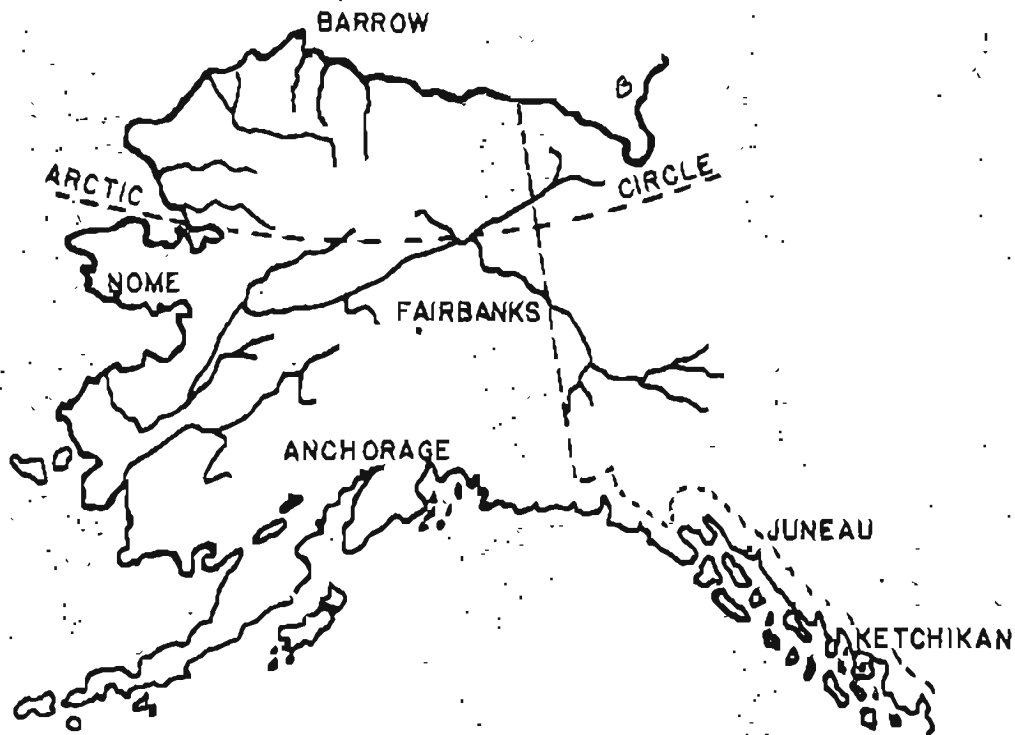


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# STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES



DIVISION OF MINES AND MINERALS

## THE MINERAL INDUSTRY OF THE KENAI - COOK INLET - SUSITNA REGION

MP 27

JUNEAU, ALASKA  
1962

THE MINERAL INDUSTRY  
OF THE  
KENAI-COOK INLET-SUSITNA REGION

By William H. Race

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1962

STATE OF ALASKA

William A. Egan - Governor

DEPARTMENT OF NATURAL RESOURCES

Phil R. Holdsworth - Commissioner

DIVISION OF MINES AND MINERALS

James A. Williams - Director

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Box 1391, Juneau, Alaska

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# THE MINERAL INDUSTRY OF THE KENAI-COOK INLET-SUSITNA REGION

by

William H. Race

## SUMMARY

The Kenai-Cook Inlet-Susitna Region is an area of about 44,500 square miles. Approximately 70% of it is mountainous. The remainder of the region varies from tidal mud flats, through large areas of flat land, to lower foot hills. The flat land and lower hills are covered with dense stands of birch, spruce, and cottonwood. The climate varies from mild seacoast weather to severe mountain weather. Average frost-free days vary from 34 to 175 per year, and average snowfall varies from 45 to 149 inches. The region is one of favorable geology and structure for the formation of ore, coal, and petroleum deposits. Part of it has not been mapped geologically, and large portions remain relatively unprospected. Mineral production to 1961 amounted to approximately 75 million dollars.

Mineral development of the region is largely dependent upon new deposits being found. Vigorous exploration is needed. The presently known deposits, other than petroleum, appear marginal or submarginal, though most of them have not been fully developed. Modern scientific prospecting will uncover more deposits, and improved transportation will place the region's minerals in a better position to compete economically with similar commodities now being marketed in the Pacific Rim Countries. Much of the region is within 50 miles of rail, ship, and truck transportation. There are adequate sources of labor and supplies within the region. Taxes are no higher than in the other states, and inducements to new industry are offered by State tax laws.

## INTRODUCTION

This is the first regional report published by the Division of Mines and Minerals. It is hoped that similar reports of other regions of the State can be presented in the future with the aim of providing useful background information which will help and encourage mineral development, and add to the general interest in Alaska.

The Division maintains an office and laboratory within the region at Anchorage. Anchorage personnel presently include a Mining Engineer, Coal Mine Inspector, Petroleum Engineer, Petroleum Geologist, Assayer, and Clerk-Stenographer. The Division was created by law to promote the mineral industry, to provide for the safety of miners, to assist miners and prospectors, and protect investors in the mineral industry. The Division has the responsibility of collecting and disseminating information relative to the mineral resources, mines and mineral projects of the State, and has charge of the administration of the laws with respect to all kinds of mining and petroleum operations. It is also responsible for safety in the mineral industries. The Division and its predecessors under Territorial status have investigated prospects and mines for over 45 years.

The U. S. Bureau of Mines presented the first regional report in 1958, i.e. Bureau of Mines Information Circular 7844, Southeastern Alaska's Mineral Industry. This report is a cooperative project under a formal agreement with the U.S.B.M. for the mutual exchange of information. The Bureau, through its field and laboratory work is aiding in the search for new mineral deposits, and has been active in the State for 50 years.

The U. S. Geological Survey has been active in Alaska for over 65 years, making topographical and geological maps, and investigating various mines, deposits, and areas.

The three agencies have written reports of their individual investigations, most of which have been made public and are to be found in many libraries. The Division, in each of its regional reports, intends to collect selected information available from these and other sources on individual deposits, areas, and factors affecting the mineral industry in the region, and to present it under one cover.

## Acknowledgments

The writer wishes to express his indebtedness and thanks to Gordon Herreid, Mining Geologist, Division of Mines and Minerals, for his contribution of the Geology Chapter; and to Anthony Evans, formerly Commodity-Industry Analyst, U. S. Bureau of Mines, who outlined and started the Cook Inlet-Susitna Report during 1958. Also, thanks are due to the many people who read and edited this report.

## PHYSICAL FEATURES

### Location and Size

The Kenai-Cook Inlet-Susitna region encompasses approximately 44,500 square miles in south-central Alaska. The area is contained, generally, between longitudes 146°W to 154°W and latitudes 58°N to 64°N. The boundary on the east is the drainage divide separating the Cook Inlet-Susitna basin from the Prince William Sound and Copper River basin. Western and northern boundaries extend along the crest of the Aleutian and Alaska Ranges from Mt. Douglas on the south to Hess Mountain on the north. The southern boundary is the Gulf of Alaska. See Figure 1.

### Climate

Although the region borders tidewater, the climate resembles that of Interior Alaska, due to the fact that the Chugach Mountains to the east prevent the storms of the Gulf of Alaska from reaching the region. The Kenai Peninsula experiences milder weather whereas the northern area experiences severe winter weather conditions. Winter usually extends from mid-October to mid-April and consists of cloudy, mild weather alternating with clear cold weather. Summer usually lasts from June through early September. The latter portion of this season is marked by wet, cloudy weather which accounts for nearly 40 percent of the annual precipitation in some areas. At higher altitudes, wide deviation from normal temperature and precipitation can be expected.

General climatic data for the Kenai-Cook Inlet-Susitna region are shown in Table I.

### Topography

The Kenai-Cook Inlet-Susitna region is composed of areas of varying relief. The Kenai Peninsula is about 40% flat land with an elevation of less than 1000 feet. This area is composed of grass land with a few large lakes and many small lakes and swamps. There are dense stands of spruce, cottonwood and birch in the better-drained lowlands. The remainder of the area is composed mainly of the Kenai Peninsula Mountains, which are the southerly extension of the Chugach-Talkeetna Mountains.

Sections of the Susitna, Matanuska and Knik Rivers follow braided courses over extensive sand and gravel flats, which are flooded during periods of high water. Low swampy areas along these rivers are similar to the flats of the Kenai Peninsula.

Upper valleys of the Susitna River and its tributaries have been covered by talus slides and glacial debris; many areas are modified by post-glacial drainage changes, leaving benches above the present water course. The lowlands extend to the foothills of the Alaska Range and Talkeetna Mountains. The foothills are generally smooth in outline and covered with low bushes, moss and scattered groves of spruce, willow and birch. In some areas, upland plains are found between the foothills and the mountains. The mountains cover about 70% of the region. They contain rugged peaks, glacier filled valleys, and sharp ridges. For this reason much of the area remains relatively unexplored.



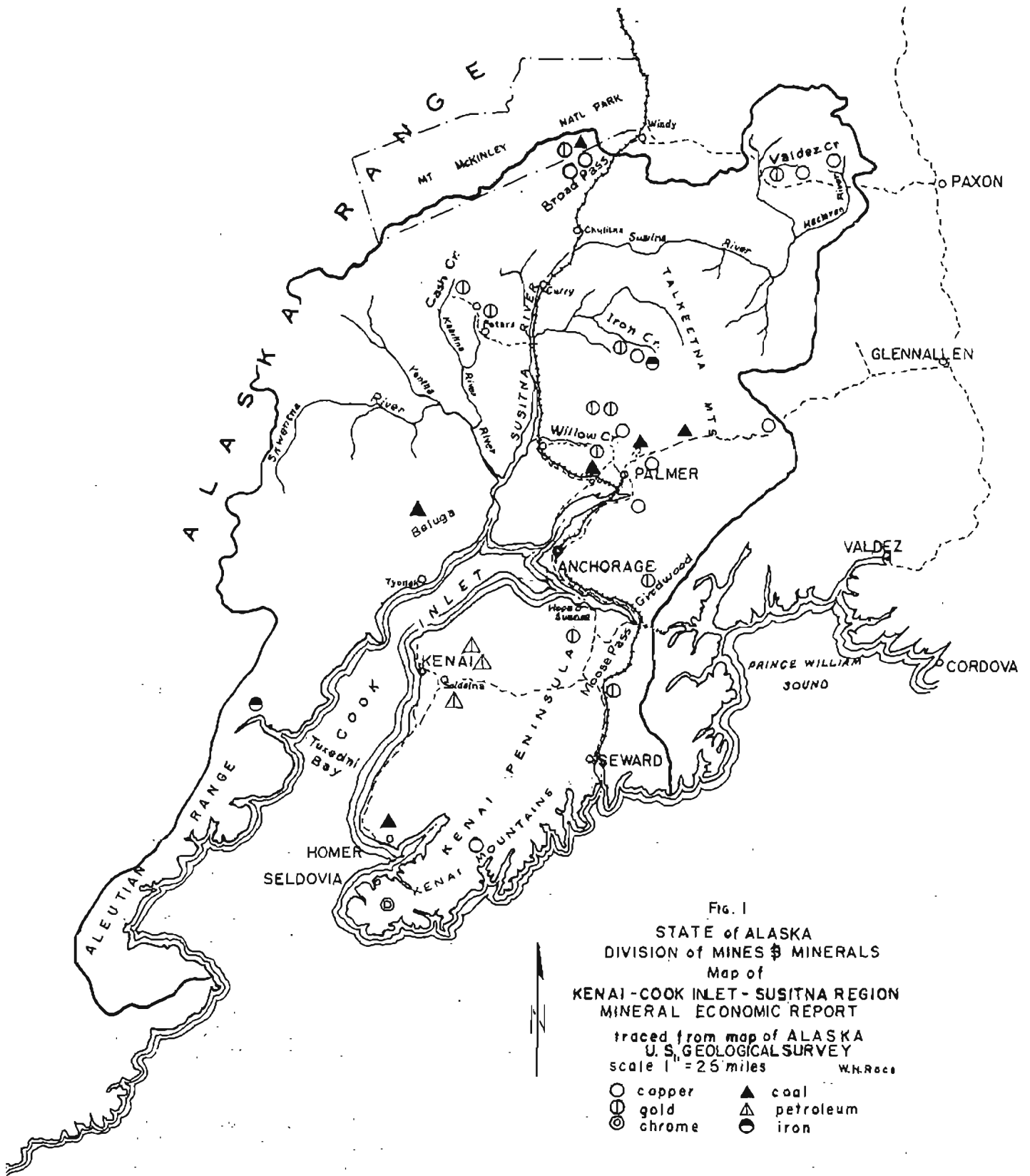


Fig. 1  
 STATE of ALASKA  
 DIVISION of MINES & MINERALS  
 Map of  
 KENAI-COOK INLET-SUSITNA REGION  
 MINERAL ECONOMIC REPORT  
 traced from map of ALASKA  
 U. S. GEOLOGICAL SURVEY  
 scale 1" = 25 miles W.H. Rice

- |          |             |
|----------|-------------|
| ○ copper | ▲ coal      |
| ⊙ gold   | △ petroleum |
| ⊗ chrome | ● iron      |

Table I - General Climatic Data, Kenai-Cook Inlet-Susitna Region 1/

| Station                 | Elev.<br>(feet) | Yrs. of<br>Record | Mean temperature<br>(degrees F) |      |        | Average<br>Annual<br>Precip.<br>(inches) | Average<br>Annual<br>Snowfall<br>(inches) | Average Frost-free Period |                                   |                                  |
|-------------------------|-----------------|-------------------|---------------------------------|------|--------|--|---|---------------------------|-----------------------------------|----------------------------------|
|                         |                 |                   | Jan.                            | July | Annual |  |   | Length<br>(days)          | Last Temp.<br>of 32°<br>in Spring | First Temp.<br>of 32°<br>in Fall |
| Anchorage               | 134             | 29                | 12.9                            | 57.3 | 35.2   | 14.54                                    | 60  | 115                       | May 19                            | Sept. 11                         |
| Caswell                 | 290             | 3                 | 1.5                             | 58.5 | 31.0   | 26.05                                    | <u>2/</u>                                 | <u>2/</u>                 | <u>2/</u>                         | <u>2/</u>                        |
| Curry                   | 544             | 6                 | 12.2                            | 58.7 | 34.9   | 43.66                                    | 149                                       | 95                        | May 30                            | Sept. 2                          |
| Matanuska<br>Valley #14 | 150             | 32                | 13.1                            | 57.4 | 35.1   | 15.50                                    | 45  | 105                       | May 27                            | Sept. 9                          |
| o Puntilla              | 1832            | 9                 | 5.1                             | 51.6 | 26.0   | 13.50                                    | 100                                       | 34                        | July 12                           | Aug. 15                          |
| Skwentna                | 153             | 11                | 7.0                             | 58.3 | 32.7   | 30.62                                    | 120                                       | 94                        | May 29                            | Aug. 31                          |
| Summit                  | 2401            | 10                | 4.5                             | 52.1 | 25.9   | 20.86                                    | 124                                       | 74 <u>3/</u>              | June 11 <u>3/</u>                 | Aug. 24 <u>3/</u>                |
| Susitna                 | 50              | 15                | 12.6                            | 58.2 | 35.1   | 27.97                                    | 64  | 74 <u>3/</u>              | June 14 <u>3/</u>                 | Aug. 27 <u>3/</u>                |
| Talkeetna               | 345             | 32                | 8.7                             | 57.9 | 33.4   | 30.01                                    | 127                                       | 69 <u>3/</u>              | June 13 <u>3/</u>                 | Aug. 21 <u>3/</u>                |
| Homer                   | 1000            | 8                 | 22.6                            | 52.8 | 37.3   | 25.2                                     | 45.6                                      | 175                       | June                              | Sept.                            |
| Kenai                   | 85              | 18                | 10.                             | 53.1 | 33.3   | 18.5                                     | 61.8                                      | 149                       | June                              | August                           |

1/ Reconnaissance Report on Susitna River Basin, U.S. Bureau of Reclamation: Department of Commerce, Weather Bureau: Records.

2/ Insufficient data.

3/ Freezing temperatures have been recorded in every month in occasional years.

## GENERAL GEOLOGY

The topography of the Kenai-Cook Inlet-Susitna region mirrors the bedrock geology, the major features of which were developed during the Mesozoic era. The distribution of mineral deposits is also controlled by the bedrock geology, and is the result of the geological events that took place during Mesozoic time.

The rugged mountains of the Aleutian Range northwest of Cook Inlet and the Talkeetna Mountains were the site of an arcuate volcanic belt during the Jurassic Period, and have been a topographic high for much of the time since then. This area contains many granitic intrusions of Jurassic and Cretaceous age.

The low lying belt occupied by Cook Inlet and the Matanuska River which lies south of this mountain belt has been a linear topographic low since the Jurassic and before, and has received sediments during much of its existence. The near-shore sediments deposited in this trough during Jurassic time provide one of the most complete Jurassic sections in North America. Sedimentation was sporadic during the Cretaceous, but sediments deposited during the Tertiary contain the oil sands of the Kenai Peninsula and widespread coal beds. These Jurassic sediments may also be present in the extension of this trough in the southern part of the Copper River Basin.

The Chugach-Kenai Mountain Range lies south of the Cook Inlet-Matanuska River trough. This range is composed of Upper Cretaceous and perhaps older sediments whose source was in the Aleutian-Talkeetna Mountains to the north. These sediments were poured into an abyssal trough (the Chugach Mountains geosyncline) with little sorting to produce the graywacke and slate rocks typical of the area. The border area between the Cook Inlet-Matanuska River trough and the Chugach Mountains geosyncline is a tectonic belt where faulting has taken place at intervals since Mesozoic time, and where a number of Mesozoic granitic stocks are present. The Chugach Mountains geosyncline has been a topographic high during Cenozoic time.

Between the Talkeetna Mountains and the Alaska Range and westward along the south slope of the Alaska Range to the Skwentna River, the bedrock is largely made up of graywacke and shale of Jurassic and Cretaceous age. These are spilled in sediments similar to those of the Chugach geosyncline of similar age, and likewise derived, at least in part, from erosion of the Talkeetna Mountains.

## MINING HISTORY AND PRODUCTION

In 1848 the Russian-American Company sent Peter Doroshin, a mining engineer, to their American colony to find gold. His search for placer gold was confined to the Kenai Peninsula. The first gold mined in Alaska was taken from the Kenai River basin by Doroshin in 1850. The venture was not successful and was soon abandoned. Another mining venture by the Russians was the development of the coal at Port Graham; the first coal was mined in 1854. Mining continued in a small way to supply the Russian steamers, convict labor being used in part. In 1889, coal from Kachemak Bay was mined for export to the west coast of the United States, but this venture failed also. Placer gold was found on Resurrection Creek in 1888 and about 1890, gold was found in beach placers at Anchor Point on Cook Inlet. In 1894, the placers of Bear and Palmer Creeks were found. This led in the next two years to an influx of prospectors into the region which up to that time had been known only by the fur traders. In 1897, prospectors found placer gold in the Willow Creek district. The Valdez Creek and Yentna districts were found in 1903 and 1905 respectively. About 1902, the high-grade coal in the Matanuska Valley became known, and the Fairbanks gold district was discovered. During this period, the Alaska Northern Railway was started, but track was laid only 72 miles north from the seaport of Seward by 1915. At this date, the government purchased the railway and completion soon followed. (7, 8, 18)

The entire region has accounted for 852,857 ounces of gold, 28,654 short tons of chrome, 7.4 million tons of coal, 7,116,844 barrels of petroleum, and 1,511,000 MCF of natural gas to the close of 1961. Platinum, silver, copper, sheelite, and cassiterite are among the minerals recovered as byproducts (U.S.B.M. Records).

### Gold

The early exhaustion of placers in the Willow Creek and Kenai districts and the resultant search for lode deposits led to numerous lode discoveries in the Moose Pass area and the first gold lode discovery in the Willow Creek area at Fishhook Creek in 1906. During the period 1909-1961, lode mines in the district yielded gold valued at approximately \$12.5 million (8, 17). Gold production reached its peak during the 1932-1942 period, but began to decline in 1943 under the effects of a government order which allocated supplies only to mines producing strategic minerals. Attempts to regain the pre-World War II production heights have been unsuccessful, due to the increasing cost of wages and supplies in relation to the fixed price of gold. Leading past gold producers in the district include the Gold Bullion, Lucky Shot, War Baby, Independence, Gold Cord, Mabel, and Fern mines of the Willow Creek district and the Mukalaska, Kenai-Alaska, and Lucky Strike mines of the Moose Pass area. The mines of the Willow Creek district produced from gold-quartz vein deposits in the quartz-diorite of the Talkeetna batholith, and are considered to continue to greater depths than have been mined or developed. This area would be of further interest in the event of a change in the economics of gold mining. Table II presents production from the Willow Creek district lode mines.

During the period 1903-1961, placer gold deposits in the region yielded gold valued at nearly \$8.8 million. Most of the placer gold was recovered from deposits in the Kahiltna Valley, Cache Creek, Resurrection Creek, Bear

Table II - Willow Creek District Lode Mine Production - 1909-1961 <sup>1/</sup>

| Year  | Value     | Year | Value      | Year         | Value               |
|-------|-----------|------|------------|--------------|---------------------|
| 1909  | \$ 13,751 | 1927 | \$ 158,000 | 1945         | \$ 64,610           |
| 1910  | 21,630    | 1928 | 104,000    | 1946         | 44,625              |
| 1911  | 53,662    | 1929 | 12,000     | 1947         | 12,530              |
| 1912  | 100,000   | 1930 | 36,000     | 1948         | 16,765              |
| 1913  | 100,958   | 1931 | 459,000    | 1949         | 177,485             |
| 1914  | 297,184   | 1932 | 709,000    | 1950         | 304,534             |
| 1915  | 299,193   | 1933 | 776,000    | 1951         | 15,400              |
| 1916  | 247,267   | 1934 | 1,391,000  | 1952         | 7,910               |
| 1917  | 195,662   | 1935 | 620,000    | 1953         | 2,310               |
| 1918  | 269,624   | 1936 | 705,000    | 1954         | 5,495               |
| 1919  | 162,994   | 1937 | 888,000    | 1955         | 1,865               |
| 1920  | 63,400    | 1938 | 1,163,000  | 1956         | Development<br>Only |
| 1921  | 118,273   | 1939 | 1,338,000  | 1957         | "                   |
| 1922  | 238,000   | 1940 | 1,858,000  | 1958         | "                   |
| 1923  | 178,238   | 1941 | 1,686,790  | 1959         | "                   |
| 1924  | 201,878   | 1942 | 1,314,215  | 1960         | "                   |
| 1925  | 454,581   | 1943 | 457,765    | 1961         | "                   |
| 1926  | 334,000   | 1944 | 134,365    |              |                     |
| Total |           |      |            | \$12,209,164 |                     |

<sup>1/</sup> 1909-1950 production figures from: Ray, R. G., Geology and Ore Deposits, Willow Creek District, Alaska: USGS Bulletin 1004, 1954, Table 6, p. 36.

1951-1961 from U.S. Bureau of Mines records.

Creek, Girdwood area and Hope area. Production was at its highest level before the second World War. (13, 31, 33, 38)

### Coal

Coal outcrops are found in many places in the Kenai-Cook Inlet-Susitna region. Commercial production of coal started in the Matanuska coal field in 1903 and has continued to date (except as noted below), totalling 7.4 million tons at the end of 1961. Although the Matanuska Valley coal deposits were known earlier than 1903, it wasn't until this date that a market was found. This market was provided by the start of the Alaska Northern Railroad. Development of the coal field as a source of locomotive fuel continued until the withdrawal of Alaskan coal lands from entry in 1906. From 1906 until the enactment of the Coal Leasing Act in 1914, active development in the Valley was confined to the Chickaloon Naval Reserve where 1100 tons of coal was mined in 1914.

In 1915, exploration activity increased with the purchase of the Alaska Northern Railroad by the government and the start of construction of the Alaska Railroad to Fairbanks. To assure a coal supply for the railroad and the Navy, the Alaska Engineering Commission and Navy-Alaska Commission (government agencies) performed the necessary pioneer work in the Matanuska coal field. (4, 23)

Except for approximately 27,000 tons from the Navy reserve, about 92,000 tons from the Houston beds, and small local consumption from the Kenai and Cache Creek lignite beds, all coal produced in the Valley has been mined from the Wishbone Hill area. Table III presents coal production from the Matanuska Field. The government-operated mine at Eska which opened in 1917, produced coal for the Alaska Railroad. In 1922, when privately-owned mines were sufficiently developed to supply the demand, the Eska mine closed, but was maintained in standby condition for several years. The same year, Navy development work ended in the Chickaloon district. This coal is still reserved for the Navy but has been requested by the State as part of its land grant under the Statehood Act. The Eska mine reopened under government operation in 1940 when military activity indicated a need for additional coal, and closed again in 1946. (1, 19, 40) The Eska coal reserves are held by the government, but surface installations and washing plant were sold to Mrak Coal Co. With the addition of these facilities and modern strip methods of mining, Mrak Coal Co. has emerged as the newest large-scale coal producer in this area. The Evan Jones Coal Co., now the largest coal producer in the Matanuska field, started mining in 1921, and has mined nearly two-thirds of all coal produced in the Matanuska field.

### Chrome

The existence of chromite deposits at Claim Point and Red Mountain have been known for at least 50 years. (21) Production has been sporadic depending upon prices which usually are not sufficient without government subsidy. In fact, it has been mainly during periods of shortages caused by wars that these deposits have been worked. During World War I, about 2000 tons of chromite were produced, and during World War II and shortly thereafter, about 26,000 tons were produced and shipped. Thus, total chromite production from the

Table III - Matanuska Valley Coal Production - 1916-1961 1/

| Year             | Tonnage | Year      | Tonnage           |
|------------------|---------|-----------|-------------------|
| 1916-1934        | 918,561 | 1948      | 147,436           |
| 1935             | 48,819  | 1949      | 180,042           |
| 1936             | 60,998  | 1950      | 153,010           |
| 1937             | 49,789  | 1951      | 177,867           |
| 1938             | 52,490  | 1952      | 243,234           |
| 1939             | 51,084  | 1953      | 286,465           |
| 1940             | 64,566  | 1954      | 227,700           |
| 1941             | 110,732 | 1955      | 257,548           |
| 1942             | 138,527 | 1956      | 269,067           |
| 1943             | 173,909 | 1957      | 237,114           |
| 1944             | 210,243 | 1958      | 290,144           |
| 1945             | 166,744 | 1959      | 251,319           |
| 1946             | 164,873 | 1960      | 300,341           |
| 1947             | 171,799 | 1961      | 340,000 <u>2/</u> |
| Total Production |         | 5,602,809 |                   |

1/ Source: 1916-1952: Barnes, F. F. and Payne, T. G., Wishbone Hill District, Matanuska Coal Field, Alaska: USGS Bulletin 1016, 1956, p. 81;  
1953-1960: from USBM records.

2/ Estimated

Note: Total includes 92,000 tons from Houston beds and 27,000 tons from Navy Reserve at Chickaloon not listed in yearly production.

Kenai area has been in excess of 2,250,000 dollars. (16. USBM records) Several chrome occurrences were staked in Knik Valley during World War II, some of which were drilled by the U.S. Bureau of Mines and found uneconomic at that time. (6)

### Petroleum

The existence of oil in the region has been known since 1853. These oil seeps and "gas springs", located at Oil and Dry Bays, were first prospected by a Russian named Paveloff in 1882. The first well was drilled to a depth of over 1,000 feet by the Alaska Petroleum Co. in 1900. No log was kept, but it was reported that gas was encountered continually below 190 feet, and that considerable oil was found at a depth of 700 feet. The flow of oil is reported as having been estimated at 50 barrels a day. Strong water pressure was encountered and the well was abandoned.

Exploration fell off sharply after 1904, and oil lands were withdrawn from entry in 1910. With the passage of the Oil and Gas Leasing Act of 1920, a rush to obtain title was started and several oil companies investigated the region. Between 1926 and 1930, drilling was carried on intermittently about 2 miles west of Chickaloon in the Matanuska Valley. Leasing activity was revived in the Chinitna area in 1933-34, and a test well drilled in 1938-39 was abandoned at a depth of 8,775 feet. The well found many shows of oil and gas but suitable reservoir beds apparently were lacking. In 1948 and 1949, geologic investigations were commenced in the Kamishak area and several leases were taken but were relinquished upon completion of the investigation. In 1952, oil companies began numerous geologic investigations, and brisk leasing followed. (25, 27) On July 23, 1957, oil was struck in the Swanson River field on the Kenai Peninsula. In the spring of 1959, a gas field was discovered about 25 miles southwest of the Swanson River field. At the end of 1961, there were 48 producing oil wells on the Kenai Peninsula, and gas was being piped to the Anchorage area from the Kenai Unit gas field. Two refineries are planned. (Records)



## MINERAL RESOURCES

### General

The mineral resources of the Kenai-Cook Inlet-Susitna region comprise a variety of metallic and nonmetallic minerals and fuels. Exploitation of these resources has varied from nil to considerable. Lack of roads and transportation facilities in the northern sections have impeded exploration and development there. Economic conditions have caused the closure of the Willow Creek gold producers. Coal production is limited to local market and military requirements even though large beds of lignite and bituminous grade coals are available in the Matanuska Field and in the newly developed Beluga Field west of Anchorage. The chromite deposits of the Kenai Peninsula have not been fully developed because of market conditions. The oil and gas resources are being developed and utilized. Political unrest in several oil producing countries will probably accelerate Alaska exploration. There are indications that the limestone beds will be mined for cement manufacture to satisfy local requirements, but this will be only a start toward the utilization of this resource. There are several favorable geological areas in and around granitic intrusive bodies that should be further explored: the upper Susitna, Willow Creek, Talkeetna, Kahiltna River, Mt. Susitna, Sheep Mountain and the west coast of Cook Inlet. These areas have been prospected primarily for placer and lode gold deposits, and very little by modern methods for other metallics which are becoming more desirable due to export demand. The following resume describes the known deposits believed to have the best possibilities for development.

### Coal

The principal known coal deposits of the region are in the Matanuska Valley in an area of moderately deformed clastic rocks. Present mining is confined principally to deposits in the Wishbone Hill syncline. (1, 3, 4, 19, 23, 39, 40) All minable coal occurs in the upper sections of the Chickaloon formation. Coal beds range from a few inches to as much as 23 feet in thickness. The thickest beds include many partings. Faulting and folding affect the direction and extent of mining. The Federal Bureau of Mines and U.S. Geological Survey estimate coal reserves in excess of 185 million tons in the northern limb of the Wishbone Hill syncline.

Matanuska Valley coal is high-volatile B bituminous, in rank, and is suitable for power generating purposes. The coal is situated near rail, highway, and deep-water transportation. Present market for the coal is the Anchorage area and its surrounding military establishments. Typical analyses of the Cook Inlet coal deposits are shown in Table IV.

The newly explored coal field in the Beluga Lake area indicates that there are over 20 million tons of sub-bituminous in the one bed drilled to date. The deposit is elliptical bowl shaped and lends itself to strip mining although there seems to be a need of further research into ground conditions at various times of the year due to the presence of clay which may prove difficult to move during rainy periods. The bed drilled by the U.S. Bureau of Mines (39) has an average width of 48 feet. The tests and analyses made

to date indicate an ash content of about 17% and dry BTU value of about 9,000. See Table V. These tests also indicate that washing is probably uneconomical. Therefore, the best use of this bed would be for a mine-mouth generating plant to supply the rapidly growing electrical requirements of the Anchorage area.

There are many other coal beds in the Beluga field that have not been tested, and these may have better fuel characteristics.

### Gold

Low output can be expected to continue until mining costs decrease, the price of gold is increased, better grade deposits are found, or technological improvements make mining profitable. Because of difficulty and expense in mining the small, highly faulted gold veins in the Willow Creek district, small operators have been unable to develop fully their lode gold potential. Most production came from overhead stoping above adits; deep development and exploration was limited by the relatively small individual operations. Some authorities believe that the Willow Creek veins compare favorably with those at Grass Valley, California, which carry values to considerable depths. A consolidation of adjoining mines and a comprehensive geological mapping program could result in the establishment of profitable operations. The ore mined ran from \$25 to \$50 per ton and in some cases higher. In several places, faulting has truncated valuable ore shoots; at the Gold Bullion mine, faulted sections of a rich vein were never found. (8, 13, 24, 31, 32) Full realization of the district's lode gold potential will require a coordinated, well directed exploration program, probably through low-level adits from the valleys of Fishhook, Willow, Archangel or Craigie Creeks.

Alluvial deposits can still be profitably mined, but either they must be very large deposits for dredging or small ones on which 1 to 3-man operations can process large quantities of gravel per man shift.

### Construction Materials

Preliminary investigations of nonmetallic minerals suitable for use in the construction industry have been made within the region by the Federal Bureau of Mines. Ample supplies of sand, gravel, and stone were found in nearly every section; for this reason, no attempt was made to estimate reserves. Gypsum, clay, shale, argillite, and limestone deposits, accessible to rail or highway transportation, were examined in the Matanuska Valley, Anchorage area, and along the Alaska Railroad.

The U. S. Geological Survey has investigated diatomaceous earth near Keani, (29) and haydite in the Kings River area. (15) The results of these studies indicate that there are suitable clays for building purposes; haydite for light weight aggregate; diatomaceous earth for light weight aggregate; and suitable deposits of limestone for the manufacturing of cement. Except for sand, gravel, stone, and small tonnages of clay used in the manufacture of fire brick, materials for the construction industry are shipped in from Outside. Forty to seventy thousand tons of cement are imported into the Anchorage area yearly. There are five companies manufacturing concrete tile and block in the Anchorage area. (Records, 15, 34)

Table IV - Selected coal analyses Kenai-Cook Inlet-Susitna region 1/

| Deposit by districts | Proximate percent |                 |              |      | Calorific value-BTU as received |
|----------------------|-------------------|-----------------|--------------|------|---------------------------------|
|                      | Moisture          | Volatile matter | Fixed carbon | Ash  |                                 |
| <u>Valdez Creek</u>  |                   |                 |              |      |                                 |
| Broad Pass           | 29.5              | 28.8            | 20.7         | 21.0 | 5,790                           |
| <u>Redoubt</u>       |                   |                 |              |      |                                 |
| Tyonek               | 27.6              | 31.5            | 37.2         | 3.7  | 8,350                           |
| Beluga               | 18.7              | 34.6            | 29.7         | 17.0 | 7,530                           |
| <u>Willow Creek</u>  |                   |                 |              |      |                                 |
| Chickaloon           |                   |                 |              |      |                                 |
| U.S.Navy Res.        | 2.0               | 17.8            | 62.1         | 18.1 | 12,090                          |
| Eska                 | 4.9               | 41.6            | 48.0         | 5.5  | 13,030                          |
| Jonesville           | 3.6               | 35.5            | 39.3         | 21.6 | 10,440                          |
| Moose Creek          | 5.2               | 39.7            | 47.3         | 7.8  | 12,450                          |
| Premier              | 5.8               | 38.8            | 49.1         | 6.3  | 12,580                          |
| Houston              | 13.9              | 35.0            | 34.2         | 16.9 | 8,880                           |

1/ Source: Analyses of Alaska Coals, U.S. Bureau of Mines Technical Paper 682, 1946, pp. 28, 42, 44, 48, 50, 54, 58, and 60.

Table V - Proximate analysis of raw coal - Beluga Field 1/

|                               | As received | Moisture free |
|-------------------------------|-------------|---------------|
| Moisture, percent.....        | 24.4        | -             |
| Volatile matter, percent..... | 30.1        | 39.8          |
| Fixed carbon, percent.....    | 28.7        | 38.0          |
| Ash, percent.....             | 16.8        | 22.2          |
| Sulfur, percent.....          | .2          | .2            |
| B.T.U., per pound.....        | 7160        | 9470          |

1/ Investigation of Subbituminous Coal Deposits in the Beluga River Coalfield, Alaska. Open file report, U.S. Bureau of Mines, by R.S. Warfield

## Copper

There are at least seven areas in which copper bearing minerals are found in the region. See Figure 1. The most concentrated and least known of the copper areas is the Iron Creek deposit. S. R. Capps of the U.S.G.S. examined the area in 1917. (23) The principal copper lodes at that time were the Copper Queen Group, Copper King Group, Copper Wonder Group, Phoenix Group, Blue Lode Group, Eastview Group, and the Talkeetna Group. The principal metals were found to be copper, iron, and gold. The gold content was insufficient to permit economical mining and the copper content was not assayed. Most of the orebodies were identified as replacement type along zones of faulting and shearing, but some resembled contact-metamorphic deposits. Principal minerals found were chalcopyrite, gold, silver, hematite, pyrite, bornite.

Activity in recent years has increased and a program of geological investigation and mapping has been undertaken by private interests. Unofficial reports indicate reserves of low grade iron, medium grade copper and low grade gold.

## Iron

The principal known iron deposit in the region is that at Tuxedni Bay, on the west side of Cook Inlet about 120 miles southwest of Anchorage. This deposit has been known since 1916. It lies near the contact of a quartz diorite batholith and is of contact metamorphic origin. The western exposure is a lens of high grade magnetite, and the eastern exposure consists of magnetite disseminated in hornfels occurring in two parallel zones. The ore contains from 25 to 50% iron and its extent is unknown due to cover. (20) Private investigations indicate that these two occurrences and possibly others are located along a mineralized zone.

This area along the northwest shore of Cook Inlet appears to be one of particular interest due to its accessibility to deep water shipping and its favorable geology. The proximity of natural gas for direct reduction of iron should encourage prospecting and development. It is an area of structural complexity adjacent to igneous intrusives in the Aleutian Range. Prospecting within the area has been comparatively limited.

## Other Deposits

Occurrences of antimony, chrome, copper, gold-silver, iron, lead-zinc, molybdenum, platinum, scheelite, and cassiterite have been noted by various agencies investigating minerals within the region. Many of these have been found in placer mining, others have been small lodes that have been investigated and reported as not warranting further examination. (31, 32) Economical factors, such as transportation, may have improved since these examinations were made and some of these deposits might now warrant re-valuation.

# ECONOMIC FACTORS

## Labor

Experienced underground miners generally are available in the Anchorage area. The similarity of equipment used by construction workers and miners, makes possible the recruitment of skilled labor from the construction industry. Although the prevailing wage scale of the construction industry is higher than that for mining, this scale is not necessarily applicable, as shown by table VI. Mining companies are able to attract workers at somewhat lower hourly rates by providing housing, good food, commissary privileges, and overtime work. Underground mines or those that provide year long employment can compete with other industry in that they provide steady employment whereas the construction industry is highly seasonal.

Mines operating in remote areas also have the advantage of hiring local or native help who are usually obtainable at slightly lower rates and are more likely to stay on the job. At the present time, these outlying areas are somewhat depressed and have a considerable labor force available. Also, many people enjoy living in remote areas and are willing to work in the mines.

Table VII is presented to show the general increase in wages since World War II, which in effect caused the closure of the mining industry in Alaska. It is of interest to note that while the hourly rate of the mining industry is in some instances half that of contract construction, the weekly earnings are only 25% less and are somewhat higher than the weekly earnings of the other categories. Of further interest is the fact that weekly earnings of the mining industry have increased five fold since 1940.

Table VI - Comparative Hourly Rates of Pay <sup>1/</sup>

|              | Public Contract | Metal Mines<br>Placer & Lode |      | Coal Mines |
|--------------|-----------------|------------------------------|------|------------|
| Carpenter    | 4.98            | 3.00                         | 3.50 | 4.25       |
| Mechanic     | 5.09            | 3.00                         | 3.50 | 4.25       |
| Truck driver | 4.88            | 2.00                         | 2.50 | 4.07       |
| Miner        | 5.52            | 2.50                         | 3.00 | 4.52       |
| Oiler        | 4.77            | 1.67                         | 2.25 | 3.82       |

<sup>1/</sup> Source: Alaska Employment Security Commission, Juneau, Alaska  
R & A Section, Employment Security Division, Alaska Department  
of Labor  
Rates of Individual Companies - personal communication

Table VII - Average Weekly Earnings - Selected Industries <sup>1/</sup>

| Industry                        | 1940 | 1955  | 1957  | 1959  | 1960  | Increase<br>since 1940 |
|---------------------------------|------|-------|-------|-------|-------|------------------------|
| All Industry                    | \$36 | \$115 | \$131 | \$137 | \$152 | 4.22:1                 |
| Mining                          | 34   | 126   | 148   | 164   | 172   | 5.05:1                 |
| Contract Construction           | 45   | 174   | 210   | 214   | 239   | 5.31:1                 |
| Transportation, Communication   | 17   | 106   | 114   | 121   | 150   | 8.82:1                 |
| Finance, Insurance, Real estate | 48   | 102   | 106   | 110   | 116   | 2.42:1                 |

### Transportation

The Kenai-Cook Inlet-Susitna region with its rail, water, highway, and air facilities is becoming the transportation center of Alaska. Through Anchorage, air passenger and freight service is available to a large part of Alaska, the Far East, Europe, and continental United States. Steamship lines and several barge companies provide surface freight facilities between Alaska, West Coast, and foreign ports. A federally owned railroad connects the Interior of Alaska with seaports at Anchorage and Seward. A road network connects the Kenai Peninsula with Anchorage, Matanuska, Valdez, Haines, Fairbanks and the South 48 States. Land transportation routes are shown in figure 1.

Rail - The Alaska Railroad, which is operated by the U. S. Department of the Interior, provides year-round service over 539 miles of track extending from Seward on the south through Anchorage to Fairbanks on the north. A branch line extends into the Matanuska Valley. Main headquarters and terminal yards are in Anchorage. Service to the Yentna and Valdez Creek districts is furnished by the Talkeetna and Cantwell railroad stations. Freight rates between regional stations are shown in Table VIII.

Highways - Within the region, a road network connects the Kenai Peninsula with the ports of Seward and Anchorage and with the Fairbanks area. The Glenn Highway, which passes through the Matanuska Valley, provides the region with routes from Anchorage to Fairbanks or Valdez via the Richardson Highway, or Haines via the Haines Highway, and to Canada and the South 48 States via the Alaska Highway. Gravel-surfaced roads in the Willow Creek, Yentna, Valdez Creek districts give mines within these areas limited access to highway or rail transportation systems. Generally, gravel roads are not maintained during winter months. Freight shipped by barge, trailer-barge, or steamship-van is transhipped by truck from Seward, Anchorage, or rail head to local areas.

<sup>1/</sup> Source: Alaska Employment Security Commission, Juneau, Alaska  
R & A Section, Employment Security Division, Alaska Department  
of Labor  
Rates of Individual Companies - personal communication

Many trucking enterprises, some of which are affiliated with large national trucking concerns, operate in the region. Representative truck freight rates are listed in Table IX.

Table VIII - Intra-Alaska Rail Freight Tariffs, Selected Commodities <sup>1/</sup>

| Commodity          | Rate in cents per hundred pounds from Anchorage |                   |                   |                   |                   |                   |
|--------------------|---|-------------------|-------------------|-------------------|-------------------|-------------------|
|                    | Broad Pass                                      | Cantwell          | Palmer            | Talkeetna         | Wasilla           | Seward            |
| Building Materials | 148   | 157               | 56                | 100               | 62                | 100               |
| Coal               | 391 <sup>2/</sup>                               | 407 <sup>2/</sup> | 154 <sup>2/</sup> | 292 <sup>2/</sup> | 171 <sup>2/</sup> | 385 <sup>2/</sup> |
| Lime & Lime Rock   | 49  | 52                | 19                | 33                | 21                | 33                |
| Lumber             | 49  | 52                | 19                | 100               | 21                | 100               |
| Machinery          | 148   | 157               | 56                | 33                | 62                | 33                |

Water - Water-borne commerce for the Kenai-Cook Inlet-Susitna region is largely funneled through two deep water seaports: Anchorage and Seward. Freight arriving at Seward is shipped to the region via truck or rail. Whittier, used exclusively for military cargo destined for Interior Alaska, was closed during 1961, but it is now proposed to reopen this port to allow a rail barge operation between Prince Rupert, British Columbia and Whittier. Combination steamship-rail freight service is provided on regular schedules by the Alaska Steamship Company and the Alaska Railroad. Several barge lines schedule trips from the Pacific coast to Seward and Anchorage. The barge lines haul bulk freight in special trailer-vans which connect to the company's trucks at these terminals. The steamship-railroad service also offers container service.

In March of 1961, the new \$8,750,000 port of Anchorage was opened for deep water shipping. The initial construction consists of a dock 600 feet long by 400 feet wide with a 150 by 250 foot transit shed. The pilings are over 75 feet in length to overcome the fluctuations of a 30 foot tide change. Four large cranes are track-mounted on the dock to facilitate rapid loading and unloading. This facility has resulted in several of the barge lines reducing their rates on food items from Pacific Coast ports. Wharfage costs at the new port are approximately the same as those of Seward, Table X. During this past winter, one of the barge lines operated an icebreaker to assist in maintaining schedules.

<sup>1/</sup> Alaska Railroad Tariff 16-F, June 14, 1958, October 16, 1959, April 19, 1960

<sup>2/</sup> Rate in cents per 2000 pounds from Matanuska coalfield

Table IX - Combined Truck-Barge Freight Rates - Selected Commodities 1/

| Commodity   | Rates in cents per hundred pounds <u>2/</u> |        |                              |        |                   |
|---|---|--------|------------------------------|--------|-------------------|
|   | Oakland or San Francisco to                 |        | Los Angeles or Long Beach to |        | Seattle/Tacoma to |
|   | Anchorage Group                             | Palmer | Anchorage Group              | Palmer | Anchorage Group   |
| Boilers or heating apparatus                                  | 329   | 359    | 356                          | 386    | 341               |
| Building materials  | 476   | 503    | 548                          | 575    | 344               |
| Explosives  | 965   | 1021   | 1127                         | 1183   | 639               |
| Iron and steel articles                                       | 310   | 336    | 334                          | 356    | 323               |
| Lumber  | -   | -      | -                            | -      | 224               |
| Machinery   | 384   | 402    | 454                          | 472    | 263               |
| Ore and concentrates <u>3/</u><br>(in sacks or steel barrels) | 181   | -      | 202                          | -      | -                 |
| Pipe - iron or steel  | -   | -      | -                            | -      | 562               |
| Petroleum Products  | 400   | 427    | 472                          | 499    | 250               |

1/ Alaska Freight Lines, Inc., Tariff No. 10. June 1961 and January 1962

2/ Includes one pickup and one delivery in local areas at each end of trip.

3/ Southbound only; minimum weight 20,000 pounds. If value exceeds \$60.00 per ton, rate is increased 25% for each 100% excess valuation.



Table X - Wharfage, Handling, Loading and Unloading Rates - Seward Terminal 1/

| Commodity                     | Rates in cents per 2000 lbs. |     |              |      |                       |     |
|-------------------------------|------------------------------|-----|--------------|------|-----------------------|-----|
|                               | Wharfage                     |     | Handling     |      | Loading and Unloading |     |
|                               | Seward Anch.                 |     | Seward Anch. |      | Seward Anch.          |     |
| Boilers and heating apparatus | 200                          | 200 | 670          | 670  | 460                   | 460 |
| Building materials            | 200                          | 250 | 670          | 1000 | 460                   | 800 |
| Drilling mud 2/ 3/            | 130                          | 120 | 200          | 350  | 250                   | 350 |
| Machinery                     | 200                          | 200 | 670          | 670  | 460                   | 460 |

Ton-mile rates for bulk ore shipped by scheduled truck-barge or steamship-rail from Anchorage to San Francisco (based on 2,300 miles) are 15.8 and 15.3 mills respectively. Table XI shows selected commodity tariffs for rail-steamship service.

Mining operators would find it advantageous to negotiate individual contracts with barge companies operating in the Cook Inlet area because they normally return to Pacific Coast ports empty. Lower back-haul rates for bulk commodities are negotiable. However, a private contract with a shipper sometimes requires the shipper to absorb loading, unloading, and insurance charges which can increase the cost considerably if not included in the negotiated price. One mining operator in the Cook Inlet area has shipped ore in recent years to Seattle for 5 mills per ton-mile.

Air - Anchorage is the center of air transportation in the Kenai-Cook Inlet-Susitna region. The International Airport there had 122,378 passenger arrivals and 127,282 passenger departures for the year 1961. This airport also received 13.35 million pounds of air freight and shipped 24.79 million pounds. Inbound and outbound traffic to other states and countries is flown by several large airlines using multi-engine and jet aircraft. Outbound traffic to other Alaskan points is flown by numerous smaller certificated aircraft to the Interior and coastal towns. Nearly all types of aircraft are available for charter service to outlying areas. Several firms in the area lease and rent helicopters for use in exploration.

Many mining ventures located in remote areas of the region must rely to a large extent upon air freight and air transportation. A runway of 1500 feet will accomodate the smaller type of aircraft capable of hauling 7 to 8 hundred pounds. A runway of 5000 feet allows loads of about 13,000 pounds and a substantial saving in air freight rates. Charter of large aircraft is possible with the longer runways at rates well below tariff rates. Prospecting and mapping crews make use of small fixed-wing aircraft with large pneumatic tires, or helicopters,

1/ Current Seward Terminal tariff

2/ 10,000 lbs. or more on pallets @ Seward

3/ Palletized - not less than 2000<sup>#</sup> nor more than 4000<sup>#</sup> @ Anchorage

Table XI - Combined Steamship - Rail Freight Rates - Selected Commodities 1/

| Commodity   | Rates in cents per 100 pounds<br>Between Seattle, Tacoma, Portland and: |      |
|---|---|------|
|   |   |      |
| Boilers and heating apparatus                         | Anchorage   | 281  |
|   | Palmer  | 281  |
| Building materials                                    | Anchorage   | 332  |
|   | Palmer  | 359  |
|   | Talkeetna   | 393  |
| Machinery   | Anchorage   | 317  |
|   | Palmer  | 317  |
|   | Talkeetna   | 351  |
| Ore & concentrates<br>¢ per ton (2000 lbs.) <u>2/</u> | Anchorage   | 2710 |
|   | Eska  | 2795 |
|   | Talkeetna   | 2820 |
| Explosives <u>3/</u> <u>4/</u>                        |   |      |

Table XII - Charter Rates for Specific Aircraft 5/

| Type Aircraft | Rate per Hour \$              | Rate of Standby<br>per hour \$ <u>*/</u> |
|---------------|-------------------------------|--|
| Piper Pacer   | 40                            | 20                                       |
| Cessna 180    | 60                            |  |
| Grumman Goose | 125                           | 30                                       |
| DC-3          | 1.25 per mile<br>150. minimum | 90                                       |
| F-27          | 1.70 per mile<br>400. minimum | 150                                      |

1/ Current Alaska Steamship - Alaska Railroad Tariff2/ Southbound only, minimum 20,000 pounds. If value exceeds \$60 per ton, rate increased 25% for \$60 or fraction.3/ Cannot be unloaded at Seward dock. Shipper pays cost of unloading at sea and lightering to land.4/ Explosives are landed by barge at various ports and by manufacturer's motor vessel at Haines and Skagway for trans-shipment to Interior.5/ Prepared by Pacific Northern Airlines, Inc.\*/ Standby rate varies per carrier.

and are thereby able to increase the amount of exploration work accomplished. Tables XII, XIII, XIV present selected freight rates, charter rates, and fares.

Table XIII - Specific Air Fares (scheduled, one way) <sup>1/</sup>

|               |           |         |
|---------------|-----------|---------|
| Anchorage to: | Kenai     | \$ 7.00 |
|               | Seward    | 7.50    |
|               | Talkeetna | 14.00   |
|               | Summit    | 22.00   |
|               | Seattle   | 36.30   |

Table XIV - Airborn Freight Rates - Scheduled Airlines <sup>1/</sup>

| From      | To        | rate ¢/lb.<br>under 100 lbs. | rate ¢/lb.<br>100 lbs. and over |
|-----------|-----------|------------------------------|---------------------------------|
| Seattle   | Anchorage | 23                           | 17                              |
| Seattle   | Kenai     | 27                           | 18                              |
| Anchorage | Kenai     | 8                            | 4                               |
| Anchorage | Fairbanks | 7                            | 7                               |
| Anchorage | Summit    | 6                            | 6                               |
| Anchorage | Talkeetna | 4                            | 4                               |
| Anchorage | Seward    | 6                            | 5                               |

#### Water Supply

During normal years, ample water supply for mining and milling use is available in most areas of the region. During the occasional dry years, and in the winter, many streams are insufficient for mining uses, therefore, water storage is advisable. Without adequate storage provisions, some mines have had to operate with an erratic water supply and production has been slowed for this reason.

The amount of snowfall in any given water shed directly affects the winter water supply. If the ice covered streams are not insulated from the cold air by sufficient snow cover, they will glacier. In this case, the stream is likely

<sup>1/</sup> Prepared by Pacific Northern Airlines, Inc.

to leave its channel and become part of the winter ice sheet covering the valley floor. If there is sufficient snow coverage, the stream remains in its bed and the water supply, while considerably lower than summer levels, remains fairly constant throughout the winter.

Water flow in glacier-fed streams is dependent more on summer temperatures than heavy rain fall. Warm summer temperatures melt the glacier ice in the mountains and increase the stream flow rather gradually. However, an overcast summer without heavy rain, as occurs occasionally, will result in the streams remaining at low water levels during most of the summer. On occasion, unusually hot weather has caused damaging floods.

An example of the fluctuation of stream flow is exemplified by the South Fork of Campbell Creek near Anchorage. The records for this stream have been fairly well kept. 29/ During the water year 1958-59, the maximum flow was 173 cfs on August 25th and the gage height was 2.54 feet. Maximum gage height observed was 5.30 feet on November 18th and was caused by ice damming. There was no flow part of October 12, as a result of temporary stoppage behind a snowslide upstream. The minimum for the year was 6 cfs, during April, and the mean for the year was 39.3 cfs.

It is noted from the above data that a typical stream can fluctuate from no water to over 173 cfs during one year.

Major streams of the Kenai-Cook Inlet-Susitna area and their mean water flow are as follows: 30/

Susitna River at Gold Creek - 10,560 cfs

Kenai River at Cooper Landing - 2,543 cfs

Susitna River 3 miles below Shell Creek - approximately 7,000 cfs.

Flow at the mouth of the Susitna River, fourth largest in the State, is estimated at 22.5 million acre-feet (1 acre-foot = 43,560 cf) annually (more than the Colorado River at Hoover Dam). Accurate waterflow measurements are not available on most streams, and very little information is available on sub-surface water supply.

#### Power

The Willow Creek district was one of the earliest areas to use water for the generation of power. This was due primarily to the lack of wood and the high cost of gasoline. In 1913, there were three water-power plants operating, one at each of the following mines: (1) Alaska Gold Quartz Mining Company, 15 to 20 horsepower, (2) Alaska Free Gold Mining Company, 25 horsepower, and (3) Gold Bullion Mining Company, 25 horsepower. These were Pelton wheel types operating under heads of from 28 to 120 feet. Located high in the hills, these hydro plants were fed from small watersheds that were sufficient for operation only three or four months of the summer. (3)

Two other hydro plants were operating on the Kenai Peninsula at the same time: one at Seward with a capacity of 150 horsepower and one at the Sleen-Lechner Mine which developed 75 horsepower. (5)

Operators of mines in the region learned that diesel generating equipment was more reliable than the small Pelton type hydro plants except in the case of coal mines where coal-fired power units were used for the twofold purpose of heating the washeries and furnishing electrical power. Diesel units for standby power are used in nearly every case.

Several surveys have been made in recent years concerning the economics and development of sufficient power for the Anchorage area. It has been proposed by several engineering firms that power development in the Anchorage area should include a transmission line from Fairbanks to Anchorage and Seward. This would result in less reserve power being required for any one city and substantial savings in the construction of power generating facilities. (14) The Kenai-Cook Inlet-Susitna region would be almost bisected by such a transmission line. This line would supply sufficient power for most industrial uses within a hundred miles of the boundaries of the region except the southwest portion of Cook Inlet.

Water - There are numerous hydroelectric sites within the Kenai-Cook Inlet-Susitna region. The U. S. Army Corps of Engineers and the U. S. Bureau of Reclamation have made comprehensive studies of the more feasible sites listed in Table XVI. There are at present two hydroelectric power plants in operation within the region. The plant at Eklutna has a rated output of 30,000 kw, and the one at Cooper Lake has a rated output of 15,000 kw. Bus bar power cost is about 6 mills, and transmission costs between Eklutna and Anchorage are calculated at about 1 mill. Table XV indicates comparative power costs in the Cook Inlet area. It is noted that diesel generation costs nearly 65 mills, so that for an industry that will require more than a very small amount of electrical energy, the possibilities of installing a hydroelectric plant should be considered. The initial cost of hydro installation will be considerably more than the equivalent amount of power in diesel equipment; however, it will soon be amortized with the price of diesel oil in remote areas as much as fifty cents per gallon delivered. Small hydro-electric plants that are capable of producing during the ice-free period of eight months, with standby diesel units, have been proven to create substantial savings to one mining operation in the Kuskokwim region.

Table XV - Power Costs in the Cook Inlet Area 1/

| <u>Customer</u>  | <u>mills/kwh</u> |
|--|------------------|
| Matanuska Electric Association, Inc.<br>(REA) - purchased from Eklutna | 11.5             |
| City of Anchorage Municipal Light &<br>Power - purchased from Eklutna  | 10.46            |
| - diesel generation  | 64.8             |
| Chugach Electric Association, Inc.<br>- steam plant                    | 29.60 @ 22¢ L.F. |

1/ The Ralph M. Parson Co., Report to Central Alaska Power Pool, Anchorage, Alaska, 1961.

Table XVI - Potential Water Power, Kenai-Cook Inlet-Susitna Region 1/

| <u>Susitna River Basin</u>   |                           | <u>kw</u> |
|------------------------------|---------------------------|-----------|
| Vee                          | Talkeetna Mountains       | 203,200   |
| Watana                       | Talkeetna Mountains       | 259,100   |
| Devil Canyon                 | Talkeetna Mountains       | 366,000   |
| Olson                        | Talkeetna Mountains       | 25,300    |
| Chulitna River               | Talkeetna Mountains       | 6,800     |
| Lucy                         | Talkeetna Mountains       | 11,000    |
| Tokichitna                   | Talkeetna                 | 123,800   |
| Trapper                      | Talkeetna Mountains       | 17,100    |
| Greenstone                   | Talkeetna Mountains       | 14,800    |
| Keetna                       | Talkeetna Mountains       | 95,300    |
| Talkeetna River              | Talkeetna Mountains       | 36,400    |
| Sheep River                  | Talkeetna Mountains       | 31,400    |
| Skwentna River No. 2         | Tyonek                    | 31,000    |
| Talachulitna                 | Tyonek                    | 40,000    |
| Susitna Station              | Tyonek                    | 9,700     |
| Kashwitna River              | Upper Talkeetna Mountains | 19,000    |
| Kashwitna River, Lower       | Upper Talkeetna Mountains | 13,100    |
| Sheep Creek                  | Upper Talkeetna Mountains | 7,300     |
| TOTAL                        |                           | 1,400,600 |
| <u>Matanuska River Basin</u> |                           |           |
| Caribou                      | Anchorage                 | 13,000    |
| Matanuska River No. 1        | Anchorage                 | 30,800    |
| Rush Lake                    | Anchorage                 | 5,500     |
| Sutton                       | Anchorage                 | 37,700    |
| Lake George                  | Anchorage                 | 47,000    |
| Eagle River                  | Anchorage                 | 5,100     |
| TOTAL                        |                           | 139,100   |
| <u>Tyonek Area</u>           |                           |           |
| Beluga River                 | Tyonek                    | 12,800    |
| Chakachamna                  | Tyonek                    | 188,400   |
| TOTAL                        |                           | 201,200   |

Gas - The discovery of natural gas in the Kenai-Cook Inlet area has led to new conceptions of electrical generation in the region. The first gas turbine is currently being installed at Kenai. It will have a rated capacity of 1500 kw and be used to furnish power to the local community.

1/ U. S. Bureau of Reclamation, January 1962

Wellhead prices of 25¢/mcf have been quoted at the Kenai gas field, but it is understood that the price of gas to the Kenai turbine will be nearer to 10¢. (personal communication).

One study made of the possibilities of producing power in sufficient quantities to supply an aluminum refining plant requiring 300,000 kw shows that a gas price of 5¢ would be required. If gas at 5¢ were available, power could be produced by gas turbine for approximately 3 mills/kw. This is computed with a twenty year amortization plan and assuming a 95% load factor. (14)

Gas-fired steam turbines are more efficient than gas turbines, but the capital investment is considerably higher. The investment cost in dollars per kilowatt is 30% greater in the case of the gas steam turbine, but the fuel cost per kw is only 54% of that of the gas turbine. The gas turbine's advantage is that it is a small compact unit that is easily placed. It requires very little maintenance and doesn't require a large investment in standby power since many smaller units are used.

If a source of heat is required, the steam turbine should be favored as a dual source of energy.

Coal - There have been several reports written on the advisability of installing mine-mouth coal-fired steam-electric power plants in the region. (14, 37, 36) It is concluded that this source of energy should be strongly considered as the solution to the power shortage in the area until the larger proposed hydro-electric projects are completed. The Devils Canyon project of 580,000 kw would, upon completion, furnish bus bar power at between 5 and 6 mills. A coal-fired steam plant, designed to burn mine-run coal, could produce electrical energy for about 5-7 mills under a ten-year contract. The mine-mouth plant would, in addition to supplying power of nearly equal cost, create economic improvement in the area for a longer period of time. It has been pointed out that the aluminum industry has preferred to locate near the coal fields of the Ohio River closer to markets and pay 4 mills for mine-mouth electricity than to pay 2 mills on the northwest coast for hydro electricity. (41)

Any proposals of new industry in the region should include consideration of the use of local coal as a source of electrical power and heat.

Diesel Engines - The diesel engine generator is almost a necessity as an initial source of power, and the same unit can be used as standby power after the principal source has been put into operation. The cost per kw of electrical power generated is dependent upon the cost of fuel at the point of consumption. Diesel fuel costs vary from 18 to over 50 cents per gallon, depending upon transportation costs. The average engine will consume about 0.1 gallon per kw hour of rated capacity. A new diesel unit generally can be purchased for about \$250 per kw of rated capacity. Reconditioned units are plentiful and considerably cheaper.

#### Taxes

Any person, firm, or corporation engaged in mining in the State of Alaska is liable for the same federal taxes as in the other States. The State personal income tax is based on a percentage of the federal income tax (16%). The State corporate income tax is 18% of the federal corporate tax. Several of the

towns and cities have sales taxes, and as boroughs are organized, they will replace the school districts as taxing units.

Each mining operation must obtain a yearly mining license, but new mines are exempted from the fee for a period of 3-1/2 years from the date of initial production. This exemption does not apply to mining sand and gravel. Further incentive to new operations is realized by the Industrial Tax Incentive Act which gives possible exemption from all State taxes for periods up to 10 years. Each application is judged separately by the State Board of Administration. To qualify for exemptions under this Act, a mining operation must substantially beneficiate or process its product within the State. Table XVII presents selected mining industry taxes in the State.

An employment security tax is levied on every mine employing 4 or more men. The rate for this tax is 2.9 percent on wages up to \$7,200 per employee with an additional 0.6 percent assessed the worker. After the employer has been subject to the tax for a period of four consecutive calendar quarters, he may be eligible for rate determination at a lesser amount.

#### Markets

Although base metal deposits occur in the Kenai-Cook Inlet-Susitna region, very few have been much explored or developed. Extensive exploration, utilizing modern geological, geochemical and geophysical methods, and a development program will be required to realize the region's potential production. Markets for base metal ore and concentrates exist at the custom smelters of the Pacific Northwest and in the Far East. See table XVIII.



Table XVII - Selected Mining Industry Taxes - State of Alaska 1/

| Mine type         | Depletion allowance % | Corporate Income tax % of Federal | Mining License Fee % of Net Income |                   |                              |                              | Personal Income Tax | Employment Security |                  |
|-------------------|-----------------------|-----------------------------------|------------------------------------|-------------------|------------------------------|------------------------------|---------------------|---------------------|------------------|
|                   |                       |                                   | Under \$40,000                     | \$40,000-\$50,000 | \$ 50,000-\$100,000          | Over \$100,000               |                     | % Wages Employer    | % Wages Employee |
| Coal              | 10                    | 13                                | 0                                  | 3                 | \$ 1,500 & 5% over \$ 50,000 | \$ 4,000 & 7% over \$100,000 | 16                  | 2.9                 | .6               |
| Metal & Non-metal | 15                    | 18                                | 0                                  | 3                 | "                            | "                            | 16                  | 2.9                 | .6               |
| Sulfur            | 23                    | 18                                | 0                                  | 3                 | "                            | "                            | 16                  | 2.9                 | .6               |

1/ Revenue and Taxation in Alaska by Alaska Legislative Council January 1962, State of Alaska, Session Law, 1960 & 1961

Table XVIII - Approximate Costs & Value of Several Ores at Selected Markets (\$) <sup>1/</sup>

| Commodity      | Bulk Shipments<br>Alaska Railroad<br>Matanuska to Anch.   | Freight & Handling<br>to Market<br>Bulk, Ship or Barge | U.S. Market  | Japanese<br>Market | \$/T @ Mine<br>Loaded in Car<br>or Ship-Barge |
|----------------|---|--|--------------|--------------------|---|
| Iron 62%       | In event ore is<br>hauled by rail or<br>truck, cost will<br>have to be de-<br>ducted from value<br>at mine. | 4.73/DLT   | 11.00/DLT 6/ |                    | 5.60  |
|                |   | 5.78/DMT   |              | 15.68/DMT          | 8.98  |
| Pig Iron 98.5% |   | 20.00/MT   |              | 60.00/MT           | 36.28   |
|                |   | 4.00/GT 3/   | 68.00/GT 4/  |                    | 64.00   |
| Copper 25%     | "   | 18.50/MT 2/  |              | 147.35/MT          | 116.87  |
|                |   | 17.00/T 2/   | 133.68/T 7/  |                    | 116.68  |
| Chrome 48%     | "   |  |              |                    |   |
|                |   | 16.00/T 4/   | 36.25/T 8/   |                    | 20.25   |
| Coal           | 2.54/T  | 4.00/MT 3/   |              | 15.20/MT           | 10.15   |
|                | 2.54/T  | 3.36/T 3/  | 6.60/T 9/    |                    | 3.24  |
| Coke           | 2.54/T  | 3.36/MT 3/   |              | 15.50/MT           | 11.01   |
|                | 2.54/T  | 3.36/T 3/  | 16.00/T 5/   |                    | 12.64   |

<sup>1/</sup> Compiled from: Potential For Use of Alaska's Energy Resources, Arthur D. Little, Inc., 1961  
 Alaska's Minerals as a Base for Industrial Development, Arthur D. Little, Inc., 1962  
 Transport Requirements for the Growth of Northwest North America, Vol. 2, Battelle  
 Memorial Institute, 1961

<sup>2/</sup> Including treatment <sup>6/</sup> Long Beach      GT - Gross ton      DLT - Dry Long ton  
<sup>3/</sup> Estimated <sup>7/</sup> Tacoma Smelter      DMT - Dry Metric ton      2,240 lbs.  
<sup>4/</sup> Seattle <sup>8/</sup> F.O.B. Atlantic Ports      MT - Metric ton - 2,204.6 lbs.  
<sup>5/</sup> Fontana, California <sup>9/</sup> Per ton 12,400 B.T.U.      T - Short ton - 2,000 lbs.

Note: A southbound rate of \$1.00/T between rail points and the Pacific Northwest in railroad cars might be the result of proposed rail-barge transportation.

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**American Smelting and Refining Company**  
**Tacoma Smelter**  
**Tacoma, Washington**

QUOTATION No.

DOMESTIC PURCHASE SCHEDULE

EFFECTIVE DATE

Shipper

Address

Mine

Shipping Point

The following purchase terms are subject to the General Clauses shown on the back of this sheet, and are subject to prompt acceptance. Unless shipments are begun within ..... days, this schedule is subject to revision. The schedule can be cancelled by 30 days' written notice to shipper at the above address.

Assignments of any part or all of the proceeds from your shipments will not be honored unless received in writing and accepted by us in writing.

PRODUCT: Copper Ore

|           |                |           |                 |           |           |           |           |           |             |           |            |          |              |           |            |
|-----------|----------------|-----------|-----------------|-----------|-----------|-----------|-----------|-----------|-------------|-----------|------------|----------|--------------|-----------|------------|
| ANALYSIS: | <u>Oz./Ton</u> |           | <u>Per Cent</u> |           |           |           |           |           |             |           |            |          |              |           |            |
|           | <u>Au</u>      | <u>Ag</u> | <u>Pb</u>       | <u>Cu</u> | <u>Zn</u> | <u>As</u> | <u>Sb</u> | <u>Ni</u> | <u>SiO2</u> | <u>Fe</u> | <u>CaO</u> | <u>S</u> | <u>Al2O3</u> | <u>Bi</u> | <u>H2O</u> |

TONNAGE: Limited to ..... tons per month except by special arrangement.

DELIVERY: F.O.B. cars or wharf at the Tacoma Smelter, Tacoma, Washington.

DATE OF DELIVERY: Date upon which the last car of each lot is accepted by Tacoma Smelter, or upon which carrying vessel commences discharge of product onto Smelter wharf.

PAYMENTS

GOLD: (A) If 0.03 of a troy ounce per net dry ton and less than 3.00 ounces pay for 91.14%, (B) If 3.00 ounces and less than 5.00 ounces pay for 92.57%, (C) If 5.00 ounces and less than 10.00 ounces pay for 93.29%, (D) If 10.00 ounces or over pay for 94.00%, at the net price per ounce paid by the United States Mints for gold recovered from domestic mine production on the fifteenth day following delivery of the product to the Tacoma Smelter. Nothing paid for gold if less than 0.03 ounces per net dry ton. Minimum deduction 0.03 ounces per net dry ton. The present Mint net price is \$34.9125 per ounce.

SILVER: Pay for 95% at the realized Mint price (i.e., Mint price less Buyer's deductions to cover delivery and other expenses), provided the silver content qualifies for Government purchase and necessary affidavit or other proof is furnished, or, if higher, at the average Handy and Harman New York silver quotation for the seven-day period ending on the Wednesday following the calendar week including the date of delivery, in either case less One Cent per ounce. Minimum deduction 1/2 troy ounces per net dry ton. The present realized Mint price is 90¢ per ounce.

COPPER: Deduct from the wet copper assay One unit and pay for 100.0% of the remaining copper at the Custom Smelter Copper Price, i.e., refinery, for electrolytic copper sold in standard shapes in the United States market as published in the Engineering and Mining Journal (Metal and Mineral Markets) for the seven-day period ending on the Wednesday following the calendar week including date of delivery of product at the plant of Buyer, less a deduction of 3¢ per pound of copper paid for. Nothing shall be paid for copper if less than One % by wet assay.

No payment will be made for any metal or content except as above specified.

DEDUCTIONS

BASE CHARGE: \$ 11.00 per net dry ton of 2,000 pounds, provided the sum of payments for gold, silver, and copper does not exceed \$ 100.00 per net dry ton. Add to the base charge ten per cent of the excess over such payment of \$ 100.00 to a maximum base charge of \$ 17.50 per net dry ton.

SILICA: For ores of a siliceous character, add to the base charge ..... for each unit deficiency in available silica below ..... per cent; fractions in proportion. To determine available silica deduct two-thirds of the iron assay from the silica assay.

ZINC: 5.0 % free. Charge for the excess at 30¢ per unit of dry weight; fractions in proportion.

ARSENIC: 1.0 % free. Charge for the excess at 50¢ per unit of dry weight; fractions in proportion.

ANTIMONY: 1.0 % free. Charge for the excess at 100¢ per unit of dry weight; fractions in proportion.

NICKEL: 0.5 % free. Charge for the excess at 300¢ per unit of dry weight; fractions in proportion.

MOISTURE: 10.0 % free. Charge for the excess at 10¢ per unit of wet weight; fractions in proportion.

OTHER CLAUSES: See reverse side of this schedule.

Consign all shipments to the American Smelting and Refining Company, Tacoma, Washington, and mail original bill of lading and, if not forwarded prior, one completed yellow instruction blank for making payment to P. O. Box 1605, Tacoma 1, Washington. We will also require proof of your right to dispose of this material, such as a certified copy of your lease or deed or the filing of your claim with the County Auditor, before we can accept any initial shipment.

AMERICAN SMELTING AND REFINING COMPANY

P. O. Box 1605  
 Tacoma 1, Washington

By .....

(over)

**American Smelting and Refining Company**  
**Tacoma Smelter**  
**Tacoma, Washington**

QUOTATION No.

DOMESTIC PURCHASE SCHEDULE

EFFECTIVE DATE

Shipper

Address

Misc

Shipping Point

The following purchase terms are subject to the General Clauses shown on the back of this sheet, and are subject to prompt acceptance. Unless shipments are begun within \_\_\_\_\_ days, this schedule is subject to revision. The schedule can be cancelled by 30 days' written notice to shipper at the above address.

Assignments of any part or all of the proceeds from your shipments will not be honored unless received in writing and accepted by us in writing.

PRODUCT: Copper Concentrates

|           |   |                 |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|---|-----------------|--|--|--|--|--|--|--|--|--|--|--|--|
| ANALYSIS: | <u>Oz./Ton</u>  | <u>Per Cent</u> |  |  |  |  |  |  |  |  |  |  |  |  |
|           | <u>Au</u> <u>Ag</u> <u>Pb</u> <u>Cu</u> <u>Zn</u> <u>As</u> <u>Sb</u> <u>Ni</u> <u>SiO<sub>2</sub></u> <u>Fe</u> <u>CaO</u> <u>S</u> <u>Al<sub>2</sub>O<sub>3</sub></u> <u>Bi</u> <u>H<sub>2</sub>O</u> |                 |  |  |  |  |  |  |  |  |  |  |  |  |

TONNAGE: Limited to \_\_\_\_\_ tons per month except by special arrangement.

DELIVERY: F.O.B. cars or wharf at the Tacoma Smelter, Tacoma, Washington.

DATE OF DELIVERY: Date upon which the last car of each lot is accepted by Tacoma Smelter, or upon which carrying vessel commences discharge of product onto Smelter wharf.

PAYMENTS

GOLD: (A) If 0.03 of a troy ounce per net dry ton and less than 3.00 ounces pay for 91.14%, (B) If 3.00 ounces and less than 5.00 ounces pay for 92.57%, (C) If 5.00 ounces and less than 10.00 ounces pay for 93.29%, (D) If 10.00 ounces or over pay for 94.00%, at the net price per ounce paid by the United States Mints for gold recovered from domestic mine production on the fifteenth day following delivery of the product to the Tacoma Smelter. Nothing paid for gold if less than 0.03 ounces per net dry ton. Minimum deduction 0.03 ounces per net dry ton. The present Mint net price is \$34.9125 per ounce.

SILVER: Pay for 95% at the realized Mint price (i.e., Mint price less Buyer's deductions to cover delivery and other expenses), provided the silver content qualifies for Government purchase and necessary affidavit or other proof is furnished, or, if higher, at the average Handy and Harman New York silver quotation for the seven-day period ending on the Wednesday following the calendar week including the date of delivery, in either case less 1¢ per ounce. Minimum deduction 1/2 troy ounces per net dry ton. The present realized Mint price is 90¢ per ounce.

COPPER: Deduct from the wet copper assay one unit/ and pay for 100.0% of the remaining copper at the Custom Smelter Copper Price, f.o.b. refinery, for electrolytic copper sold in standard shapes in the United States market as published in the Engineering and Mining Journal (Metal and Mineral Markets) for the seven-day period ending on the Wednesday following the calendar week including date of delivery of product at the plant of Buyer, less a deduction of 3¢ per pound of copper paid for. Nothing shall be paid for copper if less than one% by wet assay.

No payment will be made for any metal or content except as above specified.

DEDUCTIONS

BASE CHARGE: \$ 14.85 per net dry ton of 2,000 pounds, provided the sum of payments for gold, silver, and copper does not exceed \$ 100.00 per net dry ton. Add to the base charge ten per cent of the excess over such payment of \$ 100.00 to a maximum base charge of \$ 17.50 per net dry ton.

SILICA: For ores of a siliceous character, add to the base charge \_\_\_\_\_ for each unit deficiency in available silica below \_\_\_\_\_ per cent; fractions in proportion. To determine available silica deduct two-thirds of the iron assay from the silica assay.

ZINC: 5.0% free. Charge for the excess at 30¢ per unit of dry weight; fractions in proportion.

ARSENIC: 1.0% free. Charge for the excess at 50¢ per unit of dry weight; fractions in proportion.

ANTIMONY: 1.0% free. Charge for the excess at 100¢ per unit of dry weight; fractions in proportion.

NICKEL: 0.5% free. Charge for the excess at 300¢ per unit of dry weight; fractions in proportion.

MOISTURE: 10.0% free. Charge for the excess at 10¢ per unit of wet weight; fractions in proportion.

OTHER CLAUSES: See reverse side of this schedule.

Consign all shipments to the American Smelting and Refining Company, Tacoma, Washington, and mail original bill of lading and, if not forwarded prior, one completed yellow instruction blank for making payment to P. O. Box 1605, Tacoma 1, Washington. We will also require proof of your right to dispose of this material, such as a certified copy of your lease or deed or the filing of your claim with the County Auditor, before we can accept any initial shipment.

AMERICAN SMELTING AND REFINING COMPANY

P. O. Box 1605  
 Tacoma 1, Washington

By \_\_\_\_\_

(over)

**American Smelting and Refining Company**  
**Tacoma Smelter**  
**Tacoma, Washington**

QUOTATION No.

DOMESTIC PURCHASE SCHEDULE

EFFECTIVE DATE

Shipper

Address

Mine

Shipping Point

The following purchase terms are subject to the General Clauses shown on the back of this sheet, and are subject to prompt acceptance. Unless shipments are begun within \_\_\_\_\_ days, this schedule is subject to revision. The schedule can be cancelled by 30 days' written notice to shipper at the above address.

Assignments of any part or all of the proceeds from your shipments will not be honored unless received in writing and accepted by us in writing.

PRODUCT: Siliceous Cre & Cts.

|           |  |          |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------|--|----------|--|--|--|--|--|--|--|--|--|--|--|--|--|
| ANALYSIS: | Oz./Ton  | Per Cent |  |  |  |  |  |  |  |  |  |  |  |  |  |
|           | Au Ag Pb Cu Zn As Sb Ni SiO2 Fe CaO S Al2O3 Bi H2O |          |  |  |  |  |  |  |  |  |  |  |  |  |  |

TONNAGE: Limited to \_\_\_\_\_ tons per month except by special arrangement.

DELIVERY: F.O.B. cars or wharf at the Tacoma Smelter, Tacoma, Washington.

DATE OF DELIVERY: Date upon which the last car of each lot is accepted by Tacoma Smelter, or upon which carrying vessel commences discharge of product onto Smelter wharf.

**PAYMENTS**

**GOLD:** (A) If 0.03 of a troy ounce per net dry ton and less than 3.00 ounces pay for 91.14%, (B) If 3.00 ounces and less than 5.00 ounces pay for 92.57%, (C) If 5.00 ounces and less than 10.00 ounces pay for 93.29%, (D) If 10.00 ounces or over pay for 94.00%, at the net price per ounce paid by the United States Mints for gold recovered from domestic mine production on the fifteenth day following delivery of the product to the Tacoma Smelter. Nothing paid for gold if less than 0.03 ounces per net dry ton. Minimum deduction 0.03 ounces per net dry ton. The present Mint net price is \$34.9125 per ounce.

**SILVER:** Pay for 95% at the realized Mint price (i.e., Mint price less Buyer's deductions to cover delivery and other expenses), provided the silver content qualifies for Government purchase and necessary affidavit or other proof is furnished, or, if higher, at the average Handy and Harman New York silver quotation for the seven-day period ending on the Wednesday following the calendar week including the date of delivery, in either case less 1¢ per ounce. Minimum deduction 1/2 troy ounces per net dry ton. The present realized Mint price is 90¢ per ounce.

**COPPER:** Deduct from the wet copper assay ONE unit and pay for 100.0% of the remaining copper at the Custom Smelter Copper Price, f.o.b. refinery, for electrolytic copper sold in standard shapes in the United States market as published in the Engineering and Mining Journal (Metal and Mineral Markets) for the seven-day period ending on the Wednesday following the calendar week including date of delivery of product at the plant of Buyer, less a deduction of 3¢ per pound of copper paid for. Nothing shall be paid for copper if less than 1% by wet assay.

No payment will be made for any metal or content except as above specified.

**DEDUCTIONS**

**BASE** \$ 4.00 per net dry ton of 2,000 pounds, provided the sum of payments for gold, silver, and copper **CHARGE:** does not exceed \$ 50.00 per net dry ton. Add to the base charge ten per cent of the excess over such payment of \$ 50.00 to a maximum base charge of \$ 17.50 per net dry ton.

**SILICA:** For ores of a siliceous character, add to the base charge Twenty Cents for each unit deficiency in available silica below Seventy per cent; fractions in proportion. To determine available silica deduct two-thirds of the iron assay from the silica assay.

**ZINC:** 5.0% free. Charge for the excess at 30¢ per unit of dry weight; fractions in proportion.

**ARSENIC:** 1.0% free. Charge for the excess at 50¢ per unit of dry weight; fractions in proportion.

**ANTIMONY:** 1.0% free. Charge for the excess at 100¢ per unit of dry weight; fractions in proportion.

**NICKEL:** 0.5% free. Charge for the excess at 30¢ per unit of dry weight; fractions in proportion.

**MOISTURE:** 10.0% free. Charge for the excess at 10¢ per unit of wet weight; fractions in proportion.

**OTHER CLAUSES:** See reverse side of this schedule.

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AMERICAN SMELTING AND REFINING COMPANY

P. O. Box 1605  
 Tacoma 1, Washington

By \_\_\_\_\_

(over)



THE ANACONDA COMPANY

ANACONDA SAMPLER

SCHEDULE FOR COPPER, GOLD & SILVER ORES

(EFFECTIVE NOVEMBER 1, 1956)

Subject to change without notice

PAYMENT FOR METALS

- Copper - - - 96% of copper content, with minimum deduction of 10 pounds per ton, at Engineering and Mining Journal average price of electrolytic for week ending Wednesday preceding date of sampling, less 3.5¢ per pound.
- Silver - - - 95% of silver content, with minimum deduction of one ounce per ton at Government price less 6¢ per ounce. This applies to silver eligible for Government price. Silver not eligible for Government price will be paid for at open market quotation, using the average price for week ending Wednesday preceding date of sampling, as quoted by Engineering and Mining Journal.
- Gold - - - 95% of gold content, with minimum deduction of 0.01 ounce per ton, at \$20.00 per ounce, plus 90% of premium in excess of \$20.67 per ounce. (At present Government price of \$35.00 per ounce this is equivalent to paying for 100% at \$31.81825 per ounce.)

TREATMENT CHARGE F.O.B. ANACONDA SAMPLER, ANACONDA, MONTANA

- Base Charge - \$3.75 per ton  
Add 10% of sum of metal payments in excess of \$15.00 per dry ton.  
Add 12¢ for each 1% iron (Fe)  
Deduct 2.5¢ for each 1% silica (SiO<sub>2</sub>) in excess of Alumina (Al<sub>2</sub>O<sub>3</sub>)

Maximum total treatment charge to be \$5.25 per dry ton.

Lots of less than ten tons will be assessed an extra sampling charge of \$5.00 flat on each lot.

Small lots of unusually high grade will be purchased only by special arrangement.

SHIPPING INSTRUCTIONS

Consign all shipments to: Anaconda Sampler, Anaconda, Montana, unless instructed otherwise.

Forward bills of lading and communications to: Anaconda Reduction Dept., Anaconda, Montana.

Advise name of mine, and state whether ore is newly mined or from a dump. We request that shipments be made in flat bottom gondola cars or end-dump trucks.

Domestic Open Zinc Schedule

Payments:

|              |                      |                                 |
|--------------|----------------------|---------------------------------|
| <u>Zinc:</u> | If 55% or over,      | pay for 85% @ E.St. Louis Quot. |
|              | If 54% but under 55% | " " 84% @ " " " "               |
|              | If 53% " " 54%       | " " 83% @ " " " "               |
|              | If 52% " " 53%       | " " 82% @ " " " "               |
|              | If 51% " " 52%       | " " 81% @ " " " "               |
|              | If 50% " " 51%       | " " 80% @ " " " "               |
|              | If under 50%         | " " 75% @ " " " "               |

Lead: Deduct 3%, pay for 80% of balance @ N.Y. quot., less 2¢ per lb.

Silver: If 1.0 oz. or over, pay for 80% @ Handy & Harmon N.Y. quot., or U.S. Government quot.

Gold: If .03 oz. or over, pay for 80% @ \$34.2425

Cadmium: Deduct .25%, pay for 70% of balance @ E & M.J. Ton lot quot., less 50¢ per lb.

Deductions:

Base: \$43.00 per short dry ton when Zinc quot. is 10¢. Add \$2.00 for each 1¢ increase above 10¢.

Lead: Charge under 3.0% @ \$1.50 per unit.

Iron: Charge over 2.0% @ \$ .40 per unit.

Insol: " " 4.0% @ \$ .60 " "

Lime: " " 0.5% @ \$ .50 " "

Magnesia: " " 0.1% @ \$2.50 " "

Arsenic: " " 0.1% @ \$1.00 " "

Antimony: " " 0.1% @ \$3.00 " "

Freight: Base St. Louis freight rate \$17.92. Any change in rate or tax thereon for Seller's account. Figured on Zinc pounds paid for.

Labor: Base hourly labor rate \$2.5889. Charge or credit 8¢ for each 1¢ increase or decrease in labor rate. Hourly rate January 1, 1962 - \$2.7215

Delivery: F.O.B. cars Silver King, Idaho. A switching charge, as assessed by the U.P. railroad, will be made on lots delivered by truck.

Quotations: All settlement quotations shall be the average for the calendar month following date of receipt.

Settlement: Payment shall be made for 80% on agreement of weights & assays. Final payment when settlement quotations are determined.

Freight Address: Silver King, Idaho.

Payments:

- Gold: If .03 ozs. and under 3.0 ozs., pay for 100% @ \$31.81825.  
3.0 ozs. or over, pay for 100% @ \$ 32.81825.
- Silver: If 1.0 oz. or over, pay for 95% @ applicable quotation.
- Lead: If 2.5% and under 25.0%, pay for 90% ) of Wet assay @ New York quotation,  
25.0% and under 50.0%, pay for 91% ) less 2¢ per pound.  
50.0% or over, pay for 92% )
- Zinc: If 2.5% or over, pay for 50% @ 25% of E. St. Louis quotation.
- Quotation: Average for calendar month following date of receipt.

Deductions:

- Base: \$18.00 per short dry ton. Based on 50.0% Wet Lead. Credit lead over 50% @ 10¢ per unit.
- Silver: If Government quotation used, charge 1/2¢ per oz. silver paid for.  
If Handy & Harman quot. used, charge 1¢ per oz. silver paid for.  
Charge over 50.0 ozs. per ton paid for @ 1-1/2¢ per ounce
- Arsenic: Charge over 1.0% @ \$1.00 per unit.
- Bismuth: Charge over 0.1% of Wet Lead @ 50¢ per pound.
- Sulphur: Charge over 16.0% @ 10¢ per unit.
- Moisture: Charge over 10.0% @ 20¢ per unit.
- Labor: Base hourly labor rate \$2.5889. Charge or credit 8¢ for each 1¢ increase or decrease in labor rate. Hourly rate January 1, 1962 - \$2.7215
- Freight: Base New York freight rate \$27.17 Any change in rate or tax thereon for Seller's account. Figured on lead pounds paid for.
- Payment: 80% on agreement of weights & assays. Final payment when settlement quotations are determined.
- Delivery: F. O. B. Bunker Hill Smelter, Bradley, Idaho.