of the thinner air at high altitudes (over 7,000 feet) loads must be reduced for work in the higher mountains, or special takeoff conditions must be available. The usual charter rate is $100 per hour, plus fueling charges. This rate is more than offset by the extra man-hours that would be consumed in walking over the extremely rugged, heavily forested country that predominates in Southeastern Alaska. Most of the helicopters used in the region can carry 2 passengers and 100 pounds of equipment. The actual cargo capacity is contingent upon the weight of the passengers, the altitude, and the quantity of fuel being carried.

Land Transport

Highway travel from one part of Southeastern Alaska to any other part is impossible because the rugged terrain and the predominance of swampland in level areas have prevented highway construction. A north-south highway along the coast is unlikely. Land transport to the United States, in the future, will be over feeder roads to routes east of the Coast Range; in most instances these roads will follow the river valleys.

Water Supply

The exceptionally heavy rainfall in Southeastern Alaska makes this region one of the wettest of the Western Hemisphere; it assures a more than ample water supply.

Many streams of the mainland originate in the glaciers and snowfields of the Coast Range and St. Elias Mountains. These creeks and rivers, whose runoff is more affected by temperature than by precipitation, usually have a low runoff in winter and carry a high volume of water in summer and autumn.

The nonglacial streams have a runoff pattern directly proportional to normal rainfall. Flood conditions are aggravated during heavy rains, because the reservoir effect of the luxurious vegetation is partly offset by steep slopes and shallow soil, which permit the water to run off quickly.

In many instances glacial and nonglacial streams rise in or flow through lakes that act as natural catch basins for precipitation, thereby smoothing out floods

and reinforcing the low runoff periods.13/ Table 9 presents the average stream-flow data for some of the larger creeks and rivers in Southeastern Alaska.

TABLE 9. - Average stream-flow data,1/ selected streams

Stream	Tidal drainage	Drainage area at mouth (square miles)	Average flow	
			Cubic feet per second	Cubic feet per second (square miles)
Mainland streams:				
Salmon River	Portland Canal	160	2/1,600	2/10
Soule Glacier River .	do.	80	2/880	2/11
Davis River	do.	83	917	11
Wilson River	Behm Canal	150	2/1,500	2/10
Chickamin River	do.	600	2/5,400	2/9.1
Unuk River	do.	960	8,600	2/9.0
Anan Creek	Bradfield Canal	48	580	12.1
White River	do.	43	530	12.3
Harding River	do.	109	2/1,300	2/12.0
Aaron Creek	do.	113	2/1,320	2/11.7
Stikine River	Dry Strait	19,700	2/59,000	2/3.0
Whiting River	Stephens Passage	880	2/8,800	2/10.0
Speel River	do.	214	2,600	12.2
Turner Creek	Taku Inlet	52	2/500	9.6
Taku River	do.	6,700	20,000	3.0
Chilkat River	Lynn Canal	1,230	2/2,460	2/2.0
Endicott River	do.	150	2/750	2/5.0
Alsek River	Gulf of Alaska	9,500	2/14,000	2/1.5
Prince of Wales Island:				
Klakas Creek	Klakas Inlet	11	2/130	2/11.5
Reynolds Creek	Hetta Inlet	6	2/60	2/10.3
Clover Creek	Clarence Strait	15	2/145	2/10.0
Kugel Creek.....	Moira Sound	9	95	10.0
Karta River.....	Kasaan Bay	50	459	9.3
Chichagof Island:				
Goulding Creek.....	Pacific Ocean	27	340	12.5
Admiralty Island:				
Hasselborg River.....	Mitchell Bay	107	2/700	2/10.0
Thayer Creek.....	Chatham Strait	53	2/420	2/7.9
Florence Creek.....	do.	39	2/310	2/8.0

1/ 83d Cong., 2d sess., Southeastern Alaska: H. Doc. 501, 1954, pp. 26-27.
2/ Estimated.

Power

Waterpower

Hydropower is one of the major potential resources of Southeastern Alaska. A large number of possible power sites, (many small ones) might be utilized by mining or metallurgical operations. Precedent for this was established as early as 1882, when the first waterpower development in Southeastern Alaska was undertaken to provide power for operating the Treadwell stamp mill on Douglas Island. The Treadwell Co. also constructed the first integrated power project in 1915, when the Sheep Creek and Nugget Creek plants were connected.

13/ Henshaw, Fred F., Surface Water Supply, Southeastern Alaska, 1909-1930: Geological Survey Bull. 836c, 1933, pp. 147-151.

Producing large blocks of power would be a major incentive to the development of such mineral industries as aluminum and magnesium reduction and electric smelting of iron, copper, and zinc ores.

The three largest potential sources of waterpower in the region are the Taiya project and the Taku and Stikine Rivers. Drainage basins and storage sites for these major projects lie largely in British Columbia or the Yukon Territory; therefore, development depends on the cooperation of the Canadian Government. The Taku and Stikine River projects are believed capable of producing 1.5 million and 4 million kilowatts (firm power), respectively. The Taiya project, including the Teslin River diversion and the Sloko Lake drainage, is estimated to be capable of producing 22 billion kilowatt-hours annually, with a firm capacity of 2.5 million kilowatts. The Taiya hydropower project appears to be the most economical at this time; the estimated cost to the consumer at the power site would be approximately 3 mills per kilowatt-hour. If Canadian approval could be obtained and the Federal Government or a private company (such as a pulp-mill operator) built the dams, generating facilities, and other necessary structures, mineral industries in the transmission area also would reap the benefits of low-cost hydroelectric power.

The United States Forest Service and the Federal Power Commission prepared a study of 200 power sites, other than the three mentioned.[14/] All are on United States soil. The primary capacity of these 200 sites was estimated to be 789,860 horsepower; the average capacity, 1,008,370 horsepower. The results of the Power Commission-Forest Service study are summarized in table 10.

The effective waterhead at the various sites ranged from as little as 18 to as much as 2,345 feet. Of the 200 stations studied, 59 percent had an effective head ranging from 100 to 500 feet, 20 percent were in the 500- to 1,000-foot range; and most of the remaining 21 percent had effective heads below 100 feet. Fifty-one of the projects had been developed at one time or another. Of these, 10 have been dismantled or abandoned, and only 8 developed approximately the estimated potential average horsepower capacity for the site. The Power Commission and Forest Service believe that, of the 200 projects, 6 have a range of less than 100 average horsepower, 45 range from 100 to 1,000 average horsepower, 74 are in the 1,000- to 3,500-horsepower class, 48 in the 3,500- to less than 10,000- class, 26 in the 10,000- to less than 51,000-horsepower group, and 1 is capable of producing 51,000 average horsepower.

The United States Army Corps of Engineers prepared generating- and construction-cost figures for the larger of the 200 hydropower sites, based upon 3-percent interest on the loan, amortized over a 50-year period.[15/] These estimates are presented in table 11. The cost of power from most sites will be high, compared with major power developments in the United States, because construction costs in Alaska are relatively high and because the ratio of construction costs to power output also will be relatively high.

14/ Federal Power Commission and U. S. Forest Service, Water Powers, Southeast Alaska: 1947, 168 pp.

15/ 83d Cong., 2d sess., Southeastern Alaska: H. Doc. 501, 1954, pp. 91-108.

TABLE 10. - Potential waterpower, by areas[1/]

Area	Number of potential power locations	Facilities required: Number of dams or structures[2/]	Facilities required: Number of generating stations[3/]	Total capacity of stations[4/]: Primary: Horsepower	Primary: Equivalent kw.	Average: Horsepower	Average: Equivalent kw.
Hyder	7	9	8	30,620	22,843	50,000	37,300
Rudyerd Bay	16	20	18	49,700	37,076	60,000	44,760
Bradfield Canal	11	13	13	69,900	52,145	107,500	80,195
Dall Island	1	1	1	1,800	1,343	1,800	1,343
Sukkwan Island	1	1	1	1,600	1,194	2,700	2,014
Tuxekan Island	1	1	1	110	82	280	209
Kosciusco Island	1	1	1	1,400	1,044	1,400	1,044
Prince of Wales Island	20	25	24	36,760	27,423	46,280	34,525
Annette Island	7	8	7	7,750	5,782	8,150	6,080
Gravina Island	1	4	1	30	22	200	149
Revillagigedo Island	14	23	19	94,250	70,311	100,520	74,988
Etolin Island	6	7	7	15,100	11,265	18,400	13,726
Wrangell Island	1	1	1	2,500	1,865	3,600	2,686
Mitkof Island	1	1	1	1,080	806	1,400	1,044
Area north of Stikine R.	5	6	5	56,920	42,462	63,600	47,446
South of Taku Inlet	13	16	16	156,110	116,458	197,600	147,410
North of Taku Inlet	14	16	16	45,210	33,727	76,530	57,091
Douglas Island	1	2	2	700	522	6,000	4,476
Skagway	5	13	7	16,040	11,966	28,700	21,410
Admiralty Island	8	8	8	41,450	30,922	45,670	34,070
Kuiu Island	3	3	3	2,030	1,514	2,150	1,604
Kupreanof Island	1	1	1	60	45	300	224
Baranof Island	45	54	46	136,280	101,665	159,010	118,621
Kruzof Island	1	1	1	500	373	600	448
Chichagof Island	16	21	20	21,960	16,382	25,980	19,381

1/ Federal Power Commission and U. S. Forest Service, Agriculture Water Powers, Southeast Alaska, 1947: 1947, 168 pp.
2/ Major structures required for operation, such as reservoir, dam, diversion dam, tunnel, conduit, penstock.
3/ Stations required to produce proposed power.
4/ Based on available information.

Diesel Power

Despite the huge power potential available from the streams and rivers of Southeastern Alaska, most new mining operations will find it more expedient to utilize diesel equipment for their power needs than to invest substantial sums for erecting dams, penstocks, turbines, generators, transmission lines, etc. A 50-kilowatt diesel unit can be purchased for $8,000; larger units, such as 975-kilowatt units, sell for prices exceeding $250,000. Generally, diesel equipment can be purchased for approximately $240 per kilowatt of rated capacity.

Fuel consumption of diesel-power units ranges from 5 gallons per hour for a 50-kilowatt unit to 94 gallons per hour for 975-kilowatt units and averages approximately 0.1 gallon per hour per kilowatt of rated capacity. Fuel in Southeastern Alaska averages $0.21 per gallon.

TABLE 11. - Selected waterpower projects[1/]

Project	Kilowatts		Estimated cost	
	Prime power	Installed capacity	Generation (mills/kw.-hr.)	Construction (thousand dollars)
Ketchikan area:				
Lake Grace	11,000	22,200	7.0	11,477
Mirror, Ella, Manzanita Lakes	14,500	29,600	9.7	24,000
Swan Lake	7,630	15,000	9.0	10,800
Petersburg-Wrangell area:				
Cascade Creek	16,900	34,000	6.2	16,600
Scenery Creek	9,000	18,000	8.8	13,000
Sitka area:				
Green Lake	2,400	4,800	12.6	4,800
Blue Lake	7,400	15,000	10.2	12,000
Takatz Lake	7,600	15,000	6.2	6,540
Juneau area:				
Speel River	36,000	72,000	10.3	68,700
Long River	21,000	42,000	5.3	17,000
Crater Lake	11,000	22,000	6.4	10,400
Dorothy Lake	15,000	28,000	6.0	13,500

1/ 83d Cong., 2d sess., Southeastern Alaska: H. Doc. 501, 1954, pp. 91-107.

The number of employees required for maintaining and operating diesel generators varies, depending on the number of hours operated each day and the capacity of the unit; those having a capacity of less than 100 kilowatts will require the services of parttime employees only; larger units may require the services of 2 or 3 men. Wage rates for maintenance men range between $2.84 and $4.95 per hour.

Taxes

Businesses active in the Territory of Alaska are subject to the same Federal income and corporate taxes as their counterparts in the continental United States. In addition, the Territorial Government levies a corporate income tax at the rate of 18 percent of the calculated Federal income tax; the personal-income-tax rate is 14 percent of the Federal tax. Every mining venture also must have a mining license. The license fee, based upon net income, is levied on persons, firms, or corporations in a graduated manner, as follows:

Net income under $40,000	No tax
Over $40,000 and not over $50,000	3 percent
Over $50,000 and not over $100,000	$1,500 + 5 percent of the excess over $50,000
Over $100,000	$4,000 + 7 percent of the excess over $100,000

Mining operations are not required to pay the license tax during the first 3-1/2 years of production. Receipts for both the income and license taxes are subject to allowances for depletion at the rate of 10 percent for coal mines, 15 for metal mines, and 23 for sulfur mines. New ventures may, on application and at the discretion of the Territorial Board of Administration, be exempted from income, license, excise, and other taxes levied by the Territory of Alaska for a maximum period of 10 years after operations are begun. This applies only to those mines at which the product is beneficiated or substantially processed within the Territory. The final date

on which applications for exemption may be received is June 20, 1967. Exemptions granted by the Board of Administration apply solely to taxes levied by the Territory of Alaska and do not apply to any Federal tax.

Corporations doing business in Alaska also pay an employment-security tax at the rate of 2.7 percent on wages up to $4,200 per employee; an additional 0.5 percent is paid by the workers. In addition to these major taxes, various minor taxes and fees are levied; included are a corporation tax of $15 per year and an annual-report filing fee of $2.50 for domestic corporations and $5 per year for foreign corporations. Mining companies operating commissaries are also required to have a business license similar to the mining license but based upon gross receipts of the commissary.

The Territory has no sales or real-estate tax. Some of the incorporated areas and school districts, however, do levy these taxes. In most instances mining operations would be outside incorporated regions; in any instance the Industrial Tax Incentives Act, described above, provides for exemption from real or personal-property taxes on a sliding scale of 5 to 10 years, depending on the size of investment in Alaska.

Markets

The major deterrents to development of a mineral industry in Southeastern Alaska have been the difficulties of access and transportation (except along protected shorelines), the lack of purchasers within economic shipping distance, and (to some extent) mineral-dressing difficulties caused by the complexity or low grade of some ores. The latter has been alleviated somewhat through research in beneficiation methods conducted by the Bureau of Mines and industrial organizations and by improvements in equipment. The location of ore buyers in relation to Southeastern Alaska has improved because of the growth of the Northwestern United States. As population and industry shifted westward to take advantage of relatively inexpensive hydropower, the demand for raw materials close to the Pacific coast increased, resulting in a brighter marketing outlook for Southeastern Alaska ores.

Access and transportation continue to improve with the natural development of the Territory. The economy of the region would benefit most, however, if electric-smelting facilities, utilizing the tremendous waterpower resources of the region, were constructed. Such plants, using local ores, would produce high-quality electrolytic products capable of commanding premium prices. Most metals available in Southeastern Alaska can be refined by electrolytic processes; in addition, large-scale hydrodevelopment would result in low-cost power. The development of large-scale hydropower appears unfeasible at this time because of political factors; therefore, a review of present market possibilities is presented below.

Copper, Lead, Zinc

Copper and lead ore and concentrate have been shipped to The American Smelting & Refining Co. copper smelter at Tacoma, Wash., and to the company lead smelter at Selby, Calif. These two plants are located at tidewater and provide a market within easy shipping distance. Other smelters within the economic area are The Anaconda Co. copper and zinc smelter at Anaconda, Mont.; The American Smelting & Refining Co. lead smelter, East Helena, Mont.; and The Bunker Hill Co. Bradley and Silver King, Idaho, lead and zinc smelters. The latter plants are inland, and ores consigned to them require transshipping via railroad. This increases shipping costs by at least $4.62 per ton (plus 3 percent tax) for the Idaho plants; handling charges for moving ore from the boat or barge to the railroad are added to the cost of shipping.

The choice of a smelter would depend in large measure on the amount received as payment for the ore. In some instances the difference in transportation costs between tidewater and inland smelters would be balanced by a higher rate for the ore paid by the inland plant. Smelters pay for ore on the basis of published or negotiated schedules. Sample schedules are given in the appendix. These, are for calculating purposes only and should not be considered final. The actual terms of a schedule are based on the expected monthly tonnage, grade and analysis of the ore, shipping point, needs of the smelter for certain types of ore, and other items.

Iron, Titanium

One of the most promising mineral resources in Southeastern Alaska is iron. The growing need for steel on the west coast of the United States could provide an outlet for iron ores and concentrate. There are iron blast furnaces at Fontana, Calif., Pueblo, Colo., and Geneva and Ironton, Utah; these apparently are well supplied with ore from Utah, Wyoming, and California. A possibility remains, however, that the companies[16/] would be interested in a supplemental supply.

The Orient, particularly Japan, is another possible market for the iron ores. Japanese companies, for many years, have been seeking steady sources of raw material for their blast furnaces. In the past these foreign manufacturers have purchased iron ore from Utah and Nevada. If proper arrangements could be made with Japanese concerns, Southeastern Alaska ores and concentrates could be sent abroad in Japanese ships. The distance to that country would not be excessive, particularly in view of the Territory's strategic position on the Great Circle route. Many ships en route to the Orient traverse the Great Circle route from San Francisco; this requires a course approaching the Aleutian Islands. Shipments directly to Japan from Southeastern Alaska should save nearly 2 days' sailing time, compared with the sailing time from San Francisco to Japan.

Some iron ores of the region contain a considerable percentage of titanium as ilmenite. If this material could be recovered economically, possibly as a titaniferous slag from electrosmelting, it might be sold for pigment or other uses. Little chance exists that ilmenite could be used in manufacturing titanium metal, inasmuch as the metal-producing plants use mainly rutile for this purpose.

Uranium

The seller of uranium ore must be licensed by the Atomic Energy Commission (AEC) and must sell his material to a licensed AEC buyer at a price determined by the Commission. Southeastern Alaska ores probably would be sent to the newly constructed plant of the Dawn Mining Co. at Ford, Stevens County, Wash. This mill uses a process that appears suitable for those uranium ores discovered in the region to date.

Antimony, Nickel, Tungsten

Other metal resources of the region comprise antimony, nickel, and tungsten. Under present conditions, it is doubtful if antimony ore produced in Southeastern Alaska could compete with low-cost foreign material; however, shipments of antimony ore have been made from other parts of the Territory in the past few years for use as a pigment. Pigment producers are the National Lead Co., Laredo, Tex.; and The

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16/ Kaiser Steel Corp., Fontana, Calif.; Colorado Fuel & Iron Corp., Pueblo, Colo.; and Columbia-Geneva Steel Div., U. S. Steel Corp., Geneva and Ironton, Utah.

Glidden Co., Baltimore, Md. Antimony smelters are at Omaha, Nebr., and Kellogg, Idaho; both smelters have sources of supply and usually do not accept custom ore.

The nickel deposits of Southeastern Alaska constitute a substantial proportion of the nickel reserves of the United States. Nickel ore could, perhaps, be sold to the Hanna Nickel Smelting Co., Riddle, Oreg. This plant is equipped for electrosmelting silicate ores and probably could not treat Alaskan sulfide ores without some changes in its flowsheet. A more promising market for a nickel output from the Southeastern region would be Japan (see Iron, Titanium.)

Small quantities of tungsten ore have been produced from Southeastern Alaska mines in the past. High-grade scheelite concentrate could be sold for direct charging to steel furnaces. Typical specifications for high-grade scheelite concentrate require a minimum of 70 percent tungsten trioxide, with maximum percentages of other materials as follows: 0.10 percent each tin, arsenic, antimony, lead, and zinc; 0.05 percent each copper and phosphous; 0.25 percent bismuth; 0.50 percent each sulfur and manganese; and 0.8 percent molybdenum (for Class B steels; no maximum percentages of molybdenum specified for Class A steels). Low-grade concentrates for use in manufacturing various tungsten compounds might be sold to the United States Vanadium Co., Pine Creek, Inyo County, Calif.; and Salt Lake Tungsten Co., Salt Lake City, Utah.

Nonmetals

Substantial reserves of nonmetals, including limestone and gypsum, also occur in the region. It is doubtful if a market could be found for the gypsum because of new discoveries in the United States, plus the present decline in the building-products industry. Stone has been sent to the Seattle area for use in manufacturing cement; however, the availability of suitable limestones closer to Seattle has since negated this market.

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APPENDIX I

Representative Open-Smelter Schedules for Calculating Purposes Only

AMERICAN SMELTING & REFINING CO.
New York, N. Y., June 3, 1957

Copper Ores and Concentrates

DELIVERY: F.o.b. receiving smelter.

PAYMENT:

Gold: If 0.03 troy ounce per ton or over, pay for 91.14 percent at the United States Mint price.

Silver: If 1 troy ounce per ton or over, pay for 95 percent at the Handy & Harman quotation, less 1¢ per troy ounce of silver paid for. Minimum deduction, 1 ounce.

Copper: Deduct 1.3 units and pay for 100 percent of the remaining copper at the Engineering & Mining Journal export refinery quotation, less a deduction of 2.75¢ per pound.

DEDUCTIONS:

Treatment charge: $12.50 to $15.00 per net dry ton of 2,000 pounds.

Zinc: 7 percent free; charge for excess at 30¢ per unit.

Arsenic: 1 percent free; charge for excess at 75¢ per unit.

Antimony: 1 percent free; charge for excess at $1.00 per unit.

Bismuth: 0.05 percent free; charge for excess at 50¢ per pound.

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Lead Ores and Concentrates

DELIVERY: F.o.b. receiving smelter.

PAYMENT:

Gold: If 0.03 troy ounce per ton or over, pay for 91.14 percent at the United States Mint price.

Silver: If 1 troy ounce per ton or over, pay for 95 percent at the Handy & Harman quotation, less 1¢ per troy ounce of silver paid for. Minimum deduction, 1 ounce.

Lead: Deduct 1.5 units from the wet-lead assay and pay for 95 percent of the remaining lead at the New York price, less a deduction of 1.75¢ per pound.

Copper: Deduct 1.3 units, and pay for 100 percent of the remaining copper at the Engineering & Mining Journal export refinery quotation, less a deduction of 8¢ per pound.

DEDUCTIONS:

Treatment charge:	$15 per net dry ton of 2,000 pounds.
Zinc:	7 percent free; charge for excess at 30¢ per unit.
Arsenic:	1 percent free; charge for excess at 75¢ per unit.
Antimony:	1 percent free; charge for excess at $1 per unit.
Bismuth:	0.05 percent free; charge for excess at 50¢ per pound.

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Zinc Concentrates

DELIVERY: F.o.b. receiving smelter.

PAYMENT:

Zinc: Pay for 85 percent at the East St. Louis price, less a deduction of an amount equivalent to the spelter freight from Texas smelters to East St. Louis - approximately 6¢ per pound.

DEDUCTIONS:

Treatment charge:	$53.50 per net dry ton of 2,000 pounds based on a zinc price of 11.5¢ per pound, plus $1.00 per ton for each 1¢ over 11.5¢ per pound and less $1.00 per ton for each 1¢ under 11.5¢ per pound.
Iron:	7 percent free; charge for excess at 50¢ per unit.
Other impurities:	Subject to individual negotiation.

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Productions of any copper, lead, or zinc ores and concentrates must be of a satisfactory metallurgical quality.

United States taxes, duties, etc., are for account of the shipper.

Smelter schedules are subject to labor and fuel escalation.

THE BUNKER HILL CO.

Electrolytic Zinc Plant

Concentrate Schedule 4 June 1957

Delivery: F.o.b. cars, Silver King, Idaho. A switching charge as assessed by the Union Pacific Railroad will be made on lots delivered by truck.

Settlement: Based upon a split of assays, if within the following limits:

	Oz.		Percent
Gold.....	0.01	Lead.....	0.5
Silver....	.50	Zinc.....	.5
		Iron.....	1.0

Umpire: See sheet attached.

Payment for metals: Zinc: For 80 percent, in excess of 3 units, at the New York quotation.

Lead: For 80 percent, in excess of 3 units, at the New York quotation, less 2 cents per pound.

NOTE: As long as the government price remains fixed at the present levels, payment for gold and silver will be as follows:

Gold: For 80 percent, if 0.01 oz. per ton or over, $34.2425 per oz.

Silver: For 80 percent, if 1 oz. per ton or over, the prevailing price published by Handy & Harman based on either the Treasury's purchase price of newly mined domestic silver or the official price paid for bar silver in New York, whichever is higher. If the Treasury should discontinue the purchase of silver at a fixed price, the price paid shall be the official New York price for silver quoted by Handy & Harman.

Quotations: Metals prices as of date of sampling as published in the weekly Market-News service (E&MJ Metal & Mineral Markets) of the Engineering & Mining Journal. Should settlement date fall upon a legal holiday or date upon which no quotation for a metal is issued, the next preceding quotation for that metal shall be used.

Treatment charge: $16 per dry ton of concentrate when the price of Prime Western zinc in East St. Louis is 4 cents per pound or less, which is the base charge.

Add $2.50 per ton for each 1-cent-per-pound rise in the price of zinc above 4 cents, fractions in proportion.

If zinc is under 45 percent, an additional charge of 50 cents per unit of deficiency under 45 percent will be made, fractions in proportion.

Penalties:

Iron: 30 cents per dry ton for each unit of iron, fractions pro rata.

Insoluble: No penalty for insoluble.

Lead: Should lead content of concentrate fall below 3 percent, deduct from the amount payable for the metals in such concentrate, the sum of $1 per dry ton of concentrate, for each unit of lead under 3 percent, fractions in proportion.

Sampling cars: Buyer has option of sampling and settling for each car separately or in any group up to four cars in a lot.

General conditions: See sheet attached.

BUNKER HILL & SULLIVAN M. & C. CO.

Electrolytic Zinc Plant

General Conditions Covering All Custom Schedules

1. The rates herewith apply on any size lot down to five tons. On anything under five tons we add to these rates a flat sampling charge on each lot of $10.00.

2. All Federal or State taxes now or hereafter imposed and all duties and excise or other taxes levied by the United States or any foreign government shall be for shipper's account.

3. Base charges apply on the concentrates delivered in our Plant at Silver King, Idaho.

4. On the above schedule where the word "ton" is used, it is understood to be a ton of two thousand pounds avoirdupois; where the word "ounce" is used, as referring to gold and silver, it is understood to mean the troy ounce; and where the word "unit" is used, it is understood to mean a unit of one percent, or twenty pounds avoirdupois.

5. Weighing and sampling (at which seller or a representative may be present) as done by Buyer according to standard practice, promptly after receipt of product, will be accepted as final. The absence of Seller or a representative shall be deemed a waiver of the right in each instance. After sampling the product may be placed in process, commingled, or otherwise disposed of by Buyer. In case of disagreement on assays, an umpire shall be selected in rotation from a list mutually agreed upon, whose assays shall be final if within the limits of the assays of the two parties, and if not, the assay of the party nearer to the umpire shall prevail. Losing party shall pay cost of umpire. In case of Seller's failure to make or submit assays, Buyer's assays shall govern.

BUNKER HILL & SULLIVAN M. & C. CO.
Electrolytic Zinc Plant
Kellogg, Idaho

BUNKER HILL SMELTER

Lead Ore Schedule

Aug. 18, 1952
Kellogg, Idaho

METAL PAYMENTS

Gold: No payment for gold when under 0.03 oz. per ton;
0.03 but under 3.0 oz. per ton, pay for 100 percent at $31.81825;
3.0 oz. per ton or over, pay for 100 percent at $32.81825.

Silver: No payment for silver under 1 oz. per ton;
1 oz. per ton or over, pay for 95 percent at the applicable quotation.

Lead: No payment for lead when under 2.5 percent;
2.5 percent but under 25 percent, pay for 90 percent of wet assay*;
25 percent but under 50 percent, pay for 91 percent of wet assay*;
50 percent or over, pay for 92 percent of wet assay*.

*At the lead quotation less 1.5¢ per pound when the lead quotation is 15¢ per pound. For each 1¢ increase or decrease in the lead quotation of 15¢ per pound, the refining and marketing deduction charge of 1.5¢ per pound shall be accordingly increased or decreased by 0.033¢ per pound. Fractional proportions apply.

Copper: No payment for copper when under 0.5 percent;
0.5 percent or over, pay for 85 percent of the contents at 60 percent of the applicable copper quotation, less 30 percent of the applicable lead quotation, negative values applying.

Example	Copper quotation, per cwt.	Lead quotation, per cwt.
1	$25	$16
2	10	22

(1) $0.85 \left(0.60 \times \frac{25.00}{100} - 0.30 \times \frac{16.00}{100}\right) = \$0.0867$ payment per pound of copper contained.

(2) $0.85 \left(0.60 \times \frac{10.00}{100} - 0.30 \times \frac{22.00}{100}\right) = \$0.0051$ penalty per pound of copper contained.

Zinc: No payment for zinc when under 2.5 percent;
2.5 percent or over, pay for 50 percent of the content at 25 percent of the applicable zinc quotation.

Antimony: No payment for antimony when under 1 percent;
1 percent or over, pay for 70 percent of the content at 50 percent of the applicable antimony quotation, less the applicable lead quotation, negative values applying.

Example	Antimony quotation, per cwt.	Lead quotation, per cwt.
1	$40	$16
2	20	16

(1) $0.70 \left(0.50 \times \frac{40.00}{100} - \frac{16.00}{100}\right) = \$0.0280$ payment per pound of antimony contained.

(2) $0.70 \left(0.50 \times \frac{20.00}{100} - \frac{16.00}{100}\right) = \$0.0420$ penalty per pound of antimony contained.

SMELTING AND REFINING DEDUCTIONS

The minimum combined smelting and refining deduction will be $11 per dry ton.

Smelting deductions:

Base charge:

$8 per dry ton on products containing 50 percent wet lead or over. Debit the base charge 10¢ per unit for wet lead under 50 percent.

Iron compensation:

Credit the base charge for percent iron over (percent zinc x 1.8) at 40¢ per unit.

Debit the base charge for percent iron under (percent zinc x 1.8) at 40¢ per unit.

Silica compensation:

Credit the base charge for percent silica over percent iron at 8¢ per unit.

Debit the base charge for percent silica under percent iron at 8¢ per unit.

Lime compensation:

Credit the base charge for percent lime over percent iron at 10¢ per unit.

Debit the base charge for percent lime under percent iron at 10¢ per unit.

The maximum net combined credits for iron, silica, and lime will be $3 per dry ton.

Refining deductions:

Silver: Debit the base charge for all silver in excess of 50 oz. per ton at 1.5¢ per ounce.

Arsenic: Debit the base charge for all arsenic in excess of 1 percent at $1 per unit.

Bismuth: Debit the base charge for all bismuth in excess of 0.1 percent of the wet-lead content at 50¢ per pound.

Moisture: Debit the base charge for all moisture in excess of 10 percent at 20¢ per unit.

Sulfur: Debit the base charge for all sulfur in excess of 16 percent at 10¢ per unit.

All fractional proportions applying.

Freight: This schedule is based on the lead freight rate from Bradley, Idaho, to New York of $16.84 per ton, plus tax of 3 percent. Any increase or decrease shall be for account of the Seller.

All freight on the product from shipping point to Buyer's smelter at Bradley, Idaho, shall be for account of the Seller.

QUOTATIONS

Gold: As long as the Government pays the present fixed price for gold, the gold payments as indicated herein, shall apply. If, at any time, the Government should change the present price paid for gold, or discontinue an established price for gold, the price to be paid for gold shall be 91.137 percent of the recognized gold price when the gold content is 0.03 but under 3.0 oz. per ton. When the gold content is 3.0 oz. or over per ton, additional payment of $1 per ounce will be made.

Silver: Based on the fixed Government price for eligible domestic silver as indicated, or the official price for bar silver in New York as quoted by Handy & Harman, New York, and published in the Metal & Mineral Markets of the Engineering and Mining Journal, whichever price is the higher. For silver other than that eligible for the Government price supported by affidavits, the Handy & Harman quotation shall apply.

In the event the Government should discontinue purchasing silver at a fixed price, then the price paid for silver shall be the official New York price for silver as quoted by Handy & Harman, New York, as outlined above.

Should the Government, for any reason whatsoever, refuse to accept silver covered by Seller's affidavit, the difference between the price paid to Seller for silver under this schedule and the price prevailing in the open market at the time of such refusal, shall be refunded to the Buyer.

Lead: The New York quotation for lead, as published in the Metal & Mineral Markets of the Engineering and Mining Journal.

Copper: The New York quotation for electrolytic cathode copper, as published in the Metal & Mineral Markets of the Engineering and Mining Journal.

Zinc: The St. Louis quotation for Prime Western zinc, as published in the Metal & Mineral Markets of the Engineering and Mining Journal.

Antimony: The quotation for bulk antimony in carload lots f.o.b. Laredo, Tex., as published in the Metal & Mineral Markets of the Engineering and Mining Journal.

BUNKER HILL SMELTER

Freight Address: Bradley, Idaho
Post office Address: Box 29
Kellogg, Idaho

October 22, 1952

General Clauses Covering Ore Purchase Schedules

WEIGHTS AND SAMPLES:

All settlements shall be made on the basis of weights and samples taken by the Company.

REPRESENTATION:

Representation is urged and welcomed. Every shipper is urged, especially for his initial shipment, to be represented in person or by a member of his company while the shipment is being weighed and sampled. In lieu of this, the services of an independent professional representative are available. Because of limited storage space for individual shipments, it is impractical to hold shipments intact until assays and settlements are completed. The company, therefore, reserves the right to commingle all shipments immediately upon completion of weighing and sampling.

ASSAYS:

Every shipper shall, without delay, deliver to the company, his assay certificates on the samples taken by the Company. The Company's assay will be considered the settlement assay but, in case of disagreement of assays, a sample may be sent to umpire. The umpire's assays shall be final if within the limits of the two parties and, if not, the assays of the party nearer to the umpire shall prevail. The party whose results are farther from the umpire assays shall pay costs of umpire.

DATE OF ARRIVAL:

For rail shipments, the day (until 3:00 p.m.) that the Union Pacific delivers or constructively places, the car on our Smelter highline track, will be the "date of receipt." When several cars are grouped together into one settlement lot, the date of receipt of the last car will be considered the date of receipt of the entire lot for settlement purposes.

For truck shipments, the "date of receipt" will be the date on the written notification from the shipper that the lot is completed.

Since the Ore Receiving Department does not work on that day, the "date of receipt" for any deliveries on Sunday will be Monday.

HAND SAMPLES:

Before making shipment, it is advisable that prospective shippers submit to the company a small, thoroughly representative sample of one or two pounds for assay and quotation.

SMALL SHIPMENTS:

All lots of less than 5 tons (dry weight) are subject to an additional charge for sampling and assaying of $10.00 per lot.

ADVICES AND SHIPMENTS:

Shippers shall notify the company promptly at time of shipment, advising number of lots in car (if more than one lot) and giving instructions as to how remittance is to be made, including the particulars of royalties, if such payments are called for. Consign shipments to Bunker Hill Smelter, Bradley, Idaho. Mail original bill of lading to Bunker Hill Smelter, Box 29, Kellogg, Idaho.

TERMINATION:

All open rates quoted are subject to change without notice.

LOTTING OF SHIPMENTS:

By mutual agreement, lots will be made of either one, or two, or three, or four, or five cars, with the following exceptions:

1. If requested by the shipper and advised of the last car number, lots will be terminated or cut off to conform with his month's production.

2. Lots will be terminated, or cut off, to conform with the Smelter's monthly receipts.

3. Lots will be terminated, or cut off, each time there is a change in the applicable quotation.

INT.-BU.OF MINES,PGH.,PA. 9290