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TERRITORY OF ALASKA  
DEPARTMENT OF MINES

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Industrial Minerals as a Field for  
Prospecting in Alaska

including

A Glossary of Elements and  
Minerals

BY

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JUNEAU, ALASKA  
March, 1945

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## PREFACE

Foreseeing that Alaska must develop industrial enterprise in order to support further population increases, it is the hope of the author that the information presented here will awaken an interest in many metallic and non-metallic minerals that can ill-afford to be overlooked if there is to be an orderly development of Alaska. Industrial growth and substantial population gains must go hand in hand. One cannot exist in Alaska without the other.

The success and even the existence of new industries may well depend upon local development of minerals previously deemed valueless. As an illustration; should the paper and pulp industry become established in the Territory, there would immediately exist an interest in paper clays, talc, sulphur, and other raw materials. Markets may indeed be small at first, but advance knowledge of the existence and location of certain minerals may be the deciding factor in influencing the establishment of small industry which, we may trust, will thrive. The average person fails to realize the extremely important part that minerals play in the everyday existence of modern civilization. To produce this sheet of paper required the use, in some way or another, of sulphur, limestone, salt, gypsum, talc, and even the lowly sandstone and clay.

No attempt has been made in this report to restrict it to those minerals of immediate value in Alaska. Some of those listed will remain more or less valueless until such time as the development of the Territory makes possible their local utilization. The exploitation of some may be hastened by industrial expansion along the coast of Washington, Oregon and California. (This is a strong possibility due to the development and availability of cheap hydroelectric power and, if that occurs, it would seem likely that some mineral raw materials, produced in Alaska and shipped by boat, could compete favorably with transcontinental rail deliveries.) Some, as will be readily seen, are in good demand, at high prices and warrant the fullest attention of the prospector. Still others, producible in small quantity, yet having high unit value, are of special importance to the average prospector as a means of financing himself for further prospecting. Of particular import-

ance in this class is the collecting and sale of specimen material and gem stones, both semi-precious and precious.

Great detail is not possible in a report of this nature. It is hoped that the reader will supplement and amplify the information presented by consulting up to date standard texts, especially those on mineralogy. It should be mentioned, however, that accurate identification of most of these minerals had best be done in a well-equipped laboratory, and it is suggested that the prospector avail himself of the free services offered by the Territorial Department of Mines, and send in all samples for identification or for confirmation of his findings. The Department would also welcome the opportunity to be of service in suggesting or locating market outlets for any new mineral production.

## INTRODUCTION

The information presented in these pages is based upon available information up to recent date, but during the present world conflict there have been many outstanding technical developments taking place, so far unpublicized. When peace has been won we will learn of these new developments; of new uses for both metals and minerals, many of them finding use in quantity for the first time. Others, the majority in fact, have long ago proven indispensable to the degree of civilization we know today. To acquaint the prospector with these minerals; to assist him to realize the greatest benefits from his efforts, even though he may be primarily searching for gold, is the purpose of this report. Further development of the Territory largely depends upon his discoveries. Conversely, much of the ultimate value of his discoveries depends upon development of and by the Territory.

To stimulate and encourage development of mining in the Territory is one primary purpose of the Territorial Department of Mines. No single project can accomplish more in that direction than the offering of the fullest support and assistance to the prospector and, of course, receiving his cooperation. The following services are available, free of charge.

### Mineral Identification

Mineral identification service is provided at the Juneau office and at the Assay Offices at Ketchikan, Anchorage and College (Fairbanks). Specimens sent for identification are classified, and if any commercially important mineral or metal is present, a brief description of its use and value is included in the report. If, in the opinion of the mineralogist, the specimen warrants an assay for any particular element, such assay is made and reported without the necessity of a specific request therefor.

### Assaying

Fully equipped assay offices are maintained at Ketchikan, Anchorage and College (Fairbanks). Prospectors are encouraged to submit samples to the most convenient office. When possible to do so, carefully taken channel samples should be submitted

rather than hand samples. Often samples are received with a request for certain assays entailing much work, when a proper knowledge of the rock, or possibly qualitative tests, would show such work to be unnecessary and unwarranted. It is, therefore, often necessary for the assayer to exercise his best judgment in determining how much labor is actually warranted in such cases.

Although such information is not required, a brief description of the approximate location of the source of the sample would be appreciated by the Department. This information is most helpful in maintaining files on the mineral resources of the Territory. All such information is kept strictly confidential.

It has been observed that some persons, fearing that they may become "bothersome", hesitate about submitting samples. Whenever the prospector has any question as to the identity or content of any rock or mineral, the Department of Mines hopes that a specimen will be submitted for examination. Many important minerals occur in inconspicuous and common appearing rocks.

#### Engineering Services and Examinations

Field engineers in the employ of the Department of Mines are available for examining prospects, the owners of which are unable to afford the services of a private engineer. Requests for such examinations should be addressed to the Commissioner of Mines, Juneau, Alaska. Services available include sampling and mapping of mineral showings if a preliminary examination indicates that type of work is justified. The information obtained is made available to the owner of the prospect in a form suitable for presenting to companies or individuals who might be interested in financing development and mining operations. Advice of the engineer may also be obtained if desired on development and mining problems that are met in the course of bringing a newly discovered mineral deposit to the productive stage. Requests for engineering service should be accompanied by information that would be useful to an examining engineer, including location, nature and extent of the deposit so far as known, transportation available, season of the year most favorable for an examination, etc.

#### Lapidary Services

Equipment for the sawing and polishing of stone is a part of the facilities of the department office at College (Fairbanks). Any

rock or mineral suspected of being useful as an ornamental stone or gem may be sent to this office where a polished surface will be prepared and returned to the sender along with a report of its possible usefulness and value.

#### Other Services

All offices of the Territorial Department of Mines welcome visits and inquiries. Files are kept that may be helpful in locating purchasers for various minerals or in suggesting local utilization. A library of U. S. Geological Survey bulletins, other Alaskan reports, and maps are available for study by anyone interested. Display collections of minerals also are accessible for study.

## THE ELEMENTS

Although some 86 elements are known to exist, 21 of them are of no present practical value. The remaining 65, from the familiar aluminum, copper or gold, to the less well known zirconium, are all more or less important to industry and civilization as we know it today. Inclusion of this section, briefly discussing these 65 elements, is intended to give a more comprehensive understanding of the value and importance attached to the less familiar elements.

### ALUMINUM

Aluminum will undoubtedly continue to play an important role in all types of industry. New uses and new alloys have been developed and are constantly being improved upon. Increased production and technological advances of recent years will likely lower its price. As a result aluminum ores, to be of commercial importance, must be favorably located, of good grade, and exist in almost unlimited quantity. Commercial extraction of aluminum from other more abundant sources, portends little hope for ores of aluminum in Alaska. Aluminum minerals, used for purposes other than extraction of the metal, may hold promise, however.

Aluminum is the most abundant metal, constituting about eight per cent of the earth's crust. It is a constituent of nearly all rocks but never occurs native. It is found chiefly in silicates such as feldspars, clays, micas, etc., but also as the oxide, CORUNDUM; the hydroxide, BAUXITE; as fluoride in CRYOLITE; and in various sulphates and phosphates. The gem stones RUBY, GARNET, SAPPHIRE, TOPAZ, TURQUOISE, and TOURMALINE are all aluminum minerals. The chief commercial sources of aluminum are BAUXITE, and CLAY.

Aluminum metal and its alloys are chiefly used as structural material in aircraft and other articles of commerce. As an electrical conductor it competes with copper and there are many other varied uses.

At present the metal in ingot form has a value of fifteen cents per pound.

### ANTIMONY

Prior to the war most of the antimony used in the United States was produced as a by-product of lead smelting. Imported Chinese ore made up most of the balance. Pressure of war needs encouraged production of ores in the United States proper and in Alaska. However, normal demands are not particularly great. Profitable production of antimony ore in Alaska, therefore, is questionable. Antimony minerals are commonly associated with ores of gold and other metals.

Metallic antimony is rarely found native. Usually it occurs as the sulphide, STIBNITE; also in various antimonides, and sulphantimonides of the heavy metals, and as secondary oxides.

Metallic antimony is used in various alloys for the manufacture of storage battery plates, type metals, bearing and anti-friction metals and chemicals. It has a value of fifteen cents a pound.

### ARGON

A gaseous element of limited use, argon is commercially recovered from the atmosphere. It constitutes about 0.94 per cent by volume of the air and is also found in volcanic and other natural gases, and in a few minerals. No compounds of argon are known. It is used for filling of incandescent light bulbs and fluorescent tubing.

### ARSENIC

As in the case of antimony, most of the arsenic produced comes as a by-product of domestic smelters. Ores of arsenic offer little encouragement in Alaska for any realization on the arsenic content. Attention should, however, be paid to ores containing arsenic minerals, especially ARSENOPIRITE, as they are frequently associated with gold and other metals.

Arsenic is occasionally found native in limited amounts. Usually it is combined with the heavy metals in the form of arsenides and sulpharsenides. Many such minerals are known.

Very little use is made of metallic arsenic, most industrial usage depending upon the oxide, which is used in insecticides, weed killers, and various chemicals.

The metal is valued at about fifty cents a pound.

### BARIUM

The element barium never occurs native and has very little use in its metallic form. The chief minerals of barium are BARITE and WITHERITE, both of which are utilized for their own particular properties rather than for their barium content. Minor amounts of the metal find some use in radio tubes and, when alloyed, in ignition systems. To be of commercial importance in Alaska a deposit of barite would have to be large, high-grade, and easily accessible to transportation as it is low in price. Witherite (barium carbonate) brings a higher price and might be of economic value under less favorable conditions.

### BERYLLIUM

The beryllium industry is one of the most promising infant industries. Even before the present war the advantages of beryllium and its alloys were deemed of great importance and the future of the metal seems assured. Any important source of beryllium ore in the Territory would command attention. The price of BERYL, the mineral from which the metal is recovered, is sufficiently high to warrant Alaskan interest even at the present time.

This element is chemically related to aluminum and magnesium. Like them, its importance lies in its application to the light metals industry. Seldom used alone it is generally alloyed with copper, aluminum, nickel, iron or silver. With copper it is used in manufacturing special springs and similar small parts in scientific instruments and business machines; also in making "non-sparking" safety tools. Alloying with aluminum produces a metal, lighter than aluminum, having the tensile strength of good steel, and comparatively non-corrosive.

Many factors govern the present price of beryllium metal, and very likely the price will be substantially reduced as greater supplies of ore are discovered. Most of the metal is produced as a four per cent alloy with copper, selling for fifteen dollars per

pound of contained beryllium. Beryllium metal itself costs about \$46.00 per pound.

## BISMUTH

Like antimony and arsenic, bismuth is commercially produced as a by-product of smelters and refineries. Demand for the metal is good but there is little likelihood of profitable exploitation of ores for their bismuth content alone since by-product recovery will probably continue to supply all demands. The association with other metals of value is, however, important.

Bismuth is frequently found in the native state in placer operations, but more frequently it occurs as a sulphide, and occasionally as a telluride, with gold, silver, copper, lead and zinc. It also is found with ores of tin, tungsten and molybdenum.

Bismuth is principally used, in alloys, for bearing and anti-friction metals, also in easily fusible alloys such as safety plugs for boilers, fire-sprinkler systems and other special uses.

Market value of the metal, in ton lots, is \$1.25 per pound.

## BORON

While the demand for certain minerals of boron is appreciable, the non-metallic element itself is difficultly prepared and finds little, if any, use. Existing deposits are capable of supplying, at low cost, all world demands for the boron minerals.

## BROMINE

Bromine is important in modern industry but of little interest in this discussion since commercial recovery is largely obtained from sea water. It is used in the production of tetra-ethyl lead for the gasoline industry, also in chemicals and medicinals.

## CADMIUM

A relatively rare metal found almost entirely in association with zinc ores from which it is recovered as a by-product, cadmium is chiefly used in corrosion-resisting plating of iron; also in alloys for bearings, etc., and in chemicals and pigments.

## CALCIUM

Metallic calcium is being more widely used in modern industry, yet the greatest attention will continue to be focused upon the important calcium minerals which are used in enormous quantities due to their own properties and uses. (see LIMESTONE and GYPSUM).

Recent advances in the metals industries have developed uses for calcium metal in various of the light weight alloys.

## CARBON

Carbon is a non-metallic element occurring as a constituent of coal, petroleum, asphalt, carbonate minerals and all organic matter. Native carbon occurs as the minerals DIAMOND and GRAPHITE.

CERIUM (see Rare Earth Elements)

CESIUM (Caesium)

The limited supply of cesium minerals has retarded commercial development of the metal. The unusual properties of this element and its compounds would very likely find more extensive application if adequate supplies were available.

The metal and its alloys are highly prized in photo-electric cells, finding application in sound movies, television, and elsewhere. Considerable is used in the preparation of radio tubes.

The minerals POLLUCITE and LEPIDOLITE are possible commercial sources of cesium. Little information is available regarding present prices; several years ago the metal sold for \$10.00 per gram.

## CHLORINE

Many and varied uses exist for this gaseous element but commercial production is derived from various industrial processes. No mineral is mined expressly for the recovery of chlorine.

It is ordinarily compressed from a gaseous to a liquid state and marketed in steel cylinders for use in (1) water purification,

(2) disinfectants, (3) preparation of chemicals, (4) bleaching agent.

## CHROMIUM

Extensive use in modern industry is found both for the metal and for the ore. Known Alaskan deposits have been developed under the impetus of wartime requirements and continued or at least future production may be possible if development of the west coast steel industry continues.

CHROMITE is the ore from which the metal is recovered. The metal is one of the principal elements used in the manufacture of alloy steel, especially stainless steels. The metal is valued at 80 to 90 cents per pound.

## COBALT

Cobalt is another metal whose uses are constantly expanding. Any Alaskan occurrences of cobalt-bearing ores should command attention, not only for the cobalt content, but also for the nickel, copper, silver, gold and other values with which it may be associated. LINNAEITE, SMALTITE and COBALTITE are the usual ore minerals of importance.

Alloys of steel and cobalt are used for cutting tools, drills, welding rods and other special purposes. Electroplating and ceramic coloring utilize minor amounts. The metal has a value of \$1.50 to \$2.00 per pound.

## COLUMBIUM

The element columbium is a high priced metal, which because of price and probable increased demand, warrants special attention. Present demands are based, to a great extent, upon military needs, but recent developments indicate substantial increase in peacetime consumption. It is recovered chiefly from the mineral COLUMBITE which occurs in pegmatite veins and dikes.

The manufacture of special purpose steels and electronic tubes are commercial uses. Present market price of columbium metal is \$225.00 to \$260.00 per pound.

## COPPER

Most of the important copper minerals are readily recognized by most prospectors and, as a result, considerable attention has been devoted to copper prospects in the Territory. Many favorable occurrences are known and undoubtedly more will be discovered. With further development of the Territory bringing a reduction in operational costs, copper mining should again play an important role in Alaska.

Important copper minerals are CHALCOCITE, CHALCOPYRITE, BORNITE, TETRAHEDRITE, MALACHITE, and AZURITE. Native copper is rather common and several areas in Alaska offer possibilities in this regard. Copper ores commonly contain values in gold, silver, lead, nickel, etc.

Copper is widely used in construction and apparatus where workability and resistance to corrosion are important factors. Electrical uses are many as are the uses in alloys of various types, particularly brass and bronze. Many other uses also exist.

During recent years, prior to the war, the price of copper ranged from eight to twelve cents per pound.

## FLUORINE

This element, a gas, is of little importance, yet its mineral compounds are of considerable commercial value. FLUORITE and CRYOLITE are particularly important because of their industrial applications.

## GALLIUM

The rare metallic element gallium has very limited use due to the extreme scarcity of supply and the resultant high price. What production there is comes as a by-product of zinc smelters as it occurs in zinc ores, iron ores and some aluminous minerals.

Because of its unusual properties it finds use in high temperature thermometers, optical mirrors, electron tubes and as a less poisonous substitute in filling teeth. Its value is approximately \$3.00 per gram.

## GOLD

Placer gold prospecting has been quite thorough in certain areas of Alaska; some prospecting for placers having been undertaken almost everywhere. While there may yet be new discoveries, it is felt that the future of gold mining in the Territory lies predominately in the lode mines. Particular attention should be given to complex ores containing little or no "free gold," and to large low grade deposits. The former have commonly been found and passed by because identifiable gold was not seen, or the extraction appeared too complicated. The latter have been neglected because economic conditions prohibited profitable recovery of the gold. Gold mining should increase markedly as the Territory is developed and operating costs decline.

Gold is usually easily recognized when it occurs "free" or native, in placers and rich quartz. Less easily detected is its presence in SULPHIDES, TELLURIDES, and other complex ores.

About two-thirds of the gold produced is used as a monetary medium. The remaining one-third is largely used in the arts.

## HELIUM

Inasmuch as available reserves in the States, largely government owned, will be able to supply the demand, helium is not particularly of interest in Alaska. Should natural gas be discovered in any quantity, however, the possible helium content should be ascertained. Natural gas is the chief source of helium.

It is used in inflating dirigibles, observation and meteorological balloons. Industrially it is used in diving equipment and caisson work. Electric lamp manufacture, medicine and research are other users.

## HYDROGEN

This is a common gaseous element widely used in industry. It is produced by electrolysis of water, and other means, all usually connected with some other industrial function. It is rather outside the scope of this report, but is included because it is an important element.

Uses include (1) welding, cutting, and melting of metals, (2) fixation of nitrogen, (3) hydrogenation of oils, coal tar, coal, etc., (4) formation of methyl alcohol, and countless others.

## INDIUM

This metal now has several important applications and new uses will likely be found but amounts used will be small. Most of that produced comes as a by-product of zinc refining, a source expected to supply normal demands.

It occurs in minor amount in several metallic ores mainly those of zinc and iron. Uses include plating of bearings for internal combustion engines, plating of silverware, and jewelry and dental uses. Its value is \$12.50 an ounce (Troy).

## IODINE

The world supply of this non-metallic element comes mainly from Chile where it is produced as a by-product of the nitrate industry. United States production is derived from treatment of sea-water, an unlimited source of iodine.

It is used in various chemicals, medicine and photography, and is worth about \$1.00 a pound.

## IRIDIUM

Although new uses are being found for iridium, they will consume relatively small amounts of the metal. However, it will continue to be a valuable by-product of platinum mining. (See

## PLATINUM).

In spite of the price of \$120.00 per troy ounce, it is used in surgical tools scientific apparatus, pen points, electrical equipment, jewelry, etc.

## IRON

Iron deposits in Alaska, especially those located on or near tide water are of possible commercial importance if West Coast steel operations continue to expand. Cheapness of production is a critical factor as the value of iron ore is very low. Only very large deposits will warrant operation but seemingly small occurrences should receive sufficient attention to prove their extent.

Possible constituents of iron ores such as copper, nickel, vanadium, manganese, and others should be investigated. The possibility that the iron ore is a gossan occurrence (a superficial

covering over sulphide ore bodies or veins) should likewise be investigated. Such a gossan may cover important copper or gold deposits. (See GOSSAN)

Important iron ore minerals are HEMATITE, LIMONITE and MAGNETITE. Others, useful for other reasons than extraction of the metal, are PYRITE, and PYRRHOTITE.

The uses of iron are numerous and well-known. Commercial pig iron is valued, roughly, at \$16.00 to \$18.00 per ton.

## LEAD

Numerous prospects containing lead are known in Alaska, most of them in areas where profitable exploitation is questionable or impossible at the present time. Some of these areas should receive further attention to determine their probable value, special attention being paid to other values possibly contained in the ore.

The principal ore of lead is GALENA usually containing some, often large, amounts of silver. Copper and zinc are often present and in some instances rich gold ore is found with the galena. Numerous other lead minerals of minor importance are rather common.

Lead is utilized in (1) construction work where corrosion-resistant and pliable metal is needed, (2) alloys, particularly solder, type metal, pewter, fusible alloys, (3) storage battery plates, (4) shot and bullets, (5) chemicals, etc. Prices before the war were from four to six cents per pound.

## LITHIUM

Recent technological developments indicate a wider application of this metal and increased demand. It is the lightest metal known, a fact which is of great importance in the trend to light metals and alloys.

Lithium metal is recovered from the minerals LEPIDOLITE, SPODUMENE, and others. At present the price of metallic lithium is \$15.00 per pound.

## MAGNESIUM

The production of magnesium utilizes two main raw materials, MAGNESITE and sea water. Wartime development of this

industry in the States resulted in unprecedented production from both. Future production may eventually come largely from sea water, but other possible mineral sources are also being investigated. Magnesium minerals in Alaska are not likely to be used for extraction of the metal, but several may become useful for properties of their own. BRUCITE, DOLOMITE, and TALC, as well as MAGNESITE, are a few that may find commercial outlets.

Magnesium metal has gained in importance until it now ranks along with aluminum and copper. A very light metal, like aluminum, it also is of paramount importance in light metal industry. In addition, it finds use in pyrotechnics, chemicals, etc. It is worth about twenty to thirty cents per pound.

## MANGANESE

The steel industry relies heavily on the use of manganese, yet, very little is normally produced from domestic sources, the bulk of requirements being imported. Substantial quantities of high grade manganese ore, if found in a favorable location in Alaska, might possibly be of value.

The minerals of importance are PYROLUSITE, PSILOMELANE, RHODONITE, and RHODOCHROSITE.

Manganese is used in various steel and copper alloys. It is worth about thirty-seven cents a pound.

## MERCURY

Mercury is the only metal in liquid form at ordinary temperatures. It is an important element obtained from the mineral CINNABAR, which occurs in several districts within the Territory, notably along the Kuskokwim River. Substantial quantities of mercury have been produced from this area in spite of high costs and isolated location. Under more favorable conditions, resulting from development of the Territory, there is little reason to doubt that production could be greatly expanded.

Mercury is used in (1) barometers, thermometers, pyrometers, etc., (2) mercury arc lamps, (3) mirrors, paints, drugs, chemicals, (4) boilers and electric transformers, (5) amalgamation of gold. Normally its market price ranges from \$1.00 to \$1.30 per pound.

## MOLYBDENUM

This is another metal demanded by the steel industry in appreciable amounts. Existing sources apparently are capable of supplying most of the demand, but if a large deposit of MOLYBDENITE ore could be developed in Alaska, it might be of value.

Molybdenum metal finds use in special steel alloys for cutting tools, transportation vehicle construction, bearings, etc. It has a value of \$2.50 to \$3.00 per pound.

## NEON

A rare gaseous element obtained commercially from the atmosphere, neon is the basis for the establishment of the gaseous tube lighting industry. It is especially adapted to use in beacon, airway and display lighting.

## NICKEL

The United States is almost entirely dependent upon imports for its supply of nickel ore. In view of the numerous industrial uses of this element and the quantities consumed, nickel-bearing ores, wherever found in Alaska, should receive careful investigation. The nickel content of various iron minerals is too frequently overlooked.

Minerals known to contain nickel in amounts sufficient to constitute ore are PYRRHOTITE, PENTLANDITE, GARNIERITE, NICCOLITE, and several others which usually occur finely disseminated in some ores of copper, platinum, cobalt or iron.

Nickel is used in many and various alloys, coinage, magnets, electrical equipment, etc. Its value is thirty-five cents per pound.

## NITROGEN

This gas is the predominate element in the atmosphere. It also is a constituent of organic matter and the nitrate minerals, but commercially it is largely derived from the atmosphere. Nitrate minerals are valuable in a sense somewhat apart from the consideration of elemental nitrogen, and play a vital role in the chemical industry. Commercial deposits are found only in arid regions, however.

## OSMIUM

One of the little used members of the platinum group of elements, osmium is produced as a by-product of platinum mining. (See PLATINUM).

Very minor amounts are utilized in alloys for the manufacture of pen points and fine instrument bearings. Its value is \$50.00 per ounce (Troy).

## OXYGEN

As an element oxygen is a gas occurring in a free state in the atmosphere. Combined chiefly in silicates, it is a constituent of all important rocks and many minerals. Oxygen gas is commercially produced, rather simply, from the atmosphere and marketed for a number of uses. Large quantities are used, with hydrogen or acetylene, for welding and cutting of metals. It is also employed to compensate for oxygen deficiency in high level air travel, medical purposes, etc.

## PALLADIUM

Next to platinum, palladium is the most extensively used element of the platinum group (see PLATINUM). About half as common as platinum but less costly, most palladium is derived from platinum mining. However, an important source in Alaska is a copper, gold, silver, palladium ore on Prince of Wales Island. It is also known to occur in other copper or nickel bearing ores associated with basic rocks.

It is widely used, chiefly as an alloy in (1) dentistry, (2) manufacture of watch and instrument parts, (3) jewelry, (4) electrical equipment. Its present value is \$24.00 per ounce (Troy).

## PHOSPHORUS

Elemental phosphorus has few uses, yet its compounds have many. Phosphorus is prepared commercially from certain of its minerals, but the same minerals are more important for the preparation of other compounds and chemicals used largely in fertilizers.

Phosphorus is used in relatively small amount in pyrotechnics, smoke screens, poisons, match manufacture and gas analysis.

## SILICON

Elemental silicon is little used and of no particular value. However, its numerous natural compounds include a great number of economically important minerals, some of which will eventually be developed in the Territory. Such minerals are commonly referred to as silicates, varieties of QUARTZ or SILICA.

## SELENIUM

Many and varied uses are now common for metallic selenium, but special interest is attached to the importance of one characteristic physical property, that of its change in conductivity when brought from darkness into light. Many uses are now based on this property and continued attempts are being made to develop others. It is quite probable that the demand for selenium will increase. However, because of the comparatively large quantities recoverable as a by-product from smelting and refining of sulphide ores, that source will likely continue to supply the demand.

Selenium is a metallic element somewhat akin to sulphur with which it is commonly associated. Many SULPHIDE ores, mined for values in copper, lead, silver, mercury and other metals, contain some selenium, but it is never mined for that content alone.

It is chiefly used in (1) photo-electric cells, photometry, (2) glass manufacture, (3) vulcanizing rubber, (4) insecticides, (5) fire-proofing electric cables, etc. It has a value of \$1.75 per pound.

## SILVER

Much of the discussion under "GOLD" also applies to silver inasmuch as the bulk of that metal produced in Alaska occurs as a natural alloy with the gold. Development of lode mines producing copper and lead, as well as gold, will result in a substantial increase in the silver production. Attention to the SULPHIDE ores may also result in rich silver ore being identified. ARGENTITE, and PYRARGYRITE are high grade silver minerals.

Silver is employed in coinage, silverware, silver plating and in the preparation of many chemical compounds, as well as in a number of industrial metal parts.

Silver is valued at 71 cents per ounce (Troy).

## SODIUM

Metallic sodium is obtained by electrolysis, and occurs in nature only in the form of compounds with other elements. As such it is a constituent of many minerals which are utilized for their own properties. It is largely used by the chemical industry for the manufacture of numerous sodium compounds. It is worth fifteen cents a pound.

## STRONTIUM

Strontium metal is little used, although its mineral compounds are rather widely employed. The minerals used are CELESTITE and STRONTIANITE.

## SULPHUR

Crude sulphur and PYRITE are the two sources of commercial sulphur. Both occur in Alaska and although no development has ever advanced beyond the initial stages, further exploitation of the crude sulphur deposits may yet be warranted. Where sulphur deposits are unavailable or remote, sulphur is sometimes obtained by the roasting of PYRITE or other sulphide ores.

Further industrial expansion along the Pacific Coast of the States, and establishment of the paper pulp industry in Alaska, would be two important factors affecting future exploitation of Alaskan sulphur deposits. All the sulphur now used by industries along the coast is shipped from Texas by boat, necessitating a much longer voyage than that from Alaska. Low price and limited markets prevent active interest at present.

Sulphuric acid, a very important industrial item, is made from sulphur. It is also used in paper making processes, fertilizer, plastics, insecticides, vulcanizing rubber, etc. Sulphur is sold for \$16.00 per ton.

## TANTALUM

Tantalum is a metallic element closely related to columbium with which it occurs. As is also true of columbium, new developments indicate material expansion in the useful applications of tantalum. It is a high priced metal and the production of even small quantities of the ore mineral TANTALITE would be most profitable.

The metal, extracted commercially from TANTALITE, is used in (1) the manufacture of acid-resistant laboratory utensils, surgical tools and equipment, (2) vacuum tubes and electrodes, (3) special alloys, both ferrous and non-ferrous. It is valued at about \$70.00 a pound.

### TELLURIUM

Because of the meager industrial use of the element and the fact that ample production can be maintained from the treatment of residues of copper, lead and gold smelting and refining, tellurium is of minor interest. Of greater interest is the possible association of tellurium with other ores, particularly those of gold and silver. (see TELLURIDES).

The metal is used in alloys of lead for the fabrication of pipes, coils, tanks, etc. Other alloys, with copper and various steels are employed. Minor amounts are employed in the staining of glass and china. Its value is about \$1.75 a pound.

### THALLIUM

A rare element, of which only minor quantities are consumed, thallium is produced as a by-product of smelters and sulphuric acid plants. No minerals are mined expressly for thallium, but, as a minor impurity, it occurs in pyrite, marcasite and other sulphides.

It finds use in the preparation of artificial stones, optical glass, rat poison and in corrosion-resistant lead alloys. It sells for \$12.00 a pound.

THORIUM (see Rare Earth elements)

### TIN

Small quantities of tin ore (CASSITERITE) will continue to be produced in Alaska chiefly as a by-product of placer gold operations in a few localities, but the future of Alaskan tin mining appears to depend largely on new discoveries. Special attention to finding and prospecting PEGMATITE veins and dikes is warranted for besides CASSITERITE, other important minerals and metals are likely to be found.

Although other tin minerals are known, metallic tin is commercially derived almost entirely from the smelting of CASSI-

### TERITE.

Tin is used in tin plate, solder, foil and numerous alloys. Its value is fifty-two cents a pound.

### TITANIUM

The metallic element titanium, and its compounds, are widely used in many different industries with promise of becoming even more important. Titanium minerals are numerous and quite common but must be found in considerable quantity to permit profitable mining.

It occurs only in combination, the chief minerals being ILMENITE and RUTILE. Some iron ores have a high titanium content.

In alloys, titanium is prepared and used as ferro-titanium, cupro-titanium, etc. In the steel making process it is also employed as a scavenger. Titanium compounds find a wider usage, being used in large quantities in the manufacture of enamels, rubber, plastics, welding rods and in the textile and dyeing industry; also as a pigment in paint manufacture. Titanium metal is worth about \$5.00 per pound.

### TUNGSTEN

Tungsten metal, recovered from the ore minerals SCHEELITE, WOLFRAMITE, HUBNERITE, and FERBERITE, is vitally important to the steel industry and there are other applications as well.

It is added in comparatively large quantities in the making of special steel alloys for high speed tools, metal cutting tools and dies, etc. The metal is also employed in the manufacture of electric lamp and radio tube filaments, contact points, and various chemicals. Tungsten is valued at \$2.50 to \$2.75 a pound.

### URANIUM

The main interest in uranium today centers about the scientific investigations of its possible use as a source of power. Several laboratories engaged in these studies have definitely established that one pound of uranium can be made to yield as much power as five million pounds of coal or three million gallons of gasoline.

Whether there will be any commercial application of this is extremely problematical to say the least.

What little metallic uranium there is produced today is derived chiefly from the ore minerals CARNOTITE and PITCH-BLENDE and is used in the making of chemicals and for scientific investigations.

### VANADIUM

Vanadium is an important industrial metal but because of apparent ample supplies elsewhere, any Alaskan occurrence would probably have to be extensive or associated with other profitably extractable metals before it could be of economic value.

Two vanadium ores are ROSCOELITE and VANADINITE. Most all uranium minerals contain vanadium and there are many others.

Vanadium is used as an alloy to produce steels requiring toughness such as axles, pistons, etc.

### ZINC

Much of what has been said under the headings of copper and lead applies likewise to zinc. Nearly all known zinc prospects in Alaska carry some values in other metals, usually gold, silver, lead or copper. Zinc mining alone would command little attention in Alaska unless the deposits were very large and favorably situated, but some production from deposits where the ore is mined chiefly for gold, silver, lead or copper may be profitable.

The principal ore of zinc is SPHALERITE, although SMITHSONITE, ZINCITE and WILLEMITE sometimes occur in quantity sufficient to constitute valuable ores.

Uses for zinc include galvanizing, manufacture of utensils, zinc salts and numerous alloys; also in batteries, castings, printing plates, etc. In normal times the price of zinc ranges from five to seven cents a pound.

### ZIRCONIUM

The last few years have witnessed a greatly improved demand for zirconium and even more interest is indicated. Prospecting

for ZIRCON, the ore mineral of greatest importance, should include examination of beach sands and other alluvial deposits.

The manufacture of radio tubes, welding electrodes and both ferrous and non-ferrous alloys all employ metallic zircon and new applications are being found. Present price of zirconium metal is \$7.00 per pound.

## THE MINERALS

The minerals, both metallic and non-metallic, considered in this section, constitute the raw materials required to furnish practically all of the necessities and luxuries of our daily existence. How many of these can be developed in the Territory, for both local use and export, will be a deciding factor in the growth of Alaska. Even though the prospector may be chiefly interested in gold, he will be wise to pay careful attention to these other minerals.

### ACTINOLITE

Actinolite is a type of AMPHIBOLE usually occurring as light green bladed crystals in irregular fibrous aggregates or in compact granular masses. It is a rather common mineral used to a minor extent, with tar, as a roofing material.

A particular variety known as actinolite asbestos has the characteristic white, silky, asbestos appearance and, if of good quality, may qualify for one or more of the uses of ASBESTOS minerals. (See ASBESTOS).

### AGATE

Agate is a chalcedonic or cryptocrystalline variety of quartz in which the color may be in bands, clouds or in distinct groups. It is considered a semi-precious stone and is found chiefly in stream gravels but sometimes in loose soil resulting from weathering of the rocks. Often an unattractive, dull exterior will cause one to overlook a beautiful specimen. Breaking of a specimen will likely destroy its value, but one soon learns to recognize their appearance and can save them unbroken.

Agate of good quality finds ready market with jewelers, lapidaries and collectors. Like most gem materials the value of any specimen depends upon the attractiveness or desirability of that particular piece. In general prices range from a few cents for average stones up to several dollars for choice polished pieces.

### AGATIZED WOOD

Agatized wood is petrified wood composed essentially of agate. Unlike true agate the color is usually some shade of brown. Some of the original wood structure may be visible, particularly on outer surfaces. Prices and demand may be slightly greater than those for agate.

### ALABASTER

Alabaster is a compact, fine grained translucent GYPSUM used in minor amount for sculpture and decorative objects, vases, etc. Good quality material may be worth from ten to twenty-five cents per pound.

### ALUM

The alums are soluble, crystalized, double sulphates of potassium, sodium, iron, or other elements. No deposits of importance are likely in Alaska since they occur in quantity only in arid regions.

### ALUNITE

Alunite is a hydrous sulphate of potassium and aluminum, often with some sodium. It closely resembles KAOLINITE in appearance. Generally it results from the action of acid water on feldspathic rocks. It is a source of potassium for use principally as a fertilizer. As a possible commercial ore of aluminum it is receiving some present attention.

### AMAZONSTONE

Amazonstone is a green microline FELDSPAR sometimes used as a gemstone. Found in PEGMATITE veins and dikes, in good crystals, its color strongly resembles that of JADE.

### AMBER

Amber is a brittle, translucent fossil resin of a yellowish or brownish color. It is usually found in or near lignite-bearing sandstones and, in some areas, upon sea beaches. It will float in salt water. Rubbing with a soft cloth easily electrifies amber allowing it to attract small bits of paper. From it are made objects such as beads, earrings, pipe stems, etc. By nature of its

mode of occurrence amber sometimes contains trapped liquids, insects, etc., and these examples are highly prized by collectors and museums.

### AMBLYGONITE

Amblygonite is a phosphate of lithium and aluminum with some fluorine. Its usual occurrence is as coarse white masses or aggregates; sometimes in large distinct crystals. It is found in PEGMATITES associated with other lithium minerals. Amblygonite is an important source of lithium as it contains about nine per cent lithium oxide ( $\text{Li}_2\text{O}$ ). Market quotations list a value of \$40.00 to \$50.00 per ton for material assaying eight to nine per cent.

### AMETHYST

Amethyst is a purple or violet transparent variety of quartz which owes its color to a minor amount of manganese impurity. Otherwise it is the same as common crystalline quartz. Good quality material is always in fair demand for use in jewelry.

### AMOSITE

Amosite is an amphibole ASBESTOS useful chiefly in the manufacture of heat insulating materials. (See ASBESTOS)

### AMPHIBOLE

Amphibole is a name applied to a certain group of minerals, some of which will be discussed under separate headings or under

### ASBESTOS.

See:

|               |                 |
|---------------|-----------------|
| Actinolite    | Crocidolite     |
| Anthophyllite | Nephrine (Jade) |
| Amosite       | Tremolite       |

### ANDALUSITE

Andalusite is aluminum silicate and occurs as large coarse, nearly square, prismatic crystals; also massive. It is found in metamorphic rocks such as gneisses and schists, especially near granites or pegmatites.

Used in ceramic work, mainly in the manufacture of spark plugs, it is valued according to grade, from \$20.00 to \$40.00 per ton.

Clear crystals, and a variety containing black, cross shaped inclusions, are used as gem stones. This latter variety is known as "Chiastolite."

### ANGLESITE

Anglesite, lead sulphate, is a secondary mineral formed through oxidation of GALENA, and occurring in white or pale colored crystals or masses. Ordinarily it is not an important ore of lead, but wherever found GALENA should be sought.

### ANTHOPHYLLITE

Anthophyllite is a type of AMPHIBOLE which occurs in the form commonly known as ASBESTOS. Anthophyllite asbestos has considerable value in insulating materials, plasters, wall board and paint manufacture; also used with cement or asphalt in road building. (See ASBESTOS)

### APATITE (Phosphate Rock)

Apatite is calcium phosphate. Commercial deposits are often of an impure massive type varying widely in both color and texture, thus they are often mistaken for limestone, volcanic ash or a number of other minerals. Chief use for apatite or rock phosphate is as a fertilizer, consequently it has a low unit value.

### AQUAMARINE

Aquamarine is the name given the pale greenish blue, transparent variety of BERYL. It is highly prized as a gemstone. (See BERYL)

### ARGENTITE (Silver Glance)

Argentite is a black silver sulphide containing 87 per cent silver. It is usually found in veins in small masses, or as an earthy coating, associated with other silver minerals; also galena. It is the most common and important silver mineral. (See SULPHIDES)

**ARSENOPYRITE (Mispickel)**

Arsenopyrite is a common sulphide mineral somewhat resembling pyrite except for its silver white color. Because of its usual associations it is a good indicator of possible values in gold and other metals. Any deposit containing arsenopyrite should have a sample submitted for assay.

Arsenopyrite is the chief source of arsenic but is seldom mined for that purpose alone (see ARSENIC). Except for the other values commonly found with it, it is of no value.

**ASBESTOS**

Asbestos is the popular name for several fibrous forms of serpentine and amphibole, hence the asbestos of commerce is usually typed under these two general heads. Many varieties of each exist, the important asbestos minerals being listed below. Each is elsewhere mentioned under its separate heading.

**AMPHIBOLE TYPE**

Actinolite  
Anthophyllite  
Amosite  
Crocidolite  
Tremolite

**SERPENTINE TYPE**

Chrysotile

Fibers may be separated from any asbestos by rubbing between the fingers. Characteristics and properties of this fiber give some rough idea of the grade.

All forms of asbestos are important industrial minerals, the various types often having distinct applications and uses. Alaskan occurrences should be fully explored as any sizeable deposit containing good quality material should find a ready market. Because of the exceptional Alaskan need for insulating materials, and the adaptability of some of the poorer grades of asbestos for this purpose, there would appear to be an opportunity for profitable exploitation should such deposits be developed.

High quality asbestos minerals have a value in the neighborhood of six or seven hundred dollars per ton. Poorer grades, including waste from production of high grade material, range in value from fifteen to seventy-five dollars per ton.

**ASH, VOLCANIC** (see PUMICE and PUMICITE)

**ASPHALT**

Asphalt is a black to brownish black, brittle, semi-solid mixture of hydrocarbons which will melt and burn in a match flame. It is often confused with a number of other similar hydrocarbon minerals which, like asphalt, are found in petroleum and coal bearing areas. "Asphalt rock" is a limestone or sandstone impregnated with asphalt and, from which asphalt can be extracted.

Principal local uses for asphalt would include surfacing material for roads and airports although many other uses also exist.

**AZURITE**

Azurite is a blue, hydrous copper carbonate found in the oxidized zone of copper deposits, often with MALACHITE. Good quality material is in demand by collectors, lapidaries and jewelers, although AZURMALACHITE and MALACHITE bring better prices. A dollar or so a pound, however, is not uncommon for AZURITE suitable for polishing.

**AZURMALACHITE**

Azurmalachite is an intimate mixture of AZURITE (blue) and MALACHITE (green). It is readily purchased by jewelers, lapidaries and collectors at a price of several dollars a pound.

**BALL CLAY**

Ball Clay is a high grade, white burning, plastic clay used as an ingredient in making high grade tile and whiteware. (see CLAY).

**BARITE**

Barite, barium sulphate, is also known as "heavy spar" and "barytes." It resembles calcite or limestone but is much heavier and may vary in color. It has a wide variety of uses, both in its natural state (ground or crushed) and in prepared products, but the price is relatively low. For that reason only those uses, which may have some possible future application locally, are listed here.

1. As a well-drilling mud it is used in large amounts in oil well drilling operations.

2. As a filler and surfacing material in paper manufacture. Mention should be made however of the possibilities of developing deposits having particularly favorable location with regard to shipments to the Pacific Coast States. Most barite is produced in the East, thus an opening for some Alaskan production may develop.

Barite price varies according to grade and manufacturers' specifications but may be in the neighborhood of \$7.00 to \$9.00 per long ton (2240 lbs.)

### BAUXITE

Bauxite is an earthy mineral having a high aluminum and low silica content. It often occurs in a clay-like mass showing rounded, concretionary grains; also in structureless, amorphous masses. Both types are generally of a brownish color.

Bauxite is an important source of aluminum but is also used in the manufacture of abrasives and "alumina cement." It also is employed as a slag-correcting additive in the smelting of iron. It is worth about \$7.00 to \$8.00 per ton.

### BENTONITE

Bentonite is a bedded, plastic, clay-like mineral, usually gray or white, derived from alteration of volcanic ash (Pumicite). Most varieties may be distinguished from clay by their property of absorbing large amounts of water and swelling. Some exhibit little swelling.

The chief use of bentonite is in oil refining. Quantities are also used in foundry work, laundries, paper mills and ceramics. Its value is from \$7.00 to \$10.00 per ton.

### BERYL

Beryl is a silicate of beryllium and aluminum usually found in long, green crystals, although sometimes it may be yellow, pink or white. Because of the similarity to quartz, light colored beryl may easily be overlooked.

It occurs in pegmatite veins or dikes or in nearby schists and gneisses. Occasionally large crystals weighing hundreds of pounds are produced.

As the commercial source of the metal Beryllium, which is fast becoming very important in the light metals industry, its value is about \$40.00 to \$50.00 per ton.

Besides Beryl in the sense above described, there are several varieties highly valued as gem stones—one, the EMERALD, ranking with the most precious of all gems. This, and the other gem varieties AQUAMARINE, MORGANITE and GOLDEN BERYL are discussed separately.

### BLACKJACK (see Sphalerite)

### BLACK-SAND

The term "black-sand", as considered here, includes any concentrate, natural or otherwise, resulting from the washing of alluvial material. It may or may not actually be black. Generally, it consists of magnetite, chromite, ilmenite, and many other minerals including the gold, platinum, or cassiterite for which it is worked. Many such "black-sands" also contain the sulphide minerals in varying amount; in fact they will contain all of the heavy minerals that were originally present in the alluvial material, with the exception of a few easily decomposed or altered minerals.

In treating "black-sands" from placer operations two things are important. One, to realize maximum recovery of the metals or minerals sought. Two, to make certain that the sands contain no other important values when they are discarded.

Assuming that the usual interest in "black-sand" lies in its gold content, the recovery is largely a matter of proper equipment and understanding how it should be used. That being a subject outside the scope of this paper, it cannot be gone into here, but, attention may be called to the advisability of having all such sands assayed before they are discarded. Too frequently all the "free-gold" is efficiently removed and the rest assumed to be valueless. Yet assays will show appreciable gold remaining. This is especially true of "black-sand" containing pyrite or other sulphide minerals. Assays on some discarded concentrates have shown a gold content as high as \$4,000.00 per ton. It is obvious that even though facilities at hand may not be able to recover this gold, it may be advantageous to save the sands for shipment to a smelter.

In any placer operation a representative sample of the sand should be submitted for examination and identification of the constituent minerals. Quite often the totally unsuspected presence of other valuable minerals has been discovered after years of working the ground. Identification of the minerals contained in the concentrate, while it may not reveal profitably recoverable amounts of other minerals, could conceivably furnish clues which, if properly followed, might lead to the finding of lode deposits.

Below are listed minerals which may occur in placer sands and gravels in sufficient quantity to permit profitable recovery:

|                             |                                     |
|-----------------------------|-------------------------------------|
| Platinum and related metals | Ilmenite                            |
| Gold                        | Jade                                |
| Silver                      | Magnetite                           |
| Copper                      | Monazite                            |
| Cinnabar                    | Quartz Gems (agate, amethyst, etc.) |
| Cassiterite                 | Rare Earth minerals                 |
| Chromite                    | Ruby                                |
| Chrysoberyl                 | Rutile                              |
| Columbite                   | Sapphire                            |
| Diamond                     | Tantalite                           |
| Ferberite                   | Wolframite                          |
| Garnet                      | Zircon                              |
| Hubnerite                   |                                     |

#### BLOODSTONE (Heliotrope)

Bloodstone is a variety of JASPER, usually dark green with scattered spots of red. Good quality material finds limited use as a minor gemstone.

#### BORNITE

Bornite is a sulphide of copper and iron containing about 60 per cent copper. Exposed surfaces tarnish to a purple or blue color while on a fresh fracture the mineral is normally brownish bronze. It occurs with other copper minerals and is an important ore of copper.

#### BORT (see DIAMOND)

#### BRICK CLAY

Brick clay is any clay that can be used to make bricks. Its value is largely determined by the grade of brick produced. Red

burning clays are usually preferable but not required. (also see CLAY)

#### BRUCITE

Brucite is magnesium hydroxide, a soft, easily carved, waxy, translucent mineral, usually green but sometimes white or bluish. It somewhat resembles TALC and occurs in serpentine or limestone with magnesite.

Good massive material finds some use in the carving of decorative and ornamental objects. It is also used in the making of refractories.

Recently a fibrous, asbestiform variety of brucite was found in Alaska which may possess qualities that will permit its use as an ASBESTOS.

#### BUILDING-STONE

Building-stone is a term applied to all stone used in masonry construction, ornamentation, etc. The subject would require a separate report to fully discuss it. Briefly, however, the common stones so used are GRANITE, SANDSTONE, LIMESTONE, MARBLE and serpentine. Many factors have important bearing on the value and usefulness of a building-stone, chief among these being (1) cost of preparing for market, (2) attractiveness of the finished stone, (3) durability and strength, (4) availability of a market.

Some building-stone is suited only to more or less local consumption. Stone possessing unusual beauty, or other desirable qualities, may benefit by a price sufficiently high to justify shipment to distant markets.

#### CALCITE

Calcite is calcium carbonate occurring most commonly in massive form as LIMESTONE and MARBLE, but also in transparent to translucent or opaque crystals. Although ordinarily white, it may be variously tinted.

Discussed separately under individual headings are the massive varieties LIMESTONE, MARBLE, CHALK and TRAVER-TINE. The crystal form is mentioned under ICELAND SPAR.

**CARBONADO (see DIAMOND)****CARBONATED SPRINGS**

Carbonated springs are not entirely out of place in this report inasmuch as they constitute a source of carbon dioxide. Carbonated waters, occurring in natural springs, are identified by the evolution of carbon dioxide gas and the similarity to familiar bottled "carbonated drinks." Frequently a deposit of accumulated "lime" is found around such springs.

Natural sources of carbon dioxide gas may be commercially exploited and the purified gas marketed in both solid and liquid form.

**CARNELIAN**

Carnelian is a name given to a reddish to reddish-brown **CHALCEDONY** or **AGATE**.

**CARNOTITE**

Carnotite is a uranium-vanadium mineral containing a small quantity of radium. It is canary yellow colored and usually occurs in powdery or earthy form disseminated in sandstone. A number of other minerals resemble carnotite and its identification should be left to a mineralogist. An important ore of uranium, vanadium and radium, its value depends upon the average content of those elements.

**CASSITERITE (Stream Tin)**

Cassiterite, an oxide of tin, is commercially recovered chiefly from placer deposits where it occurs in heavy, black to light brown, occasionally gray, pebbles, grains or crystals. Placer cassiterite is derived from tin-bearing veins in or near pegmatites and such rocks should receive careful attention.

As ordinarily produced placer cassiterite contains from 50 to 70 per cent metallic tin. Purchase is made, on the basis of contained tin, at 52 cents a pound. (see **BLACK-SAND**)

**CELESTITE**

Celestite, strontium sulphate, is a heavy, white to bluish, transparent to translucent mineral resembling barite. Occasionally

it is found massive, resembling limestone, but heavier. Tabular or prismatic crystals are more common. It may occur disseminated through sandstone or limestone, or in cavities in such rocks, usually associated with gypsum, calcite, sulphur, etc.

Celestite is used principally in the manufacture of chemicals. Crude ore is marketed at about \$15.00 to \$20.00 per ton; the high-grade, finely powdered mineral at \$35.00 to \$45.00 per ton.

**CEMENT ROCK**

Cement rock is any limestone, or mixture of limestone with other rock (shale, clay, etc.) suitable for the manufacture of cement. A separate report would be required to fully discuss the subject of cement and its raw materials. Although necessarily limited, it is hoped that this brief discussion will stimulate interest in a search for deposits capable of supplying the needs of a cement plant within the Territory.

At the present time only those limestone deposits favorably located with regard to transportation are of great interest. For the cheapest operation the deposit must be at or near the plant site. If a mix with clay or other rock is necessary, one raw material or the other may have to be transported to the plant. **GYPSUM** is employed in considerable quantity by cement plants, thus the finding of suitable limestone is not the only factor involved. These problems, as well as those of proximity to the ultimate market and sources of fuel, must all be considered.

Returns to the prospector for his efforts in finding useful deposits will probably come from the sale of his interests to large concerns rather than from individual operation. Only large deposits warrant attention, yet it must be borne in mind that apparently small deposits may prove large upon development. Chemical analyses are necessary to determine the usefulness of any cement raw material.

Consumption of cement in Alaska being definitely on the increase, there is no apparent reason why the needs of the Territory could not support a cement plant.

**CERRUSITE**

Cerrusite, lead carbonate, is a secondary lead mineral similar to **ANGLESITE** and the remarks under that heading also apply to cerrusite.

## CHALCEDONY

Chalcedony is a transparent or translucent, cryptocrystalline variety of quartz of which there are many variations. Some of these are listed below and will be separately discussed under those headings.

|            |        |
|------------|--------|
| Agate      | Flint  |
| Bloodstone | Jasper |
| Carnelian  |        |

## CHALCOCITE

Chalcocite contains 80 per cent copper and is a dark, lead-gray mineral tarnishing black or green. Found in the enriched sulphide zone of copper deposits, with other copper minerals, it is an important ore of copper.

## CHALK (Whiting)

Chalk is a soft, white, fine-grained limestone, composed of the calcareous remains of minute marine organisms and shells. A variety of uses exist, the largest quantities being used by the following industries.

1. Abrasive (fine polishing)
2. Rubber (used as filler)
3. Paint (calcimine and cold water paint)
4. Paper (coating glazed paper)
5. Ceramics and enamel-ware
6. Others

## CHROMITE (Chrome-iron ore)

Chromite is the only commercial ore of chromium. It is hard, black and heavy and occurs in serpentine or peridotite, usually with magnetite. It is frequently mistaken for any of several iron minerals. Areas in which chromite occurs are favorable areas to prospect for nickel ores, platinum and asbestos.

Chromite is used in large quantity in the metallurgical, refractory and chemical industries and has a value of \$25.00 to \$40.00 per ton depending on the grade.

## CHRYSOBERYL

Chrysoberyl is a beryllium and aluminum mineral found in crystals in pegmatite or mica schist, or as crystals and crystal

fragments in alluvial deposits derived from such rocks. The mineral is very hard and usually colored various shades of green, although yellow to brown tints also occur. Good stones are of considerable value as gems. (see BLACK-SANDS).

## CHRYSOTILE

Chrysotile is fibrous serpentine or serpentine ASBESTOS, although the fiber is ordinarily from  $\frac{1}{4}$  inch to an inch or so in length, longer fiber up to a foot or more is occasionally found.

Chrysotile brings the highest market price of all asbestos minerals, ranging from several hundred dollars per ton downward to about \$20.00 per ton as the quality and length of fiber decreases. Following are listed some of its uses.

1. Asbestos cloth, yarn, etc.
2. Brake linings, clutch facings
3. Insulating and building materials
4. Pipe covering and special cements

## CINNABAR

Cinnabar, mercury sulphide, is the commercial ore of mercury and is found in a wide variety of rocks. The color will rarely vary from a characteristic crimson or reddish-brown, particularly if a crushed particle is examined. Although sometimes confused with iron ochre, red jasper, and other minerals, cinnabar may be panned like gold, when the distinctive color will be apparent. It is sometimes found in placer deposits indicating proximity to the lode source.

Cinnabar is not ordinarily shipped but is treated, and the mercury recovered, at the mine. Mercury is generally worth from \$1.00 to \$1.30 per pound. Pure cinnabar contains 86 per cent metal.

## CITRINE

Citrine is yellow transparent quartz valuable as a gem stone when obtainable in crystals or pieces suitable for cutting.

## CLAY

The subject of clays is too large to cover satisfactorily in a report of this nature. A list of the various types of clays follows

and some idea of the uses may be obtained from the names. A few will be separately mentioned elsewhere.

- |                   |                      |
|-------------------|----------------------|
| 1. BALL CLAY      | 7. Pottery Clay      |
| 2. BRICK CLAY     | 8. Paving Brick Clay |
| 3. FIRE CLAY      | 9. Sewer Pipe Clay   |
| 4. Fuller's Earth | 10. Stoneware Clay   |
| 5. Paint Clay     | 11. Terracotta Clay  |
| 6. PAPER CLAY     |                      |

Clays vary widely in their chemical and physical properties as well as in their applications to industry. Generally they are of value only when they occur very near the market which is to utilize the final product. This is particularly true of those employed in the manufacture of low unit value commodities which cannot profitably be transported long distances. Building brick and paving brick are examples. Certain high quality clays, usually white firing, which are found by some industries to be indispensable and difficult to obtain, are sometimes shipped considerable distances.

Analyses and manufacturers' specifications determine the usefulness and value of any clay.

## COAL

The abundant coal deposits of Alaska are destined to become the subject of greater interest. The major coal-bearing areas, the existence of which have long been known, include lignite, bituminous and anthracite types. Apparently most abundant is the lignite which is considered, by American standards, to be a poor grade of coal for most industrial uses. Alaskan reserves of high grade coals, including coking coal which is indispensable to the iron and steel industry, are among the largest on the West Coast. All are capable of being put to good use.

The common uses of coal are for household heating and as a source of power in generating electricity. On a larger scale certain high grade coals are burned in "coking ovens" to produce coke for metallurgical use. By-products of these plants include gas, ammonia, tar, creosote, and numerous other products which in turn are used in the preparation of hundreds of essential commodities.

## COBALTITE (see SULPHIDES)

Cobaltite contains cobalt, arsenic, and sulphur and is similar to arsenopyrite in appearance. Ordinarily it occurs in small quan-

tity associated with pyrite, arsenopyrite, and other sulphide minerals, in metalliferous veins, notably those containing silver, copper or nickel. Surface exposures of cobalt-bearing veins often show an earthy incrustation of "cobalt-bloom," light crimson to pink in color.

Cobaltite is an important source of cobalt metal. Value of the ore is about \$1.00 to \$1.25 per pound of cobalt contained.

## COLUMBITE and TANTALITE

Columbite and tantalite are two distinct minerals containing the metals columbium and tantalum. Since they usually vary in composition, one grading into the other, they are discussed together here. It will suffice, therefore, to assume that columbite contains more columbium than tantalum while, in tantalite, the tantalum predominates.

Both minerals occur in some pegmatites and may be found in placer sands of the area. Both are heavy, hard, black minerals easily confused with wolframite and several other minerals with which they may occur. Areas known to contain pegmatite dikes and veins should be carefully prospected for the possible occurrence of columbite and tantalite as well as for other valuable minerals known to occur in such rocks. Any heavy, black concentrate, not responding to a magnet, should be submitted for identification.

Columbite and tantalite are the chief sources of the metals columbium and tantalum for which there is an increasing demand, especially by the steel and metals industries. Tantalite is particularly in demand, a concentrate assaying 60 per cent tantalum oxide ( $Ta_2O_5$ ) bringing \$2,000.000 to \$3,000.00 per ton depending upon impurities. The price of columbite concentrate is about half of that.

## CORUNDUM and EMERY

Corundum is an oxide of aluminum. The transparent crystalline varieties are the precious gemstones RUBY and SAPPHIRE, while the opaque granular corundum, accompanied by impurities of hematite or magnetite, is known as "EMERY".

Corundum ranks next to diamond in hardness and is found in barrel-shaped crystals and compact masses in a rather wide assortment of rocks; also in placer deposits in the form of crystals and grains.

Clean corundum and the impure mixture, "EMERY" are both important abrasives. The former is worth from 8 to 70 cents a pound according to grade size acquired by milling treatment. "Crude emery" is worth about \$10.00 a ton but after proper milling and classification the resultant "grain emery" brings 5 to 7 cents a pound.

### COVELLITE

Covellite is a sulphide of copper containing 66 per cent copper. Found in the enriched sulphide zone of copper deposits it usually occurs massive, with other copper minerals. It is indigo-blue in color, turning purple when moistened.

### CROCIDOLITE

Crocidolite is a fibrous amphibole, commonly of bluish color, from whence it derives its other name "blue asbestos." It is not widely found but because of the high tensile strength of its fibers and its resistance to chemical action, it is a valuable type of ASBESTOS. Depending upon the length of fiber and other factors, the value of crocidolite is from \$100.00 to \$400.00 per ton. (see ASBESTOS)

### CRYOLITE

Cryolite, composed of sodium, aluminum and fluorine, is found in compact masses, rarely crystalline. It is colorless or white and may be mistaken for quartz or a number of similar appearing minerals. Although it is somewhat heavier than quartz the difference may not be sufficient to attract attention.

Cryolite is found associated with fluorite, pyrite, galena, sphalerite and the pegmatite minerals. Its chief use is in aluminum production but there are various other uses including the manufacture of enamels, glass, abrasives, etc. Clean cryolite is worth from \$70.00 to \$80.00 per ton.

### DIAMOND

Diamond is a pure form of carbon and is the hardest mineral known. When clear and colorless, or only slightly tinted, it is highly valued as a gemstone. An opaque, black or brown variety of diamond, occurring in small, irregular, rounded nodules is termed "carbonado" or "black diamond." Another form, dark colored,

translucent to opaque, poorly crystallized and found in crystals or fragments, is known as "bort" or "bortz".

The various forms are ordinarily first found in placer deposits from which search is usually made for the parent rock. Diamond originates in certain peridotite rocks where it occurs sparsely disseminated. Commercial recovery is most favorable in stream sands and gravels and in the clay and soil derived from alteration of the diamond-bearing peridotite.

Finding of gem diamond may be no more spectacular or interesting than finding a small well worn piece of glass, consequently attention should be paid to any find of this nature.

There is, of course, no need to explain the value or uses of gem diamond. The other varieties, carbonado and bort, are highly important industrial abrasives in great demand for diamond-drill bits, diamond saws, and various machine tools.

Prices of both of these materials are high. They are sold by the carat (140 carats equal 1 ounce).

### DIATOMITE (Diatomaceous Earth)

Diatomite is composed of the siliceous remains of microscopic water organisms known as diatoms. It is about 90 per cent silica but strongly resembles chalk in that it is white, earthy, fine-grained and very light. Dry pieces will float on water until they become saturated and sink.

Deposits of diatomite occur in beds, varying in thickness up to hundreds of feet.

Its uses are many and the important ones are listed here.

1. Insulation (sound and heat)
2. Abrasive (fine polishing)
3. Filter or absorbent
4. Filler (in manufacture of numerous products)

Value of diatomite varies from \$7.00 per ton for the crude material, to \$40.00 per ton for the highest grade product after milling. Specially prepared diatomite for special purposes may bring substantially higher prices.

### DOLOMITE

Dolomite is the carbonate of magnesium and calcium, and except for the magnesium content is essentially the same as lime-

stone. Its manner of occurrence is like that of limestone, in fact most such deposits contain both. Deposits of commercial importance are large and must be favorably situated with regard to plant location, market and transportation, since all manufactured products are relatively low priced commodities.

Dolomite is often used interchangeably, depending upon the particular purpose, with limestone. Following are the important applications of dolomite. (see LIMESTONE also)

1. Lime manufacture
2. Agricultural limestone
3. Building and ornamental stone
4. Road building
5. Metallurgical flux and refractory
6. Source of magnesium metal

Some paper mills utilize dolomite in preparing bisulphite acid.

## ELECTRUM

Electrum is a natural alloy of gold and silver containing 25 to 40 per cent silver. It may be distinguished from the ordinary gold nugget by its pale yellowish white color. Its occurrence is the same as for ordinary gold.

## EMERALD

Emerald is a bright, emerald green variety of BERYL. Yet, unlike the other varieties of BERYL, it is not exclusively found in the pegmatites. Most emerald has been found disseminated through a dark metamorphosed limestone, or in schist. Good quality emerald is rare, consequently it about equals the diamond in value.

Emerald may be found in gravel deposits but since its weight is about that of quartz, it cannot be separated by gravity concentration.

## ERYTHRITE (cobalt bloom)

Erythrite is a hydrous arsenate of cobalt, a rare secondary mineral, which is only of importance as an indicator of cobalt mineralization. It is an earthy, incrusting mineral, of a pinkish color and may be found on surface exposures of cobalt bearing veins.

## FELDSPAR

Feldspar is the name applied to a group of minerals comprising (1) potassium aluminum silicates and (2) calcium and sodium aluminum silicates. These are referred to respectively as orthoclase and plagioclase feldspars. Feldspars are familiar to all as the predominate light colored mineral (other than quartz) in granite rocks. They may vary in color from white to brownish to pink and sometimes light shades of green, yellow or blue. They are about as heavy as quartz but may be distinguished from that mineral by cleavage properties, crystal form, and by other means.

Emphasizing again the importance of pegmatites as a prolific source of minerals, commercial feldspar deposits are found only in such rocks, the feldspar minerals occurring in large crystals.

The ceramic industry, making whiteware bodies, glazes and enamels, utilizes the greatest portion of all feldspar produced. Other uses include roofing and cement surfacing, scouring soaps, abrasives, etc.

Milled, ground feldspar is valued at \$10.00 to \$20.00 per ton according to type and fineness of grind.

Only the orthoclase feldspars are of industrial importance. However, various of the feldspar minerals if of good quality, find use as minor gemstones.

## FERBERITE

Ferberite, composed of iron and tungsten, is a black to brownish-black, heavy, metallic looking mineral, easily mistaken for a number of other minerals. It is an important tungsten ore related to WOLFRAMITE and HUBNERITE. Like these, it is found in granite and pegmatite rocks.

## FIRECLAY

Fireclays are those clays capable of withstanding high temperatures without material change. Sufficient plasticity for shaping must be obtained, but since many fireclays are non-plastic, this is often accomplished by additions of suitable, more plastic clays. Fireclays are transported clays (deposited in water) as distinguished from residual clays (from rock decomposition in place). They are often found in coal measures.

Fireclays are used in the manufacture of heat resisting ware such as firebrick, furnace linings and crucibles, and may also be used for tile, paving bricks, etc. Like most other clays, commercial deposits should be close to the plant and transportation. (see CLAY)

## FLINT

Flint is a cryptocrystalline variety of quartz which is dense, fine grained, very tough and breaks with conchoidal fracture. It is found as nodules or concretions, often with a white chalk coating, in limestone or chalk beds. Colors are gray to brown to black.

Flint pebbles are used in grinding mills, bringing roughly, \$10.00 per ton. Ground flint is much used as an abrasive and other minor uses exist. The United States is dependent upon import for its supply of flint pebbles.

## FLUORITE (Fluorspar)

Fluorite is composed of calcium fluoride and is a purple, green or white glassy mineral, found in lead, zinc, and tin deposits, commonly associated with limestone. It occurs crystalline in the form of cubes, or massive somewhat resembling a colored quartz, although it is softer. It often constitutes a large portion of the gangue in mineralized veins.

Fluorite is a very important industrial mineral finding its greatest use in the steel, acid making, glass and enamel industries. It is valued, according to grade, from \$20.00 to \$35.00 per ton.

Because of the ease with which it may be worked and the beauty of the finished article, good material is often in demand by lapidaries and collectors. It is too soft for gem use but is formed into objects of decorative value.

## FRANKLINITE

Franklinite contains zinc, iron, and manganese. A black mineral resembling magnetite, it is invariably associated with two other zinc minerals, WILLEMITE and ZINCITE. These ore bodies are usually in limestone.

## GALENA

Galena, lead sulphide, is readily recognized by all prospectors as a bright, lead-gray, brittle, metallic mineral, breaking into cubes or sharp, right angles. It may occur massive and very fine grained, however, this type commonly containing high silver values. Galena is accompanied by other minerals, notably silver, gold, zinc and copper. Alone it constitutes the most important lead ore.

## GARNET

Garnet is the name applied to a group of related silicate minerals including some commercially useful species. Considered as a group, garnets are usually found as characteristic crystals in rock, or as somewhat worn, rounded crystals in stream gravels. They are very hard and brittle and may be found in most any color, although the deep red, pink, brown and black colors are most common. Garnets are found in a wide variety of the metamorphic rocks, notably gneiss, schist and crystalline limestone.

Most of the garnet produced is used as an abrasive, mainly in the manufacture of abrasive paper and cloth for the wood-working industry. Another possible application would be for surfacing and polishing of marble and other building and ornamental stones.

Abrasive garnet is worth from \$35.00 to \$100.00 per ton depending upon grade and grain size.

Certain attractively colored garnet is of some value as a gemstone, especially if found in large, flawless crystals.

## GARNIERITE

Garnierite is a hydrous nickel-magnesium silicate, greenish in color, often appearing to be merely a green stain. It is associated, as a rule, with serpentine and chromite. Although it is an important nickel mineral, the nickel content is rather low and treatment expensive, so only large deposits are of great value.

## GEMS

The possibilities of precious and semi-precious gem stones in Alaska have received little or no attention. As a result practically no occurrences are known, yet they unquestionably do exist. By discussing them in this report, it is hoped that interest will be created and the value of searching for them recognized. The

prospector, who is wise enough to pause in his search for gold and spend time uncovering agatized wood or picking colored crystals from an outcrop, may be rewarded with a deposit upon which he can depend for a grubstake at any time. A ready market exists, with good prices, for hundreds of different stones, crystals and mineral specimens.

Prices ranging from a few cents to many dollars, depending on the individual specimens, are paid by collectors, jewelers, lapidaries and dealers for good display specimens of any mineral. Crystal aggregates, and other unusual forms encountered in lode mining, contain only a few cents worth of the metal for which the ore is mined, yet the value as a specimen may be several dollars.

Various of the gem minerals are found in placer deposits, a fact which should not be overlooked by operators. A substantial percentage of the profits of some gold dredges, and smaller operators, is derived from the by-product recovery of gem stones.

## GEODE

A geode is a nodule or spherical mass, of variable size, usually possessing a dull or unattractive exterior and an interior lined with agate or crystals. Only by breaking these open can any idea be had of the nature of the interior, and to do so invariably ruins the specimen. Once identified, others in the vicinity should be collected unbroken thus preserving their intrinsic value until they can be sawed in half.

Rhyolites, light colored lava rocks, and the surface soils and stream gravels nearby, are the usual source of agate filled geodes.

Values vary from a few cents for common specimens to as much as a hundred dollars or more for choice polished pieces.

## GILSONITE

Gilsonite is a natural hydrocarbon resembling asphalt or coal found filling veins in sedimentary rocks near coal and oil bearing formations. The manufacture of varnishes and inks are the principal uses although there are many minor demands.

Gilsonite is marketed at \$20.00 to \$30.00 per ton.

## GLAUCONITE (Greensand)

Glauconite is a hydrous silicate of iron and potassium, occurring in deposits, derived from marine sediments, and associated with sands and clays. It is a soft, green rock.

It finds two chief uses (1) a fertilizer (2) a water softener. The marketable product, after washing and screening sells for about \$25.00 per ton.

## GOLDEN BERYL

Golden beryl is a form of BERYL occurring in beautiful golden or yellow crystals. It is highly prized as a gem stone.

## GOSSAN (Iron Hat)

Gossan is not a mineral but it will be discussed here briefly for it bears an important relation to certain mineral occurrences, particularly those of copper and gold. Gossan, a term applied to deposits of LIMONITE, with other iron oxides, is derived from the oxidation and leaching of ore bodies containing heavy sulphide mineralization. Often this capping will show no values other than iron, but whenever such an occurrence is discovered it should be thoroughly prospected to determine the nature and value of the underlying ore body. If it is a true gossan there will be found beneath it a sulphide ore body possibly containing gold or copper or both. If appreciable gold is present in the vein it is probable that free gold can be panned from the gossan capping. Copper, however, may be entirely lacking at the surface, even though the vein is rich. A gossan capping may be any depth up to a hundred or more feet. Large deposits would be of potential importance as iron ore.

## GRANITE

Granite is a common rock, considered here for its possible importance as a building stone. (Attention may also be called to the fact that areas containing granite rocks are favorable districts in which to prospect for gold and other minerals.) To be of commercial value as a building stone, a granite must possess good color and be capable of taking a high polish. Just as important, it must possess certain physical properties which permit cheap quarrying and shaping and give durability to the stone.

The term, as used here, includes other granite type rocks such as diorite, monzonite, etc. (see BUILDING STONE)

### GRAPHITE

Graphite is a form of carbon easily recognized as a soft, black, greasy feeling mineral. MOLYBDENITE and graphite are quite similar in appearance but a person familiar with both should have no difficulty in distinguishing between them. Graphite is a common mineral found widely in non-commercial amounts. Commercial deposits contain massive graphite in veins, or flakes disseminated throughout the schist, gneiss or other country rock.

Many industrial uses are known for graphite. The most important include the making of pencils, crucibles, lubricants, paint, commutator brushes, etc. Two commercial forms of graphite are mined and there are several grades of each. Depending upon the form and grade, prices per ton range from \$10.00 to \$200.00. Samples should be taken from any substantial occurrence and submitted for determination of its type and possibilities.

### GYPSPUM

Gypsum, hydrous calcium sulphate, is a white to slightly bluish-white, soft, mineral resembling calcite or limestone. Commercial deposits occur in massive form, interbedded with sedimentary rocks, commonly with or near limestone.

Large quantities are used by the paper and cement industries, and in the manufacture of plasters, wall board, insulating board, and other building materials. From these uses it should be apparent that gypsum deposits, favorably situated, will be important factors in establishing local industry and reducing building material costs in Alaska.

### HEMATITE

Hematite, an iron oxide, contains about 70 per cent iron. It is a common mineral of no value unless it occurs in enormous quantity. Large deposits constitute the most important source of iron ore.

In these deposits the mineral may be of two descriptions (1) soft, earthy and reddish-brown (2) hard, heavy, bluish to brownish black, or reddish brown. The earthy variety, also called red ocher,

is sometimes used as a pigment in paints, etc. The value of hematite as an iron ore is about \$2.00 to \$3.00 per ton.

Black hematite in good crystals or hard, compact masses, is always in demand by jewelers and dealers in gem materials.

### HIDDENITE

Hiddenite is a yellow-green to emerald green, transparent variety of SPODUMENE, valuable as a gemstone. (see SPODUMENE)

### HONESTONE (Whetstone, Oilstone)

Honestone is a term applied to certain natural stones or rocks, whose properties adapt them to use as specialized abrasives. Such stones ordinarily are made from a fine to medium grained sandstone, or an exceptionally fine-grained crystalline quartzose rock. Other types of rocks also may yield satisfactory results.

### HUBNERITE

Hubnerite is composed of manganese and tungsten and resembles both WOLFRAMITE and FERBERITE except that its color is dark reddish brown. All three are found in or near granites or pegmatites and are ores of tungsten.

### ICELAND SPAR

Iceland Spar is pure crystallized calcium carbonate, calcite. Ordinary calcite is common and well-known, but Iceland Spar in clear crystals, free of flaws, is relatively scarce. Accordingly it is in fair demand at high prices.

Good quality crystals are marketed by the pound, bringing from \$2.00 to \$30.00 per pound. They are used to manufacture prisms for optical instruments.

Should such crystals be discovered in Alaska, representative crystals or crystal groups, should be carefully packed and submitted for examination to determine if they qualify as optical grade material. Since they lose their value if flawed or broken, it is recommended that they be extracted and handled with as much care as possible.

**ILMENITE**

Ilmenite, an oxide of iron and titanium is rather common, especially as an accessory mineral in placer concentrates. It is found as iron-black, shiny, metallic-appearing grains or masses; often in thin platy crystals. The rocks in which it occurs are chiefly metamorphic and igneous.

It is of no value unless recoverable in large quantities and then it must contain a high percentage of titanium. The concentrate is then worth about \$25.00 per ton.

Its chief use is as a source of titanium.

**JADE and JADEITE**

Jade, as generally considered, includes two minerals, nephrite and jadeite, which are enough alike to defy making any distinction between them outside of the laboratory. Both are used only as gem material so will be discussed here as one mineral.

Jade is a tough, compact, hard, translucent to opaque mineral. Ordinarily it is some shade of green and it is this material that is most used in jewelry, and ornamental figures. Occasionally white or pale colored jade is found. This is not usually regarded as highly as the green.

Areas of serpentine rocks are the most usual source of jade and the best material is often found in the form of large and small boulders in the nearby stream gravels. Only by actual cutting and polishing of sections of the rough material can its true beauty and value be determined.

Selected quality jade may be sold for several dollars per pound to jewelers, lapidaries, collectors and dealers.

**JASPER**

Jasper is an impure cryptocrystalline quartz, usually red but occasionally yellow, brown, dark green or grayish blue. The color is due to impurities of iron, more or less associated hematite, commonly being visible in the surrounding rocks.

Common jasper is widespread and consequently less in demand, but with it may occur material of excellent quality suitable for use in jewelry or specimen polishing. Such material may bring from a few cents to a dollar or more per pound.

**JET**

Jet is a dense, black, lignite coal capable of taking a high polish, and therefore fitted for use in certain forms of jewelry.

**KAOLIN (China Clay)**

Kaolin is a high grade, white firing clay, suitable for use in the manufacture of porcelain, whiteware, etc. Residual kaolins possess low plasticity while secondary kaolins are somewhat more plastic. Both types are used in large amounts, the former being especially desired for highest quality wares.

In addition to the above mentioned uses, large quantities are utilized in the manufacture of paper and there are numerous other industrial uses.

Careful attention to suitable clay deposits situated near transportation routes appears especially warranted. Good china clay has a value of from \$7.00 to \$9.00 per ton. Washed and processed material, suited to special uses, may bring as high as \$15.00 to \$20.00 per ton.

Because of the impossibility of properly grading a clay outside of the laboratory, samples should be sent to one of the Department laboratories for a report on the type and possible uses.

**KUNZITE**

Kunzite is a delicate pink to lilac colored, transparent variety of spodumene, valuable as a gemstone. (see SPODUMENE)

**KYANITE (CYANITE)**

Kyanite, an aluminium silicate, is a brittle, translucent to transparent mineral usually some shade of blue, but occasionally white, grayish, or greenish. It is found in crystals, or in masses of long, bladed, intergrown crystals. Characteristically the hardness varies with the orientation of the crystal; a knife point will scratch along the length of the bladed mineral but will not scratch across it.

Kyanite occurs in metamorphic rocks such as schists and gneisses, and is mined for use as a refractory material in the manufacture of spark plugs, enamel ware, glass, etc. Crude kyanite is worth \$15.00 to \$20.00 per ton while ground, special grade material brings up to \$40.00 per ton.

**LAPIS-LAZULI and LAZURITE**

Lapis-lazuli is a rock containing several minerals among which LAZURITE predominates, giving the stone its value. LAZURITE is a hard, opaque to translucent mineral, with deep blue or blue-green color. Its composition is complex, its only value being as a decorative or ornamental semi-precious stone. It is found in crystalline limestone, resulting from contact metamorphism.

Depending on its quality it may bring up to several dollars per pound.

Lazulite, an entirely different mineral, strongly resembles Lazurite. Inasmuch as the uses and values of both are the same, no further distinction between them is necessary here.

**LEPIDOLITE (Lithia Mica)**

Lepidolite is readily recognized as a mica, the particular type being identified by the pink to lilac color. Containing 4 to 6 per cent lithium oxide ( $Li_2O$ ), it is mined as an ore of lithium bringing \$20.00 to \$25.00 per ton. Some lepidolite may also contain sufficient CESIUM to constitute an ore of that element.

Pegmatite veins and dikes are the main source of lepidolite.

**LIMESTONE**

Limestone is a sedimentary rock, chiefly calcium carbonate (CALCITE), but containing variable amounts of magnesium carbonate. It occurs commercially in massive deposits which vary rather widely in the nature and amount of impurities contained. Thus for whatever use the rock is intended, its suitability must first be proven by analyses and other examinations.

Uses for limestone are too numerous to mention in full. Were it not for the availability, at low cost, of limestone, many of our major chemical and metallurgical industries would be greatly handicapped or nonexistent. In many respects it ranks even higher than coal or iron as a mainstay of our present civilization. Future industrial exploitation of Alaska will be dependent upon, and the location of some plant sites will be decided by, the availability of suitable limestone. Deposits near coal may be of particular interest.

Following are listed a few of the uses for limestone:

1. Manufacture of building-lime, mortar, stucco, etc.
2. Manufacture of cement and cement products.
3. Manufacture of mineral (rock) wool insulation.
4. Manufacture of paper.
5. Building stone
6. Agricultural lime
7. Coal mine dusting
8. Numerous metallurgical and chemical processes  
(see CEMENT ROCK and MARBLE)

**LIMONITE**

Limonite is a hydrous iron oxide, a very common mineral. As ordinarily encountered it is of no value, but when found in large quantity it may have importance as an iron ore. Massive limonite is heavy, rather hard, and yellowish to brown to black in color. A powdery form may occur with the massive ore.

As an iron ore, limonite is worth \$2.00 to \$2.50 per ton. The powdery form, known as yellow ocher, is used as a pigment in paints, etc. (see GOSSAN).

**MAGNESITE**

Magnesite, magnesium carbonate, exists in commercial deposits in massive or compact form. The mineral is usually white but may occur variously colored. Limestone and dolomite are often confused with magnesite.

It occurs, (1) in areas of serpentine rocks where it is formed as a result of alteration, (2) associated with limestone and dolomite as replacement deposits.

Magnesite is important as a refractory to the steel industry and as a raw material to the magnesium industry. Other uses exist chiefly in the preparation of certain building and insulating materials. Foremost among the building material is Sorrel (oxychloride) cement, used in wall plaster, stucco and special floors. Mixed with asbestos, large amounts of magnesite are used for boiler and pipe covering. The pulp and paper mills use appreciable quantities in the bisulphite process.

Calcined magnesite ranges in value from \$25.00 to \$50.00 per ton.

## MAGNETITE

Magnetite, iron oxide, contains 72 per cent iron. A common mineral, it is readily recognized since it is strongly attracted to a magnet. In addition to its presence in placer sands it is commonly found, in non-commercial amounts, in the majority of rocks. Large deposits of magnetite sand, low in titanium content, and mineable masses in metamorphic rocks, constitute possible commercial sources of iron ore. The price of magnetite iron ore is about \$2.75 to \$3.75 per ton.

## MALACHITE

Malachite is a green copper carbonate, a secondary mineral found in the oxidized zone of copper deposits. It is associated with AZURITE and other copper minerals. Large and small rounded masses present a very attractive appearance when cut and polished. Consequently it is much in demand for fashioning ornamental objects and jewelry. Raw material, of good quality, will bring up to \$3.00 a pound from dealers and lapidaries.

## MARBLE

Commercially "marble" is any LIMESTONE or DOLOMITE capable of taking a polish. The main use is in the production of ornamental building stones and monuments. For such uses it is chosen primarily for its appearance, the value being influenced to a great extent by exceptional color characteristics. Consequently it commands higher prices than ordinary structural stone and may be economically shipped over greater distances.

Finished marble has a value somewhere in the neighborhood of \$5.00 to \$7.00 per cubic foot, about three times the price for the rough, unfinished stone.

When not used as a "marble" it becomes merely a LIMESTONE or DOLOMITE and thus may have any of the uses common to those rocks.

## MEERSCHAUM (Sepiolite)

Meerschaum is a hydrous magnesium silicate occurring in compact, nodular, soft, earthy, or clayey masses in serpentine or other high magnesium rocks. It is white colored and, when pure and dry, will float on water. When dry it is rather hard and tough.

The peculiar properties of meerschaum make it admirably suited to the carving of pipes and cigar holders. Other uses would be developed if commercial deposits could furnish the material. Turkish deposits now supply nearly the entire world. Meerschaum is worth about \$1.00 to \$1.50 a pound.

## MICA

Mica is a term covering a certain group of silicate minerals occurring in transparent sheets or flakes. Varieties of commercial importance are MUSCOVITE, LEPIDOLITE, PHLOGOPITE and VERMICULITE. They are discussed under separate headings.

## MOLYBDENITE

Molybdenite is a molybdenum sulphide, a lead-gray, greasy feeling mineral resembling graphite. It may be distinguished from graphite, however, by the faint bluish tinge to its color, whereas graphite has a brownish to black tinge.

Molybdenite is found in granite rocks and is the principal ore of molybdenum. The mineral is concentrated by flotation and the resulting shipping concentrate contains about 90 per cent molybdenite. On the basis of the normal price of 45 cents per pound of molybdenum sulphide contained, this concentrate would be worth about \$810.00 per ton. Ore assaying 2 per cent molybdenum sulphide would produce \$18.00 worth per ton if it were entirely recovered.

## MONAZITE

Monazite is a phosphate mineral containing varying amounts of the Rare Earth elements, THORIUM, CERIUM, lanthanum, yttrium, etc. It is generally found as yellow to brown, translucent to opaque grains, in sands which, being heavy, are amenable to concentration by panning. Monazite sands are derived from granites and pegmatites.

In general the price for monazite sand concentrate is about \$60.00 per ton; however, an analysis of such sands must be made before prospective purchasers will quote a price. The purchaser may be interested only in the amount of one or two of the constituent elements, thus the price is set accordingly.

Monazite is used as a source of the rare elements.

**MORGANITE**

Morganite is a pink to rose-red variety of BERYL used as a gem stone (see BERYL).

**MOSS AGATE**

Moss agate is a variety of AGATE containing dendritic inclusions of brown or black color which, when polished, add attractiveness to the stone. There is a good demand for moss agate at prices ranging from a few cents for inferior specimens to a dollar or so a pound for good material. Choice polished pieces bring considerably higher prices. (see AGATE)

**MUSCOVITE**

Muscovite, the most important of the mica minerals, occurs in thin, transparent, more or less colorless flakes or sheets in granites, pegmatites, and other rocks. Occurrences in pegmatites constitute the commercial deposits, for there the mineral occurs in comparatively large "books" or sheets. The commonly encountered flake mica is of little value, sheets several inches in diameter being required for most industrial uses. (VERMICULITE and LEPIDOLITE are exceptions).

Muscovite mica is marketed according to the size of sheet produced, the price per pound ranging from twenty-five cents to six or eight dollars. Ground mica, usually prepared from scrap from trimming, is valued at \$25.00 to \$80.00 per ton.

The electrical equipment industries are the largest users of sheet muscovite. Cheaper grades, including ground muscovite, are used in a variety of industries.

**NICCOLITE**

Niccolite contains arsenic and nickel and resembles pyrite and several of the sulphide minerals. The characteristic pinkish tone to its color usually distinguishes it from the others.

Niccolite is found in silver ores (except silver-lead ores) usually with several copper and cobalt and silver minerals. It is a minor, yet important, nickel ore. (see SULPHIDES)

**OIL (Petroleum)**

It is doubtful that any prospector in Alaska is searching particularly for oil. Those engaged in the search for minerals

should, however, recognize the value of new discoveries of oil bearing areas and be able to recognize surface indications.

Oil exists in areas of sedimentary rocks, and under favorable conditions, it may find its way to the surface, the amount at the surface having no relation to the quantity of oil underlying the area. Even the most meager indications in new districts are important discoveries. Seepages of oil may exude from the sand, mud or clay, or from along the joints and bedding planes of the sandstones, slates, shales, etc.

The presence of inflammable gas, detected arising from bodies of water, or otherwise, may or may not be related to oil structures. Such gas occurrence should be heeded, however, and the area carefully studied for further evidence favorable or unfavorable to the existence of petroleum. Surface showings do not always have the appearance of oil. Due to several causes the liquid character may be replaced by semi-solid or even solid derivatives. In this case the accumulated material will resemble grease or possibly pitch or coal.

Oil may be found on the surface of pools of water, but it should be noted that what is frequently taken for oil in this case may be a film of iron oxide. This is especially true of stagnant pools.

Oil shales are another important source of petroleum products. They are easily overlooked but need not be, for several easy tests will usually identify them. They occur with sandstone and are usually of brown color. There is commonly no reason to suspect the presence of oil but the following tests should be applied.

1. Attempt to shave the shale with a knife blade. Oil shale curls as it is cut, the amount of curling being greatest in the richest shales.

2. Attempt to burn a sliver or shaving of the shale. High grade material burns, giving off a characteristic petroleum odor.

**OLIVINE**

Olivine, a silicate of iron and magnesium, is a green transparent to translucent mineral found in basic igneous rocks, especially peridotite. It is recognized by its granular form.

Demand for olivine is not particularly great at the present time, but its possibilities have been recognized and are the subject

of present investigations. It is likely to become more widely used in a variety of industrial applications, chief among which are the manufacture of refractories and magnesium compounds.

Its increased use depends, however, on its low price. At present crude olivine is worth \$5.00 to \$7.00 per ton.

In certain localities large, clear crystals of olivine suitable for gem cutting may be found. This gem variety is known as "peridot" which commands a fair price.

## OPAL

Opal is a hydrous non-crystalline variety of silica occurring in numerous forms, many of which are known commercially under other names. Only the more valuable gem varieties are considered here.

**Precious Opal** is translucent, with a noticeable play of colors, often displaying vivid flashes. Ordinary fire opal is usually white or milky, but may be variously colored, even black, which is an especially valuable type. Thus precious opal may possess various base colors, yet all display the flashes or fiery play of color. Precious opal is found deposited in cracks and crevices of rocks, a particularly favorable occurrence being in andesitic lava rocks. Detached nodules are not uncommon.

**Wood Opal**, also called opalized wood, is petrified wood in which the original structure has been replaced by siliceous solutions, forming opal. Colors are usually black and white. Wood opal will only be found in areas producing petrified wood.

## OZOKERITE (Ozocerite, Native paraffin)

Ozokerite is a wax-like hydrocarbon, yellowish-brown to green in color. It is found filling veins or fissures in sandstone, shale, or limestone, in areas containing oil.

Uses include the manufacture of high quality candles, floor wax and electric wire insulation.

## PAPER CLAY

Paper clay is a white, grit-free, high grade clay used as a filler to give weight and body to various kinds of paper. (see KAOLIN and CLAY)

## PEGMATITES

The pegmatites are coarse grained, granite type rocks, whose importance is so great that the prospector should constantly watch for them. So many valuable minerals, both rare and common, are found in or near pegmatite veins and dikes that care should be taken to recognize the rock and carefully prospect the area, including the placers.

By the nature of its formation, a pegmatite contains characteristically large, well-formed, interpenetrating crystals of quartz, feldspar and mica. These are essentially the same minerals comprising ordinary granite, the apparent difference being in the much coarser texture of the pegmatite.

Following are listed some of the minerals likely to be found in areas of pegmatite mineralization:

- |                |                            |
|----------------|----------------------------|
| 1. AMBLYGONITE | 13. MOLYBDENITE            |
| 2. BERYL       | 14. MONAZITE               |
| 3. BISMUTH     | 15. MUSCOVITE              |
| 4. CASSITERITE | 16. POLLUCITE              |
| 5. COLUMBITE   | 17. QUARTZ and QUARTZ GEMS |
| 6. CRYOLITE    | 18. RARE EARTH MINERALS    |
| 7. EMERALD     | 19. SAPPHIRE               |
| 8. FELDSPAR    | 20. SPODUMENE              |
| 9. FLUORITE    | 21. TANTALITE              |
| 10. GARNET     | 22. TOPAZ                  |
| 11. GOLD       | 23. TOURMALINE             |
| 12. LEPIDOLITE | 24. WOLFRAMITE             |

As is true of the constituent minerals quartz, feldspar and mica, the accessory minerals are also often present in large well formed crystals. This accounts for the exceptional production of relatively rare minerals, gem stones, and specimen material, from the pegmatites. Recognition of the possibilities presented may be of great value to the prospector.

The above discussion, in its entirety, deals with the acid pegmatites. A basic quartz-deficient pegmatite exists but is not common and cannot compare with the acid type as a prolific source of valuable minerals.

## PENTLANDITE

Pentlandite is an important iron-nickel sulphide and has a yellow-bronze color. It looks like pyrrhotite and almost always occurs as very fine grains in pyrrhotite, but that does not mean

that all pyrrhotite contains nickel as most of it does not carry any. Pyrrhotite that does contain pentlandite is sometimes called nickeliferous pyrrhotite. (see PYRRHOTITE).

#### PHLOGOPITE (Amber Mica)

Phlogopite is a micaceous mineral resembling MUSCOVITE. Unlike that mineral, however, it occurs in serpentine, crystalline dolomite, or dolomitic limestone.

Uses and prices are much the same as for MUSCOVITE.

#### PITCHBLENDE (Uraninite)

Pitchblende contains uranium, lead, radium, and several rare elements. It is found as a black, hard, heavy, and brittle mineral in metalliferous deposits containing silver, gold, copper, or lead ores. Pitchblende is a rare mineral but when found in substantial quantity, it is valuable as an ore of both radium and uranium.

#### PSILOMELANE

Psilomelane is a hard, black to brownish-black oxide of manganese. Other manganese oxides, soft, black and earthy may also be present. Commercial deposits are of secondary origin, being found in residual clay or bog concentrations.

A high grade manganese ore, psilomelane is used in making chemicals and dry batteries; also in the metallurgical industry. The manufacture of iron and steel requires great quantities most of which is normally supplied by imports. With increased activity of this industry in the western States, greater attention to the possibilities of Alaskan ores appears warranted.

Psilomelane ore, depending on the manganese content and impurities, is worth from \$10.00 to \$60.00 per ton.

#### POLLUCITE

Pollucite is a rare mineral, a silicate of aluminum and cesium, found in cavities in granites and pegmatites. It is a hard, colorless, not particularly heavy mineral, occurring massive and in cube-like crystals.

Pollucite contains about 80 per cent cesium and is therefore an important source of that metal. (see CESIUM)

#### PUMICE

Pumice is a light colored, light weight, cellular, volcanic lava, found in bedded deposits containing material of all sizes, from sand to large blocks. It is found in the vicinity of volcanoes.

Some of the most important uses are listed below:

1. As an abrasive in cleansing and scouring compounds, and hard soaps.
2. As an abrasive in polishing metal, glass, wood, stone, etc.
3. As a light aggregate in concrete work, lowering the amount of cement required.
4. As an insulating material.

According to the physical properties of the pumice and the use to which it is to be put, the price range varies from a few dollars to \$100.00 per ton.

#### PUMICITE

Pumicite is very similar to PUMICE in all respects except that it is entirely composed of sharp angular grains or fine powder. Pumicite is more apt to be found at greater distance from its volcanic source, sometimes hundreds of miles. Commercial deposits, in the form of beds of variable thickness, are often overlain with overburden of clay, sand, etc.

Uses and values of pumicite are much the same as those mentioned above under PUMICE.

#### PYRARGYRITE

Pyrrargyrite is a silver mineral containing silver, antimony, and sulphur. It is black to deep-red in color and is found in the upper portions of silver veins usually accompanied by galena, calcite, argentite and other silver minerals. (see SILVER and SULPHIDES).

#### PYRITE

Pyrite, iron sulphide, contains 47 per cent iron and 53 per cent sulphur. When found in quantity, pyrite is generally recognized by its cubic crystals, metallic luster, and brassy to silvery yellow color. At times, if tarnished, or if it occurs finely disseminated, it may have the appearance of other sulphide minerals.

Whenever pyrite, or any other sulphide mineral, is found or suspected, it is recommended that a sample be taken and submitted for examination and assay. Pyrite is an indication of the possible presence of gold. If gold were present, all or the majority of it would not be detected by panning, yet such ores may be very rich. Many other ore minerals are commonly associated with pyrite.

In addition to being an indicator mineral, pyrite is also a possible source of SULPHUR; and after removal of the SULPHUR, as an iron ore. Considerable pyrite is used in the production of sulphuric acid and, in the Scandinavian countries, recovery of the SULPHUR in the elemental form, or as solid or liquid sulphur dioxide gas, supplies the pulp and paper industries with their requirements. (also see PYRRHOTITE, SULPHIDES, SULPHUR, and GOSSAN)

#### PYROLUSITE

Pyrolusite is a soft, black, earthy oxide of manganese found in secondary deposits with PSILOMELANE. Their uses and values are the same.

#### PYROMORPHITE

Pyromorphite is a secondary lead mineral, essentially lead phosphate. Usually greenish to yellow to brown it is rather soft and quite heavy. Although considered a minor ore of lead, it is of chief importance to the prospector as an indicator of lead deposits. It may be found in the upper portions of lead veins or in placer concentrates nearby. Galena and other lead minerals usually accompany pyromorphite.

#### PYRRHOTITE

Pyrrhotite is a sulphide of iron usually occurring massive. It has a metallic luster and a reddish-brown bronzy color. It is found associated with or near basic rocks and may contain copper and nickel in substantial amounts. Nickeliferous pyrrhotite is the chief ore of nickel. (see PENTLANDITE).

Comments under Pyrite concerning sulphide minerals, iron and sulphur, are also applicable to pyrrhotite.

#### QUARTZ

Quartz, the most common mineral in the earth's crust, has a great many forms and colors, many of which are given different

names. The composition of all is essentially silicon and oxygen, SILICA. The association of quartz with some mineral deposits, and that form occurring massive in veins, is well recognized. Less familiar, however, are the commercial varieties and uses. Briefly, some are described here, others are described under SILICA.

QUARTZ CRYSTAL, also known as "rock crystal," is an exceptionally valuable industrial mineral when found in clear, transparent, flawless crystals. This quality, however, may be masked by a surface coating so the prospector should learn to identify them by their characteristic form. Crystals exceeding two inches in size that may be utilized in radio and related industries bring \$2.00 to \$20.00 or more per pound. Some crystals weighing many pounds are found and it is not always necessary for a specimen to have more than two or three crystal faces intact. The prospector should submit any specimen found for examination and determination of the value.

Crystal found unsuitable for such use, yet suitable for fusing to manufacture special purpose quartz glass, is worth from \$100.00 to \$150.00 per ton.

QUARTZ GEMS are separately mentioned under individual headings. (AGATE, AGATIZED WOOD, AMETHYST, BLOOD-STONE, CARNELIAN, CHALCEDONY, CITRINE, FLINT, GEODE, JASPER, MOSS AGATE, OPAL, ROSE QUARTZ, RUTILATED QUARTZ, SMOKY QUARTZ).

(see SILICA)

#### RARE EARTH MINERALS

The "rare earth minerals," while numerous, are rarely found in commercially important amounts except in placer sands. They contain the elements THORIUM, CERIUM, Lanthanum, Yttrium, etc. and are derived from coarse grained granite or pegmatite rocks. Being heavy and resistant to decomposition they are most likely to be found with other heavy minerals in streams and beach sands.

MONAZITE, a yellow to brown, translucent to opaque mineral is the most common of the group, but others possibly present are of all colors, thus accurate identification in the field is difficult or impossible. It is a wise policy, therefore, to submit a sample of any heavy, non-magnetic concentrate to the assay office for identification of the constituent minerals.

The "rare earth minerals" are utilized as a source of the rare elements. In general, the price is about \$60.00 per ton, however, an analysis of the concentrate must be made before prospective purchasers will quote a price. The purchaser may be interested only in one or two of the constituent elements, thus the price depends on the analysis.

#### RHODOCROSITE

Rhodocrosite is a carbonate of manganese, occurring in granular or compact masses, colored pink or reddish. It is found in veins with ores of silver, lead, and copper, and may also be associated with the black manganese oxides. To the prospector it is an indicator mineral particularly for silver-lead deposits.

Pacific Coast activity of the metallurgical industry would stimulate the search for Alaskan manganese ore. Where rhodocrosite occurs as a gangue mineral with silver-lead ores, the practicability of recovery as a by-product should be considered.

#### RHODONITE

Rhodonite is manganese silicate, pink in color like rhodocrosite but harder. It is little used except as an ornamental stone or gem material. Deposits of rhodonite may weather to the black manganese oxides which are important ores of manganese.

#### ROSCOELITE

Roscoelite is a mica containing vanadium, recognized by its micaceous form, minute scales and green to greenish brown color. When found in sandstones, its most frequent occurrence, it may exist in lenses or in very small flakes disseminated through the sandstone giving it a greenish appearance. It has also been found with quartz as a gangue mineral in gold lodes.

Roscoelite may contain as much as 29 per cent vanadium oxide and is therefore an important vanadium ore. It is sold for about twenty-five cents per pound of vanadium oxide contained.

#### ROSE QUARTZ

Rose quartz is similar to ordinary massive quartz in every way except color. As the name implies it is colored rose red to pink, and is seldom, if ever, found in any other form than massive.

It is of minor use as an ornamental stone and for jewelry.

#### RUBELLITE

Rubellite, a rose-red to pink variety of TOURMALINE is a valuable gem mineral when in clear, transparent crystals. Gem quality material is derived principally from pegmatite dikes and veins.

#### RUBY

Ruby, a clear, red variety of corundum, is one of the most valuable of all gem stones. Occurrences are not restricted to any particular kind of rock, although metamorphosed limestones and certain basic igneous dike rocks are the original source rocks of most of the ruby produced. Recovery from the rock is practical in special instances, but most commercial operations are confined to either working the placer sands and gravels, or the soil and clay derived from the decomposition of the host rock.

The most valuable ruby is the "pigeon's blood", a purplish red colored stone. Those of lighter shades of red are less valuable, yet individual stones of clear flawless character may be worth several hundred dollars per carat (1 ounce equals 140 carats). One exceptionally good "pigeon's blood" may bring one or two thousand dollars per carat.

Ruby mining operations market most of their production for use as "jewels" for bearings of watches and scientific instruments. This is an inferior grade unfit for gem use. SAPPHIRE also constitutes a percentage of the same deposits.

#### RUTILE

Rutile is an oxide of titanium commonly encountered in placer concentrates as a heavy, reddish-brown to black mineral, somewhat resembling cassiterite. It may be found in a wide variety of rocks from whence it finds its way into stream sands and gravels. Certain placer deposits may contain enough rutile to permit recovery as a by-product. Most commercial deposits, however, occur in dikes of ultrabasic igneous rocks or granitoid rocks deficient in silica.

Rutile is marketed chiefly as an ore of titanium. Concentrates containing 88 to 90 per cent rutile sell for \$60.00 to \$75.00 per ton. Ninety-four per cent concentrates bring about ten cents per pound.

Occasionally clear red crystals may be found which are readily salable for use as gem stones.

### RUTILATED QUARTZ

Rutilated quartz is quartz containing long, fine hair-like inclusions of rutile. Good material, suitable for cutting and polishing, or crystals and crystal masses, are in good demand at fair prices by dealers, lapidaries and collectors.

### SALT

The commercial term "salt" refers to the familiar chemical, sodium chloride, which occurs in solid masses, in natural brines, and in salt lakes and sea water. So far as is known, no deposits have been identified in Alaska. Salt, being soluble in water, only arid country is favorable to the existence of surface deposits or concentrations; therefore if salt exists in the Territory, it is probably at some depth below the effect of surface waters. One or two such areas, geologically favorable, are known and others may well exist.

Because of the relatively large amount of salt now used in Alaska, and the probability of a larger consumption, any possibility of local production should be considered.

In addition to its household use, salt is used in packing and curing fish and meat, manufacturing dairy products, curing hides, rejuvenating water softeners, thawing of ice on streets, and many others. By far the greatest quantities are used by the chemical industry in producing a long list of chemicals which are in turn used by practically all industries.

### SANDSTONE

Sandstone is a sedimentary rock composed of grains of quartz sand plus a natural cementing material. The physical, as well as the chemical properties of the rock determine to a great extent whether a given sandstone qualifies for any of the many possible uses.

Quarried and trimmed sandstone is a most useful BUILDING STONE. Probably the next in importance is its use as an abrasive in the form of grindstones, HONESTONES and whetstones. Large blocks, shaped into wheels, are employed to grind wood pulp for the pulp and paper mills.

### SAPPHIRE

Sapphire is a clear blue variety of CORUNDUM, ranking among the highest valued of all gem stones. Other, more pale

colors exist but the greatest value is in the blue stones. Occurrence of sapphire is the same as that given for RUBY.

Material for gem use brings from \$6.00 to \$125.00 per carat (1 ounce equals 140 carats). As is also true for RUBY, inferior stones are marketed for use in the manufacture of watches and precision instruments.

### SCHEELITE

Scheelite, calcium tungstate, is a white, or light colored, heavy, brittle mineral, containing 80 per cent tungstic oxide. It occurs near contacts of granite rocks and limestone; in quartz veins, or replacement deposits in the metamorphosed limestone. Scheelite may be found in placer concentrates and whenever whitish concentrates or heavy white pebbles are found they should be tested for tungsten. The location of lode deposits may readily be traced by panning. More frequently than not, the appearance of even high grade ore will fail to attract attention unless it is ground and panned.

Scheelite is one of the chief minerals from which the metal tungsten is extracted. Present prices are artificially high and post war prices are most uncertain. Concentrates assaying 60 per cent tungstic oxide are now worth about \$1,500.00 per ton but this price will certainly decline. While a drastic reduction would adversely affect production, it is felt that scheelite will continue to warrant the prospector's attention.

### SCORODITE

Scorodite is a hydrous arsenate of iron which may be encountered in surface exposures of mineralized veins. In some areas it is an important indicator of gold-bearing lodes associated with arsenopyrite. Usually it is found as an earthy material, or possibly only a stain, of pale green to brownish color. Other than as an indicator it has little or no value.

### SILICA

Silica is an oxide of silicon occurring in many forms and under many names. In addition to those already discussed under QUARTZ, other forms have numerous industrial and commercial applications. Other than FLINT, DIATOMITE, SANDSTONE, and TRIPOLI, which are discussed separately, a few may be mentioned briefly here. The principal ones are chert, quartzite, and silica sand, all possessing qualities adapting them to abrasive

use. In addition, however, certain quartzites and sands having a high degree of purity are employed in the manufacture of glass. High quality glass sands are not particularly abundant and are thus much sought, although the price seldom permits shipping great distances.

#### SMALTITE

Smaltite is an arsenide of cobalt probably containing varying amounts of nickel. It occurs massive rather than crystalline; is steel gray in color, often possessing a pinkish tone. Surface exposures may be rather black due to the presence of certain silver minerals or to effects of weathering. The gangue is likely to be calcite rather than quartz and association with silver minerals is common. If such ores are panned they will reveal a black, non-magnetic concentrate, in which case, they should be submitted for assay.

#### SMITHSONITE

Smithsonite is a carbonate of zinc, containing over 50 per cent of that metal. Found near the surface of zinc deposits, it appears as a porous material or as an incrustation. The color may be brown to greenish to gray. Smithsonite occurrences should be carefully prospected for besides being a minor ore of zinc itself, its presence indicates an underlying ore body of SPHALERITE.

#### SMOKY QUARTZ

Smoky quartz is ordinary quartz, usually crystalline, containing impurities which give it a light smoky to dark color. Areas of pegmatite and granite rocks, particularly pockets in the weathered rock, are a likely source of smoky quartz of gem quality.

#### SPHALERITE

Sphalerite is the sulphide of zinc, usually light to dark brown in color, having the appearance of resin. A wide variety of ores contain sphalerite, particularly those of gold, silver, lead and copper, in or near limestone.

#### SPODUMENE

Spodumene is lithium aluminum silicate found only in pegmatites where it sometimes forms immense crystals. White, or tinted some light shade of pink, yellow or green, it strongly resembles milky quartz except in crystal form and cleavage. Ordinary spodumene is a source of metallic LITHIUM and its

compounds. As a raw material it is extensively used in the manufacture of enamel and glass. For such uses it is valued at \$30.00 to \$35.00 per ton.

HIDDENITE and KUNZITE are two clear, transparent varieties valuable as gem stones.

#### STIBNITE

Stibnite, antimony sulphide, is a lead-gray, soft mineral occurring in bladed crystal masses in various rocks, often with gold or mercury ores. The chief ore of antimony, it is also used as a raw material in the preparation of safety matches, fireworks, and rubber manufactures.

High wartime prices for antimony ore will not continue. No prediction, at this time, of what the peacetime price may be is possible, but considering the by-product antimony normally produced by the smelters, little encouragement for Alaskan production is indicated.

#### STRONTIANITE

Strontianite, a carbonate of strontium, is similar in appearance to barite and calcite, with which it is frequently found. The preparation of chemicals and compounds of strontium consumes the greater part of the strontianite produced. It is valued at about \$55.00 per ton.

#### SULPHIDES

The relationship of the sulphides and related minerals to commercially important mineral deposits is exceedingly important, and for this reason the subject is inserted here. By "related minerals" is meant those minerals somewhat akin to the sulphides, namely the arsenides, antimonides, tellurides and various combinations, which, when encountered by the prospector, are usually considered "sulphide" ores. They may consist of only one or a mixture of several such minerals. Pyrite is the most common sulphide mineral and it is recognized as such by most prospectors. The others are more difficult to accurately identify and for our purpose here, it suffices to say that any vein or deposit containing "sulphide" minerals should be sampled and the sample submitted for examination and assay.

On fresh fractures most of these minerals have a metallic luster and, when finely ground, most are black in color. All are relatively heavy and thus may be concentrated by panning. Gold

may be present in appreciable amount in such ores and yet not be visible in the pan. Other than gold, the following may also be present, in one form or another, not readily identifiable to the prospector:

- |               |                          |
|---------------|--------------------------|
| 1. Antimony   | 8. Nickel                |
| 2. Bismuth    | 9. Platinum group metals |
| 3. Cadmium    | 10. Silver               |
| 4. Cobalt     | 11. Tin                  |
| 5. Copper     | 12. Zinc                 |
| 6. Lead       | 13. Others               |
| 7. Molybdenum |                          |

The following opinion expressed elsewhere in this report bears repeating. The majority of the prospecting done in Alaska has been for free gold and therefore deposits of the so-called "sulphide" ores offer special promise to the wise prospector.

#### TALC (Soapstone, Steatite)

Talc is a magnesium silicate mineral recognized by its characteristic smooth or soapy feel. Another mineral which responds in the same manner is pyrophyllite, which since it is marketed under the classification of talc, and has more or less the same appearance and uses, will be included here. While "soapstone" is more properly a massive rock containing a high proportion of talc, it, too, is considered under this heading.

Uses are many and varied. The chemical and physical properties determine the usefulness of any particular talc, and to some extent, the price.

Crude talc commands a low price, and for various reasons, probably could not be profitably exported from the Territory unless it was a particularly desirable type.

Ground talc finds use in the manufacture of paper, paints, ceramics, roofing, rubber and various minor fields. According to grade and range, prices may range from \$6.00 to \$12.00 per ton.

Sawed and manufactured talc offers the best opportunity; this is usually soapstone, or the massive quarried stone, from which articles such as table tops, laundry tubs, structural stones, switch boards, etc. are made at the plant.

#### TANTALITE (see COLUMBITE)

#### TELLURIDES

Telluride minerals are compounds of tellurium with other elements. They are seldom if ever mined for the tellurium content,

being chiefly of interest as ores of gold and silver. As such they may constitute extremely rich ore, yet since no free gold is visible, their importance is easily overlooked.

The appearance of gold-silver tellurides may vary from steel-gray to bronzy to black. Although they contain from 20 to 60 per cent of gold or silver, they may be brittle and strongly resemble some comparatively worthless iron sulphide mineral. (see SULPHIDES)

#### TETRAHEDRITE (Gray copper)

Tetrahedrite contains copper, antimony and sulphur and is gray to black in color, with a metallic luster. It is commonly found massive, or crystalline, in copper deposits with other copper minerals. Frequently it carries silver, and at times such content is so high as to constitute the chief value of the ore.

#### THOMSONITE

Thomsonite is hydrated calcium, sodium, and aluminum silicate, which occurs in cavities in basic igneous rocks, particularly basalt. Its only use is as a gem stone, the best material, in the form of pebbles eroded from the rock, being found in streams and residual soils. Thomsonite is gray or white but the best gem material is mottled with rings or layers of red, green or yellow.

#### TOPAZ

Topaz, aluminum fluosilicate, is a hard, transparent to translucent mineral, usually some shade of yellow, but sometimes pinkish, bluish or greenish prismatic crystals and crystalline masses are found in pegmatite dikes, in cavities in rhyolite and granite and also in other rocks. Rounded or worn crystals may be found in placer sands and gravels. Clear, transparent crystals, whether rounded or not, bring good prices from the gem cutting trade.

#### TOURMALINE

Tourmaline is a complex borosilicate of aluminum with a number of minor and variable constituents. It is ordinarily found in well developed prismatic or columnar crystals having characteristic rounded triangular cross section. Valueless, or of minor value, are the black, opaque varieties. Those of considerable value as gem stones are transparent and colored green, blue, red, pink, or yellow. Due to unusual zonal coloring, individual crystals may display beautiful arrangements of several colors, a frequent occur-

rence being a gradation from green at one end to pink or red at the other. Another type has a core of one color and an outer portion of a different color. Occasionally colorless stones are found. A pink variety, RUBELLITE, is briefly mentioned under its separate heading.

The gem tourmalines are most commonly found in pegmatites. They are a very popular semi-precious stone and also much in demand by collectors and dealers.

### TRAVERTINE

Travertine is calcium carbonate (limestone), deposited by mineral springs. It may be of a cellular, porous type or solid and banded. The former type is admirably suited for use as a soil conditioner and is marketed as "agricultural lime." The solid form has, generally, the uses of LIMESTONE, and when it takes a high polish, of MARBLE.

### TREMOLITE

Tremolite, calcium magnesium silicate is an amphibole mineral of no particular value except in one form, that of the fibrous or asbestiform variety. Tremolite asbestos, as this is called, is a minor ASBESTOS mineral, yet it may be of some importance. Only by laboratory investigation can fibrous tremolite be definitely distinguished from the more valuable ASBESTOS minerals and such investigation is also required to determine its possible usefulness. (see ASBESTOS).

### TRIPOLI

Tripoli is a form of silica, white, fine granular, porous, and usually soft and easily crumbled, although it may occur firm and rather hard. It occurs in bedded deposits in sedimentary rocks, notably chert and limestone.

Tripoli is used for an abrasive in many trades, particularly, however, in polishing metals. It is also used in foundry work, paint and rubber manufacture, and numerous other fields. The value is low, somewhere around \$10.00 per ton, but specially prepared tripoli for special uses may bring \$20.00 to \$30.00 per ton or higher.

### TURQUOISE

Turquoise is a hydrated aluminum copper phosphate, rarely found crystalline. It is found as waxy to dull blue or green, opaque

masses or veins in igneous rocks. Also usually present is an abundance of kaolinized feldspar, limonite, and other products of alteration.

Turquoise is cut and used in jewelry. There appears to be a special demand for turquoise matrix (turquoise in the associated rock). Good quality rough material may bring several dollars per pound.

### VANADINITE

Vanadinite is a vanadium and lead mineral occurring as crystalline or globular incrustations in the upper portion of lead veins. The crystals, usually quite small, are deep red in color (infrequently yellow or green) and have a resinous luster. Pure vanadinite contains about 19 per cent vanadium oxide and is sold for about 27 cents per pound of contained vanadium oxide.

### VERMICULITE

Vermiculite is a name applied to certain mica minerals that are derived from alterations of other micas and have the property of greatly expanding when moderately heated. Whenever micaeous minerals are recognized in quantity, it is well to test a selective sample of the flakes with a match flame or camp fire and note if it expands and becomes "fluffy."

Vermiculite is extremely well suited for building insulation and is chiefly so used. Production to supply the Alaskan demands alone would be a most profitable enterprise. Commercially it is valued at \$8.00 to \$12.00 per ton, but local retail sales by the sack would realize considerably more.

### WILLEMITE

Willemite, zinc silicate, is found generally in massive to granular form, near igneous intrusions in limestone. Its color varies from white to yellow to bluish, and with impurities, it may appear greenish to brown. Other zinc minerals, especially ZINCITE, are associated with the ore, but sulphide minerals are rarely present, hence SPHALERITE is absent. Such desopits are few in number, yet they are major producers of high-grade zinc ore.

### WITHERITE

Witherite, barium carbonate, is found in veins in sedimentary rocks, usually with barite; sometimes with galena or fluorite. It is a rather heavy, white or gray, translucent mineral commonly

occurring finely crystalline or granular. Used in the preparation of barium compounds and chemicals, the ground, 90 per cent pure material has a value of about \$40.00 per ton.

#### WOLFRAMITE

Wolframite, a tungstate of iron and manganese, is black to brownish black in color and very heavy. It occurs in granite and pegmatite veins either massive or in bladed or columnar crystal form. It may be found in placer concentrates and is easily mistaken for some worthless oxide mineral of iron. Wolframite is also important as an indicator mineral because of its frequent association with CASSITERITE, TANTALITE, and many others.

It is a major ore of tungsten. Prices are about the same as those for SCHEELITE. (Comments pertaining to future economic considerations made there also apply to wolframite.)

#### ZINCITE

Zincite is an oxide of zinc and occurs in the same manner as WILLEMITE with which it is associated.

A red mineral, somewhat resembling cinnabar, it has a platy or granular structure and is usually found massive rather than as recognizable crystals.

#### ZIRCON

Zircon, a silicate of zirconium, is usually found in opaque to transparent crystals or crystal fragments of some shade of brown, although they may also be colorless to greenish to red. Originally derived from igneous and metamorphic rocks, the mineral is produced commercially from alluvial sands where it has naturally accumulated. In such deposits the zircon crystals acquire a worn and rounded appearance.

Although transparent stones are sold for use as gems, this is not the only use of zircon. It has important and increasing industrial applications in the manufacture of enamels, porcelain and glass. Zirconium metal and certain compounds prepared from zircon, are of major importance to the steel and metals industry, electrical manufactures and others.

Concentrates assaying 55 per cent zirconium oxide are worth \$65.00 to \$75.00 per ton.