INVENTORY OF WASHINGTON MINERALS

PART II
METALLIC MINERALS

By
MARSHALL T. HUNTING

Volume 1 - TEXT
Volume 2 - MAPS
INVENTORY OF
WASHINGTON MINERALS

PART II
METALLIC MINERALS

Volume 1 -- TEXT
FOREWORD

Knowledge of the occurrence of minerals in Washington has been accumulating steadily since 1853, when the first mine (a coal property) was developed. Actually it antedates this, for the discovery of a coal outcrop was recorded as early as 1833, though 20 years elapsed before any particular attention was paid to mineral resources, and it was not until about 1860 that State-wide prospecting, at first for gold, was well underway. The early published references to mineral discoveries are, in general, vague and chiefly of historical value, but some are useful in describing deposits that have been forgotten or lost during the passage of years.

In 1890 the office of State Geologist was created by the State Legislature, resulting in the first coordinated effort to catalogue our mineral resources and possibilities. This work was discontinued after two years, but was resumed in 1901 through the establishment of the Washington Geological Survey and has been continuous since then.

During the 90 years or more that prospecting and mining have been active, a vast amount of information has been obtained on the minerals of the state. The literature on the subject is voluminous. The U. S. Geological Survey, U. S. Bureau of Mines, and many other agencies, as well as institutions, organizations, and individuals, have contributed extensively to the fund of published data. Also, mining journals and periodicals, many of which are no longer published, have carried useful accounts of old operations and mineral discoveries.

More than 100 bulletins and reports on geology and mineral resources have been published by the Division of Mines and Geology and its predecessor agencies. Additional material available to the Division has been unpublished, existing as personal observations of staff members and, particularly, as notes from many years of field investigations. All these sources of information can be consulted—and commonly are—when given resources are considered, but searching the literature is a time-consuming task.

To make desired data on industrial minerals and operations more readily available for Divisional use, a card catalogue of all known nonmetallic-mineral references was compiled many years ago by the writer. It gave only brief details of individual deposits, but these, with their citations to further information, became of inestimable value. An immediate use was in the preparation of Bulletin 33, "Nonmetallic Mineral Resources of Washington," published in 1936. Since then the catalogue has been steadily added to by staff members as new information has been obtained, and a similar card file was started for metallic minerals and their operations. This last has been a laborious undertaking, for which Everett P. Hougland, formerly of the Divisional staff, was originally responsible. Later, it was materially added to by Grant M. Valentine, also a former member of the Divisional staff, and was greatly expanded and organized into usable form by Marshall T. Huntting.

The present "Inventory of Washington Minerals" is the result of a considered conviction that the data in these card catalogues would be as useful to the mining industry as they have proved to be to the Division of Mines and Geology and should, therefore, be made available to all who are, or may become, interested in Washington's mineral resources. The listings are purposely made as concise as possible, yet giving certain essential facts. They may be used in obtaining brief general information about any mineral resource, or they may be used as a starting point for detailed investigations. Upon completion of the section dealing with nonmetallic minerals it was considered desirable to publish that material without delay as Part I of the "Inventory." The first printing was in 1949, Grant M. Valentine being in charge of the compilation.

Immediately thereafter work was begun on Part II, which deals with metallic mineral occurrences. This has proved to be a far more elaborate and lengthy project than was foreseen. However, it is believed that the time and expense involved are justified and that the mining industry will find that having this material readily available for reference will fill a real need.

SHELDON L. GLOVER, Supervisor
Division of Mines and Geology

October 10, 1956
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INVENTORY OF WASHINGTON MINERALS

PART II—METALLIC MINERALS

By Marshall T. Huntting

INTRODUCTION

PURPOSE OF THE REPORT

The primary purpose of this report is to present a brief annotated list of all the metallic mineral occurrences in Washington known to the Division of Mines and Geology. The desirability of making available to the public a large amount of unpublished data in the Division files has long been recognized, and this report includes all this previously unpublished information as well as a summary of all the available published data on metallic mineral occurrences in the state. Through the use of maps it is possible to show the distribution of the various minerals, and in the text the individual deposits are briefly described and also referenced—thus providing the reader with a convenient foundation for a more comprehensive study of any metal in its various mineral forms or of any specific mine or prospect in the state.

An effort has been made to include in this inventory all the metallic mineral occurrences known in the state, even though many of the deposits are obviously of negligible value. This has been done because in the past many mineral occurrences which have been considered to have no importance have, for one reason or another, later proven to be of considerable value. This is a situation which, because of increasing demand for metals, new technological developments, and improved ore-finding techniques, may be expected to develop even more frequently in the future.

The title of this report is actually somewhat a misnomer, as this is really an inventory of the occurrences of the various metals in their mineral forms rather than of the minerals themselves. This may appear to be splitting hairs, but the point is, by using this report a person may look up all known occurrences of copper in Washington but he could not readily find all the occurrences of any given copper mineral.

ACKNOWLEDGMENTS AND SOURCES OF INFORMATION

This report is strictly a compilation, although many of the data included have never been previously published. Some of the most important sources of data used for this inventory are the published reports of various private, State, and Federal agencies. Another valuable source is the large mining-properties card file of the Division of Mines and Geology and its three predecessor organizations, the Washington Geological Survey, the Division of Geology, and the Division of Mines and Mining. Perhaps the largest contribution from these files is material accumulated over a long period of years from all the available mining and geology periodicals. Other sources are the many volumes of unpublished Division field notes, the files of other State agencies, questionnaires, and unpublished private reports.

The writer was fortunate in being allowed to include much nonrestricted material from the files of the U. S. Geological Survey and the U. S. Bureau of Mines. Unavoidably, the extent of this assistance is not fully acknowledged by the individual property references, but the contribution comprises a large amount of accurate up-to-date information about many of the best described properties. These valuable sources of information were generously made available by Mr. M. E. Volin, formerly Chief of the Mining Division, Region II, U. S. Bureau of Mines, and by Mr. A. E. Weissenborn, Regional Geologist of the Spokane office of the U. S. Geological Survey. The assistance of Mr. Henry Hoard, mining deputy in the Whatcom County Assessor’s office, in furnishing information on many Whatcom County properties is gratefully acknowledged.

General data on the properties, uses, production, prices, ore minerals, and geology of the various metals were abstracted from numerous standard texts on chemistry and economic geology, from Information Circulars and Minerals Yearbooks of the U. S. Bureau of Mines, Mineral Resources of the U. S. Geological Survey, the Engineering and Mining Journal Metal and Mineral Markets, and, for some metals, from books dealing specifically with those metals. These various sources were not always in agreement in many particulars, and in such instances the most recent or what was believed to be the most reliable data were used.

To Mr. Grant M. Valentine, now District Geologist for the Shell Oil Co. and formerly on the Division staff, credit is due for the organization and a large part of the compilation of this report. His contribution to this inventory is at least as great as that of the writer, but since he had no hand in the final stages of its preparation, the writer accepts all responsibility for any shortcomings that may be noted, and at the same time gives credit to Mr. Valentine for his tedious months of compilation. To Mr. Sheldon L. Glover, Supervisor of the Division of Mines and Geology, the writer is grateful for aid in the preparation of the report.

PLAN OF THE REPORT

As in Part I of the Inventory of Washington Minerals, the data in Part II are presented in two forms—maps and text. Here in Part II, however, the maps and the text are bound in two separate volumes, so that descriptive material and corresponding map may be studied together with the least possible inconvenience to the reader.

In the text (Volume 1) the metals are arranged alphabetically; under each metal the occurrences are grouped by counties which are arranged alphabetically; and under each county they are arranged similarly by property name. Properties about which some information is known but in which the kind of ore is not known are grouped under
a separate heading following the metals. At the end of Volume 1 is a property index in which all properties are listed alphabetically.

The maps (Volume 2) are likewise arranged alphabetically by metals, with a separate map at the end for properties whose ores are not known. However, since some metals are found in only a few known occurrences in this state, some of the maps are combined to show the occurrences of several metals, thus putting some of the metals slightly out of place alphabetically in the map sequence. For example, one map shows occurrences of bismuth, cadmium, cerium, columbium, and tantalum—the latter two being mapped together because of their very close chemical relationship and their close association in nature. Bismuth, cadmium, and cerium are shown on the same map merely for printing economy. Cobalt and nickel are shown on a single map also because of their close chemical alliance and physical association. Printing economy dictated the combining of platinum, selenium, tellurium, and thorium on one map; tin and titanium on another; and uranium, vanadium, and zirconium on another. On the other hand, lode gold and placer gold deposits are described in separate sections in the text and are shown on separate maps to better differentiate the two types of deposits.

Most metallic-mineral properties have more than one metal in their ores, and as this inventory lists all known occurrences of all the metallics in the state, the names of most of the properties appear under several headings in the report, and the properties are shown on several maps. However, each property is described in only one place—under the heading which represents what is believed to be the most important constituent of the ore. For example, the Holden mine in Chelan County is described under copper and is shown on the copper map. It is assigned a number (40) which follows the name in the copper section of the text and is adjacent to the symbol for the mine on the copper map. (On the copper map all properties which are described under the heading “Copper” in the text are shown by a cross “•”). All properties which have some copper, but in which other metals account for the principal values, are shown by a large dot “•”. Most of the other maps use these symbols with the same meanings.) However, the Holden mine also produces zinc, gold, and silver, so it is shown on each of these maps, and the name appears in its proper alphabetical position under each of these headings in the text, but following the name in each of these sections is simply a notation “(see under copper)”. The number (51) assigned to the Holden mine on the gold map and in the text under gold is not the same as that given the same property under any of the other headings where it may be found, but the number given each property on any given map is the same as the number given the same property in the corresponding section in the text.

Some of the occurrences described in the text do not have a map number and are not shown on any map, because their locations are too inexactly known.

To facilitate following a numbered symbol on a map (in Volume 2) to the description (in Volume 1) of the property represented by the symbol, a finding list (numerically arranged) relating number to property name is on the page facing each map.

The scale of the state maps is such that they can be regarded as index maps only. Locations of the properties are given as precisely as possible in the text, but because of the small map scale, the detail is not as great as it would be on larger scale maps. In order to show the location of all the occurrences in some areas it is necessary to allow a single symbol to represent several closely spaced properties. Even this device leaves some of the small-scale state maps cluttered with symbols in some areas that there is insufficient room for the identifying numbers. Where this is true, special larger scale county maps are used. These are the maps for copper, gold, lead, silver, and zinc for Stevens County, and for lead and zinc for Pend Oreille County.

**PROPERTY DESCRIPTIONS**

This inventory is of course subject to the limitations and shortcomings that are inherent in any compilation of this sort in which use is made of a wide variety of sources of information. The critical reader will probably find inaccuracies; many mines and prospects are inadequately described; and others are perhaps described more than adequately—that is, they may be presented in a more favorable light than their merits justify. Very determined effort has been made to avoid these shortcomings, to eliminate duplications, and to make the data as complete and up to date as possible. The only way many of the remaining errors can be corrected is through the active cooperation of the readers. Your corrections and additions are earnestly solicited.

The reader will note that the placer properties are nearly all very inadequately described. This results from the fact that very little has been written about the placers in Washington, which in turn reflects the comparative unimportance of the state's placers. Many of the placer properties had suspended operations before their existence became generally known.

For the reader's convenience the occurrences are described under a standardized set of 14 headings: **Loc** (location), **Elev** (elevation), **Access** (property), **Prop** (property), **Owner, Ore, Ore min** (ore minerals), **Gangue, Deposit** (development), **Improv** (improvements), **Assays** (product), **Prod** (production), and **Ref** (references). A date in parentheses following any information in the descriptions indicates the date at which that information is assumed to be correct.

Under **Loc** (location) the position of the deposit is designated, wherever possible, by legal land description, and usually by some supplemental information which relates the location to some geographic feature, and further, the so-called “mining district” is usually given. The legal description is abbreviated; thus, sec. 3, (40-25E) indicates section 3, Township 40 North, Range 25 East, Willamette meridian.

Under **Elev** (elevation) is the altitude in feet above sea level, and in some instances the distance above local valley level is also given.

Under **Access** the distances by trail, road, boat, or railroad to points of principal interest are given.
Under Prop (property) the size of the property and the manner in which it is held are indicated. Where the occurrences are covered by mineral claims, the number of claims, type of claims (patented or possessory title), and in many instances the names of the claims are given. Since these features of a mining property are subject to frequent change, the information under this heading cannot be expected to be entirely up to date. Although the amount of property included under one ownership may be of considerable importance, that, of course, is not necessarily a measure of the size and value of the included mineral deposit.

Under Owner all the known owners are listed, the present or latest owner first, the earliest owner next, and subsequent owners following in chronological order. The period of ownership or control is indicated by dates in parentheses. The address of the latest owner or lessee is usually given. The names appearing in this section may be those of actual owners or they may be of holders of possessory title, of lessees, or of purchasers on contract. In most instances no attempt was made to indicate the nature of control. Information as to ownership usually can be obtained from the County Auditor of the county in which the property is located. Information on the corporate organization of any mining company doing business in Washington may be obtained from the Corporation Division of the Secretary of State's office in Olympia, and more detailed information on the corporate history of any company which is licensed to sell stock in the state may be obtained from the Securities Division of the State License Department.

Under Ore, what is thought to be the most important ore metal is listed first, but for the most part the attempt is made to list the other ores in their exact relative order of importance, although the least important metals ordinarily are last. Some of the metals listed under this heading are not ores in the true sense of the word, but they are included in order to show their presence, even though they have not been recovered and sold. To restrict the metals under this heading to those strictly meeting the qualifications of ore would be impossible in view of the definition: Ore is a mineral or mineral aggregate which contains precious or useful metals and which occurs in such quantity, grade, and chemical composition as to make extraction commercially profitable. The definition thus includes economic factors, such as market prices of the metals, cost of mining, concentration, and transportation, which may change rapidly—rendering today's ore tomorrow's waste, or vice versa.

Under Ore min (ore minerals) are all or most of the metallic minerals which have been identified at each deposit, not necessarily in order of abundance or importance. Many of the minerals listed are accessory minerals or even impurities rather than true ore minerals.

Under Gangue the ore host mineral is stated, except where this information would duplicate that in the description of the deposit which follows it. Gangue has been defined as the nonmetaliferous or nonvaluable metaliferous minerals in ore, but in this report gangue has been restricted to the nonmetaliferous minerals, and the nonvaluable metaliferous minerals are included with the ore minerals.

Under Deposit is a brief description of the occurrence, giving, where possible, the type of mineralization, the country rock, and size and shape of the deposit.

Under Dev (development) is a description of the underground workings, surface trenching, and test drill holes. Caved or flooded workings are so designated where known.

Under Improv (improvements) are listed those features which fall within the meaning as used in mining law—an artificial change of the physical condition of the earth upon or near a mining claim to facilitate discovery or extraction of minerals. Thus, camp buildings, roads, ore bins, mills, and the like are included under this heading.

Under Assays the grade of the ore is indicated by representative assays where available, and preferably by smelter returns on shipments. Assay reports, of course, are extremely subject to over-optimism, deliberate misrepresentation, careless sampling, and honest error. Owing to the none-too-reliable character of some of the source material used, the Division cannot vouch for the accuracy of the reported assays. Thus, the reader should exercise as much caution in his use of the assays reported here as he would in the use of assays from any source of unknown reliability.

Under Prod (production) is the date and amount of ore produced. Where the date but not the amount of production is known, only the date is given.

Under Ref (references) is a list of abbreviated citations to the published and unpublished reports from which the data for each property were abstracted. The reference is made by a number in bold-face type which refers to a title under the same number in the bibliography on pages 395 to 398. This is followed by the page reference or, in the case of a periodical, by a date (written 7/5/34 [July 5, 1934], or 7/34 [July 1934], or simply 1934) and then the page reference. Where the citation includes several issues of a periodical, the parts of the citation are separated by semicolons. Thus, 1, 4/18, p. 19; 7/18, pp. 45-46, refers to the Alaska and Northwest Mining Journal for April 1918, page 19, and August 1918, pages 45 to 46. References to individual titles in the bibliography are separated by periods. Certain references are omitted where a given property is listed year after year in annual directories such as the Division of Mines and Geology Directory of Washington Mining Operations or The Mines Handbook. In some instances only the latest entry is listed, and the reader may gain further information about a property by consulting earlier issues of the same annual directory.

Anyone wishing further details about a given property should refer to the specific reports cited under this heading. Most of these reports are available at public and institutional libraries. The only cited publications that are available from the Division of Mines and Geology are those, still in print, that were published by the Division or its predecessor agencies, the Washington Geological Survey, the Division of Geology, and the Division of Mines and Mining.
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The Metals

GENERAL STATEMENT

The chemical elements may be divided into two groups, the metals and nonmetals. The two groups cannot be very sharply defined, and intermediate between them are a number of elements sometimes referred to as semi-metals. Some of the semi-metals, such as arsenic, antimony, and bismuth, are more commonly thought of as metals than are some of the true metals.

The metals constitute over three-fourths of the recognized elements. They possess to a greater or less degree the physical properties of ductility, malleability, opacity to light, metallic luster, and conductivity for heat and electricity. Most metals are comparatively heavy. All except mercury are solid at ordinary room temperatures, and when solid they are crystalline in structure. (On warm days cesium and gallium, which have melting points of 83.3° F. and 85.6° F. respectively, are liquid also.) Further, their chemical properties are such that they commonly play the part of the positive or basic element in a simple compound.

The nonmetals include the gases and some solids. The solid nonmetals, as contrasted with the metals, are brittle, poor conductors for heat and electricity, and are often nonopaque. Chemically, they are usually the acid or negative elements in simple compounds.

The semi-metals are less perfectly metallic in their physical properties and, chemically, they often play the part of the acidic or negative elements in their compounds.

The physical and chemical properties of the metals are manifestations of more fundamental properties in the field of crystal chemistry. These properties—the arrangement or structure, spacing, and type of bond between the atoms—have been made the basis for still other definitions for metals, but unfortunately, as one might guess from the variety of physical properties, the elements show a great diversity of crystal chemical properties also, with continuous and gradual transition from metallic to nonmetallic atomic structures. Thus, even definitions based on the most fundamental known properties of the elements fail to sharply differentiate between metals and nonmetals.

A complicating factor is the dual role that many minerals play. For example, magnesite is an ore mineral of the metal magnesium, and as such might be classed as a metallic mineral; but on the other hand, magnesite is also used in making refractories, and for this use it would be classed as a nonmetallic mineral. Likewise, hematite and limonite, ores of iron, are also used as paint pigments; rutile, a titanium ore mineral, is used in making white pigments; chromite, the source of chromium, is also used as a refractory; and many other minerals can be classed either as metallic or nonmetallic, depending upon the particular use to which they are put. From a strictly practical point of view, the terms “metal” and “metallic mineral” as commonly used are purely conventional expressions.

Here, in Part II (Metallic Minerals) of this report, the occurrences of the following metals and semi-metals are listed: antimony, arsenic, bismuth, cadmium, cerium, chromium, cobalt, columbium, copper, gallium, germanium, gold, iron, lead, manganese, mercury, molybdenum, nickel, platinum, selenium, silver, tantalum, tellurium, thorium, tin, titanium, tungsten, uranium, vanadium, zinc, and zirconium. The occurrences of several other metals have previously been listed in Part I (Nonmetallic Minerals) of this report. These are the metals whose ore minerals can be classified either as metallic or nonmetallic. They include aluminum, barium, beryllium, boron, calcium, lithium, magnesium, potassium, silicon, sodium, and strontium.

Other minor metals probably will be found in the state as the demand for them increases. Most of the as yet undiscovered minor metals occur as accessory minerals or more often as “impurities” in other common minerals. As such they are difficult to recognize by means other than chemical or spectrographic analysis. Spectrographic analyses, especially, can be expected in the future to disclose more of the rare metals.
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<th>Specific gravity</th>
<th>Weight per cubic foot (pounds)</th>
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**DISTRIBUTION BY COUNTIES**

The following table shows the counties in Washington in which occurrences of the various metals have been reported. Many of these occurrences have not yet been proven to be of commercial grade or quality or may be of academic interest only, but many of the occurrences in these categories may later prove to have commercial value.

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ALUMINUM

Properties—Aluminum is the third most abundant element in the earth’s crust, comprising 8 percent of the crust to a depth of 10 miles, exceeded only by oxygen and silicon. It is an essential constituent of nearly all the important rocks except peridotite, sandstone, and limestone, and even in these it is a common impurity. It is easily oxidized, occurring most commonly as oxides and silicates, usually combined with other elements, and, because of its ease of oxidation, special techniques are necessary in smelting its ores. Some of the properties of aluminum are shown in the table on page 12. It is only about one-third as heavy as iron, and many of its uses derive from its light weight, combined with good malleability and resistance to corrosion, its high electrical and thermal conductivity, silvery luster, and high power of reflecting light and heat.

Uses—The largest user of the metal and its alloys is the building trade—for roofing, siding, window frames, ventilating ducts, and many other applications. Other large users are in the field of transportation—for trucks, busses, railroad cars, and of course for airplanes, the latter use being especially great during wartime expansion of the Air Force. Aluminum and its alloys are used in cooking utensils, household appliances, electrical wire and cable, machinery, furniture, tools, instruments, foil, and chemicals.

Production—Production involves reduction of bauxite to alumina (Al$_2$O$_3$) by the Bayer process, followed by treatment of the alumina by the Hall process, which produces metallic aluminum by electrolysis in a bath of molten cryolite. The largest production cost is for electricity. Because of the availability here of cheap electrical power a sizable portion of the United States production of aluminum comes from Washington, but as yet none has come from Washington ores. However, exploration of ferruginous bauxite in the southwestern part of the state by the Aluminum Company of America, and of high-alumina clays at several places in the state by Federal agencies has revealed substantial tonnages of these potential ores of aluminum, and it is reasonable to assume that some of them will be used in the not-too-distant future.

Occurrences

Occurrences of the minerals which might under certain conditions be classed as ores of aluminum are described in the previously published Part I (Nonmetallic Minerals) of this report—ferruginous bauxite, high-alumina (refractory) clays, alunite, and feldspar.

ANTIMONY

Properties—Antimony is chemically similar to arsenic and bismuth. The metal is silver white, exceedingly brittle, and has a hardness (Moh’s scale) of 3.0 to 3.5. It is a poor conductor of heat and electricity. Other properties are given in the table on page 12. Those properties which have important influence on its uses are: expansion on solidifying from a melt, strong diamagnetism (property of repelling a magnetic field), and marked thermolectric properties. It crystallizes in the rhombohedral division of the hexagonal system. Antimony commonly shows two valences, 3 and 5. With a valence of 5 it acts as a nonmetal, but in the valence of 3 it plays the part of either a nonmetal or a metal. Thus it falls in the class of semi-metals. It is not acted upon by air at room temperatures, but when heated it burns to form white fumes of the oxide Sb$_2$O$_3$.

Uses—About half of the antimony used is in the form of antimonal lead, in which the antimony content varies from about 2 to 25 percent, depending upon the use. Listed in decreasing order of importance from the point of view of tonnage, antimonal lead is used as bearing metal, storage battery plates, type metal, sheet and pipe
Antimony Occurrences—Chelan County

for the chemical and building industries, castings, cable covering, collapsible tubes and foil, and ammunition. In wartime the last mentioned use assumes greater importance, of course. Substitutes for antimony have been developed for many of these uses, but not in the manufacture of type metal. In this application its value lies in hardening the type and especially in the unusual property of expanding when it cools. Antimony has some uses as alloys with other metals—tin, copper, zinc, and aluminum being most common. Chemical compounds of antimony are used in greatest quantities in ceramics but are also important as ingredients of paints and lacquers, in flameproofing textiles, in coloring glass, in manufacturing cellulose acetate, and in miscellaneous uses such as vulcanizing rubber, colorfast dyes, and medicinal products.

Production—Antimony was first discovered in Washington probably in 1892 at the Great Republic mine in King County. A little ore was mined there between 1900 and 1905. Other small, sporadic production has been reported from Okanogan and Stevens Counties: an estimated 2,300 tons during World War I; small amounts in 1947; 48 tons in 1949; an estimated 150 tons in 1951; and an estimated 35 tons were mined and stock-piled in 1952.

Prices—The price of antimony has been very erratic, at times showing wide variations from month to month as well as from year to year. For example, the price of 10 cents per pound in 1915 jumped to 44 cents early in 1916. Later in the same year it dropped to 11 cents, only to rise to 33 cents early in 1917 and then drop back to 14 cents later that year. There were similar fluctuations during the period 1924 to 1927, and in 1952 the price ranged between an all-time high of 53 cents and a low of 14 cents. Four times during the period 1905 to 1935 the price was as low as 8 cents, with intervening highs of 16 cents or more. This chaotic price history has been a large factor in retarding the development of antimony properties in this country.

Ore minerals—The principal ore of antimony is the sulfide, stibnite, Sb₂S₃, containing 71.4 percent antimony, but most of the normal domestic supply is recovered as a byproduct from smelting copper, silver, and lead ores, in which it occurs most commonly as tetrahedrite, Cu₅Sb₄S₁₃, containing about 25 percent antimony. Native antimony occurs elsewhere, but it is not known in Washington. Three of the four known antimony oxides, valentinite, Sb₂O₃; cervantite, Sb₂O₃(OH); and stibiconite, Sb₂O₃(OH), are found in this state in small quantities, and in some countries these oxides are important ore minerals. Occurrences have been reported in Washington of the following minerals in which antimony is combined with one or more of the elements, lead, silver, copper, arsenic, iron, and sulfur: kermesite, Sb₂S₃; pyrrargyrite, Ag₃SbS₄; containing 59.7 percent silver, 22.5 percent antimony; boulangerite, Pb₅Sb₉S₂₈; stephanite, Ag₅SbS₄; jamesonite, Pb₄FeSbS₁₇; bournonite, Pb₃CuSb₂S₈; geocronite, Pb₃(Sb₂As)₃S₈; berthierite, FeSb₂S₄; bindheimite, PbSb₄S₂O₃H₂O; dyscrasite, Ag₅Sb₂; zinkenite, Pb₄Sb₃S₁₇; andorite, PbAg₃Sb₂S₈; meneghinite, Pb₁₃Sb₁₀S₂₃; and diaphorite, Pb₄Ag₃Sb₂S₈.

Geology—The antimony-bearing minerals can form under a wide range of conditions and they occur associated with a great variety of minerals, but stibnite, the only important ore of antimony, is found typically in epithermal deposits. As described by Purdy:³

³ Stibnite in Washington shows no particular affinity to any individual rock type. Commonly, stibnite occurs, (1) as all or part of the cementing material in breccias, (2) as irregular masses erratically distributed in quartz veins, or as disseminated particles or clusters throughout quartz veins, (3) as replacement deposits associated with fractured and/or silicificd areas in limestone, and (4) as small lenticular bodies, veins, veinlets, and disseminated particles throughout hydrothermally altered zones, or it is erratically distributed along shears in those zones. In all of these instances the stibnite proves to be the last sulfide mineral to have formed, which attests to the very low temperature and pressure conditions that seem to be most favorable for its development. As is characteristic of the epithermal group, the stibnite deposits are erratic and unreliable in the extreme, the majority of them the world around only reaching to comparatively shallow depths, possibly not over 2,000 feet, and containing ore of extremely irregular grade along the strike and dip. Most deposits, probably because of erosion since they were formed, seem to die out within a few hundred feet of the surface.


OCCURRENCES

The map showing the numbered antimony occurrences is plate 1, on page 7 in volume 2.

CHelan COUNTY

Bald Eagle and Gray Eagle

(see under copper)

Blewett

(see Peshastin under gold)

Caledonia (10)

(see under gold)

Ellen

(see Van Epps)

Gray Eagle

(see Bald Eagle and Gray Eagle under copper)

Humbug

(see under lead)

Hunter (4)

(see under silver)

Keefler Brothers (6)

(see under molybdenum)

King Solomon

(see Van Epps)

La Rica

(see Peshastin under gold)

Little Jap (2)

(see under silver)

Marcus Stein (1)

(see under silver)
Orphan Boy (5)  
(see under silver)

Peshastin (9)  
(see under gold)

Sevenmile Creek (1A)  
Loc: SE\(\frac{1}{4}\) sec. 15, (31-17E), on Sevenmile Cr.  Elev: 3,200 ft.  Access: Road from Lucerne and \(\frac{1}{2}\) mi. of trail.  Owner: Oscar Getty, Lucerne, Wash. (1952—).  Ore: Antimony.  Ore min: Stibnite, pyrite, nickel.  Deposit: 2 veins, one 2 to 5 ft. thick and traceable for 50 ft, the other 10 to 12 ft. thick.  Both are silicified breccia zones in granodiorite.  They contain pyrite, a very little stibnite, and some green nickel stain.  Dev: 100-ft. adit on lower (wider) vein.  Ref: 138.

Silver Fiend (8)  
(see under lead)

Snook and Ellen  
(see Van Epps)

Sunday Morning (3)  
(see under silver)

Van Epps (Snook and Ellen, King Solomon) (7)  

Wenatchee  
Loc: Wenatchee dist.  Ore: Antimony.  Deposit: Ore from the Antimony Queen mine in Okanogan County was shipped to Pateros and thence to Wenatchee during 1916.  Probably this fact is responsible for reported antimony production in the Wenatchee area.  Prod: Small production reported in 1916.  Ref: 67, p. 46.

White Star  
(see under lead)

CLALLAM COUNTY

Bright Angel (1)  
(see under manganese)

FERRY COUNTY

Advance (15)  
(see under silver)

Black Hawk (6)  
(see under lead)

Colorado (7)  
(see under silver)

Comstock (1)  
(see under copper)

Gwin (4)  
(see under silver)

Hall Creek  
(see Gwin under silver)

Juliet (9)  
(see under lead)

Keystone (14)  
(see under silver)

Kohler (3)  
(see under copper)

La Fleur  
(see Comstock under copper)

Little Tom  
(see Juliet under lead)

Longstreet (16)  
(see under silver)

Montana (10)  
(see under silver)

New York (13)  
(see under lead)

Old Nell (17)  

Perry (18)  

Pin Money (2)  
(see under gold)

Polepick (22)  
(see under copper)

Robert E. Lee (19)  

Rosario (11)  
(see under copper)

Silver Crown No. 1 (21)  
Antimony Occurrences—Ferry County

Silver Leaf (5) (see under silver)
Stray Dog (8) (see under silver)
Summit (20) (see under lead)

KING COUNTY

Aces Up (13) (see under silver)
Bear Basin (9) (see under silver)
Cleopatra (10) (see under silver)
Coney Basin (7) (see under copper)

Dawson (11)

Dutch Miller (15) (see under copper)

Gold Central (2)

Great Republic (Happy Thought) (4)
Loc: N1/4SW1/4 sec. 33, (26-11E), at first falls on Happy Thought Cr. Elev: 1,200 ft. Access: 1 1/2 mi. up Miller R. road, thence by trail. Prop: 5 unpatented claims. Owner: Charles Wible, Tacoma, Wash. (1949). Great Republic Gold Mining Co. (1902-1905). Ore: Antimony, gold, silver. Ore min: Stibnite, pyrite. Gangue: Quartz, calcite. Deposit: Flat-lying mineralized fault in andesite. At one place a lens of stibnite 2 1/2 ft. wide is exposed for a distance of 4 ft. Dev: 2 adits connected by a raise total 1,100 ft. of workings. Assays: One assay showed 14.05% Sb, 0.03 oz. Au, 2.41 oz. Ag. 6 samples taken to show mineral distribution, not av. grade of ore. showed 0.06% to 21.62% Sb, nil to 0.50 oz. Ag from widths of 0.2 to 4.0 ft. Prod: 1938-1941. Ref: 88, p. 84. 130, p. 59. 132, pp. 75-78. 141, p. 50. 157. 159, p. 135.

Happy Thought (see Great Republic)
Kimball (3) (see under gold)

Lennox (8) (see under gold)
Mohawk (5)

Pedro (see under copper)

Salmon Creek (1)

Silver Star (12) (see under silver)

Sockless Jerry (see Last Chance under gold)

KITTITAS COUNTY

Denny (see Goat Mountain)

Goat Mountain (Denny) (1)

Grizzly Bear (see under gold)

Majestic (see under gold)

Ruby King (see under gold)

LEWIS COUNTY

Jug Lake (2)
Loc: Reportedly on the W. shore of Jug Lk. Access: Trail up Summit Cr. or up Deep Cr. from Copper City. Ore: Antimony. Ore min: Stibnite. Deposit: Said to be a 2-ft. vein of antimony sulfide exposed in the lake shore and extending into the lake. Note: One investigator was unable to find this prospect. Ref: 158.

Reeves (1)

OKANOGAN COUNTY

Andy O. (see Andy O’Neil under silver)
Andy O’Neil (44)  
(see under silver)

Antimony  


Antimony Bell (Antimony Belle) (37)  


Antimony Queen (New Deal, Dixie Queen, Reedy, Silver Seal) (34)  

(see also Jumbo)  

Loc: SW¼NW¼ sec. 11, (31-21E). Elev: 2,050 to 2,550 ft. Access: 4.3 mi. up Gold Cr. road from Methow highway. 21 mi. to railroad at Pateros. Prop: 4 unpatented claims: Jumbo, Silver Bells Nos. 1 to 3. Owner: H. B. Johnston, Vernon La Motte, George Gibson (1940), William Oldfield (1941). Ore: Antimony, gold, silver, tungsten. Ore min: Stibnite, pyrite, scheelite, pyrrhotite, galena, jamesonite, sphalerite, arsenopyrite, calcicarbonate. Gangue: Calcite. Deposit: Quartz veins and mineralized breccia zones in limy argillite. One vein is 2 to 12 in. wide and carries from 10% to 90% stibnite. Ore shoots up to 2 ft. wide and 40 ft. long. Dev: 3 main adits, a caved drift, and several open cuts. Total length of workings about 1,000 ft. Assays: A 4-ft. sample from the face on the No. 5 level assayed 0.10 oz. Au, 3.6% Sb, 2.4% As. Another sample showed 0.66 oz. Ag. Prod: 1,050 tons of ore from 1907 to 1941. 20 tons produced in 1941 assayed 27% Sb. 1951. Ref: 37, pp. 50-51, 43, 1918, p. 309. 97, 1918, p. 42. 105, 1907, pp. 41, 264, 168, 4/41, p. 12. 130, p. 58. 132, pp. 109-122. 133, p. 23. 141, p. 1. 157. 158.

Apache (48)  
(see under silver)

Arizona (see under silver)

Arlington (28)  
(see under silver)

Bales (31)  


Bellevue (6)  
(see under gold)

Billy Goat (1)  
(see under copper)

Buckeye (see under silver)

Buckeye (8)  
(see under copper)

Bunker Hill  
(see Silver King under lead)

Carlquist (10)  


Castle Creek (39)  
(see under silver)

Chief Sunshine (18)  
(see under silver)

Chloride  
(see under silver)

Coyote (33)  


Crystalite  
(see under gold)

Dixie Queen (see Antimony Queen)

Double Header  
(see Little Chief under silver)

First Thought (23)  
(see under silver)

Fourth of July (29)  
(see under silver)

Frankie Boy (21)  
(see under silver)

Grand Coulee  
(see Little Chief under silver)

Hardscrabble (13)  
(see under silver)

Hargrove  
(see Silver King under lead)

Healum (36)  


Hercules (42)  
(see under lead)
Anti11Wny

Occurrences—Okanogan County

19

Horn Silver (4)
(see under silver)

Ivanhoe (7)
(see under silver)

Jumbo (25)
(see also Antimony Queen)

Laefuna
(see Leuena under silver)

Last Chance (24)
(see under silver)

Launa
(see Leuena under silver)

Lawrence
(see Lucky Knock)

Leonora (25)
(see under lead)

Leuena (19)
(see under silver)

Lilman (45)
(see under silver)

Little Chief (46)
(see under silver)

Lone Star (20)
(see under lead)

Lucky Knock (Lawrence) (9)

Mineral Hill (14)
(see under silver)

Minnehaha (15)
(see under silver)

Mountain Boy (40)
(see under lead)

Nevada (26)
(see under silver)

New Deal
(see Antimony Queen)

Olantangy (11)
(see under gold)

Panama (49)
(see under silver)

Par Value (47)
(see under silver)

Peacock (22)
(see under silver)

Plant-Callahan (30)
(see under silver)

Prince

Pyrargyrite
(see Ruby under silver)

Ramore (43)
(see under lead)

Reedy
(see Antimony Queen)

Rich Bar (5)
(see under copper)

Ruby (3)
(see under silver)

Salmon River (16)
(see under silver)

Seven Devils
(see Mineral Hill under silver)

Sidewinder
(see under gold)

Silver King (17)
(see under lead)

Silver Seal
(see Antimony Queen)

Sonny Boy (27)
(see under silver)

Stibnite (32)

Summit (38)
(see under lead)

Sunrise
(see under silver)

Sunshine Chief
(see Chief Sunshine under silver)

Swayne (2)
(see under copper)

Wasco (41)
(see under silver)

Washington Consolidated
(see Mineral Hill under silver)

Whitestone (12)
(see under gold)
Windfall  
(see under silver)

PEND OREILLE COUNTY

Bromide  
(see La Sota under silver)

La Sota (3)  
(see under silver)

Lena Belle (5)  
Loc: SE1/4NE1/4 sec. 6, (32-43E), near foot of SW. slope of No Name Peak, Newport dist.  
Elev: 3,000 ft.  
Access: Road.  
Ore: Antimony.  
Ore min: Stibnite.  
Deposit: A deposit of massive stibnite 18 in. thick was exposed for a strike length of about 10 ft. in dolomite.  
Ref: 132, p. 126.  139.

Maryland  
(see Pinnel)

Oriole (2)  
(see under zinc)

Pinnel (Maryland) (4)  
Loc: NW1/4SE1/4 sec. 12, (33-44E), on E. bank of N. Fk. of Skookum Cr.  
Elev: 3,200 ft.  
Access: 8½ mi. from Usk on the Skookum Cr. road.  
Prop: 60 acres deeded land.  
Owner: Ed Maryland, Usk, Wash. (1949).  
Ore: Antimony.  
Ore min: Stibnite.  
Deposit: Lenses of intermixed quartz and stibnite, ¼ in. wide and 4 in. in dia. fill fractures in quartzite a few hundred ft. W. of granodiorite body.  
Dev: 480-ft. adit, two open cuts.  

Silver Crest  
(see La Sota under silver)

Uncas (1)  
(see under zinc)

SKAGIT COUNTY

Higgins Mountain  
(see Lawrence under copper)

Lawrence (1)  
(see under copper)

SNOHOMISH COUNTY

Alleghany  
(see Foggy under copper)

Big Four (10)  
(see under lead)

Bonanza Queen (7)  
(see under copper)

Clara Thompson  
(see Jasperson under gold)

Columbia Mountain  
Loc: Troublesome Cr. area, 15 mi. from Index.  
Access: Trail.  
Prop: 2 claims.  
Ore: Reportedly antimony.  
Ore min: Said to be tetrahedrite.  
Ref: 158.

Commonwealth  
(see Jasperson under gold)

Consolidated  
(see under gold)

Eureka (8)  
(see under copper)

Everett (9)  
(see under copper)

Feldt (1)  
(see under silver)

Foggy (14)  
(see under copper)

"45" (11)  
(see under silver)

Glengarry  
(see under silver)

Gold Mountain (3)  
(see under copper)

Gray Mare (2)  
(see under copper)

Hard Pass (12)  
(see under copper)

Jasperson (13)  
(see under gold)

McCombs  
(see Jasperson under gold)

Mags  
(see "45" under silver)

Monitor and Sterling (6)  
(see under copper)

Monte Cristo (16)  
(see under gold)

Myrtle C (4)  
(see under copper)

Mystery  
(see Monte Cristo under gold)

New Seattle (5)  
(see under silver)

Old Gray Mare  
(see Gray Mare under silver)

Penn  
(see Foggy under copper)

Perm  
(see under gold)

Pride  
(see Monte Cristo under gold)

Sterling  
(see Monitor and Sterling under copper)

Webster  
(see Jasperson under gold)

Whistler (15)  
(see under lead)

STEVENS COUNTY

Acme (25)  
(see under lead)

Aguila (26)  
(see under lead)

Anaconda (8)  
(see under lead)

Ark (24)  
(see under silver)
Banner
(see Chinto under copper)

Blue Star
(see Eagle under silver)

Boundary Silver Lead
(see Lucile under zinc)

Brooks (47)
(see under silver)

Chewelah Eagle
(see Eagle under silver)

Chinto (30)
(see under copper)

Cleveland (42)
(see under lead)

Columbia River (20)
(see under copper)

Contention
(see Mountain View under silver)

Copper King (7)
(see under lead)

Copper Queen (28)
(see under copper)

Daisy
(see Daisy-Tempest under silver)

Daisy-Tempest (27)
(see under silver)

Deer Trail (43)
(see under silver)

Delmonico
(see Jay Dee under silver)

Dora
(see Acme under lead)

Eagle (32)
(see under silver)

Eagle-Newport
(see Aguila under lead)

Easter Sunday (1)
(see under gold)

Edna (39)
(see under copper)

Enterprise
(see Jay Dee under silver)

Frisco Standard (12)
(see under silver)

Galena Farm (17)
(see under lead)

Gold Bar (19)
(see under gold)

Hartford
(see Krug under copper)

High Grade
(see Jay Dee under silver)

Hoodoo (44)
(see under silver)

Jay Dee (29)
(see under silver)

Jay Gould (33)
(see under silver)

Joe Day (16)

Kazian

Kemp Komar
(see Loon Lake Copper under copper)

Keough (13)
(see under lead)

Key West
(see Loon Lake Copper under copper)

King
(see Edna under copper)

Krug (36)
(see under copper)

Liberty Copper (37)
(see under copper)

Little Frank (45)
(see under lead)

Longshot (22)
(see under lead)

Loon Lake Copper (40)
(see under copper)

Lucile (9)
(see under zinc)

Maple Leaf
(see Melrose under silver)

Melrose (6)
(see under silver)

Middleport (23)
(see under zinc)

Mountain View (4)
(see under lead)

Mullen (34)
(see under lead)

Myeerah (10)
(see under lead)

Nevada (38)
(see under lead)

Newland
(see Longshot under lead)

Newport
(see Aguila under lead)

Orazada (48)
(see under silver)

Owen
(see Lucile under zinc)

Paragon
(see Melrose under silver)

Pioneer
(see Longshot under lead)
Inventory of Washington Minerals—Part II, Metallic Minerals

Pomeroy (2)  
(see under zinc)

Providence (3)  
(see under lead)

Providence (Deer Trail)  
(see Deer Trail under silver)

Redwood  
(see Eagle under silver)

Rinchaw  
(see Middleport under zinc)

Robena  
(see Young America under zinc)

Royal Gold  
(see Hubbard under lead)

Santa Rita  
(see Cleveland under lead)

Saturday Night-Sunday Morning (46)  
(see under lead)

Schoneberg  
(see Schrenberg)

Schrenberg (Schoneberg) (35)  
Loe: SE1/4SW1/4 sec. 18, (32-41E), 1 mi. SE. of Chewelah.  
Access: Road within ¼ mi. of the deposit. Prop: 20 acres of  
deeded land. Owner: J. J. Schrenberg, Chewelah, Wash. (1900-  
1949). Leased to R. T. Bennett, Orland, Calif. (1943). Ore:  
Antimony. Ore min: Stibnite, chalcopyrite, pyrite. Gangue:  
Quartz, calcite. Deposit: Stibnite occurs as very small lenses  
in dolomite along the footwall of a 3-ft. quartz vein. Dev:  

Silver Mountain  
(see Daisy-Tempest under silver)

Silver Queen  
(see Ark under silver)

Sugar Loaf  
(see Vanasse under silver)

Sunday Morning  
(see Saturday Night-Sunday Morning under lead)

Sunset (5)  
(see under lead)

Tempest  
(see Daisy-Tempest under silver)

Tile Creek (15)  
Loe: SW1/4 sec. 7, (38-39E), on E. Bank of Ryan Cr. N. of  
Swede Pass. Elev: 1,800 ft., about 500 ft. above Columbia R.  
Access: Swede Pass road. Ore: Antimony. Ore min: Stibnite,  
scheelite, stibiconite, cerussite. Deposit: Quartz lens as much  
as 2 ft. thick along contact of limy argillite with a sill. Lens  

United Copper (31)  
(see under copper)

United Silver Copper  
(see United Copper under copper)

United Treasure (11)  
(see under silver)

Vanasse (21)  
(see under silver)

Venus  
(see Deer Trail under silver)

Victory  
(see Vanasse under silver)

Wall Street (14)  
(see under copper)

Wells Fargo (41)  
Loe: NW1/4NE1/4 sec. 36, (31-38E), on E. slope of Huckle­ 
berry Range near summit, Deer Trail dist. Elev: 3,800 to 3,950  
Owner: Leased by C. R. Carr, J. M. Carr, and F. B. Carr  
(1846-1949). Wells-Fargo Mining Co. (1897-1920). Ore: Anti­  
mony, silver, gold, lead, zinc. Ore min: Stibnite, pyrite, jameson­  
ite. Gangue: Quartz, barite. Deposit: 3- to 5-ft. quartz vein in  
argillite and dolomite essentially parallel to laminations of  
the country rock. Jamesonite occurs disseminated in the vein.  
Dev: 2 crosscut adits and a shaft. One adit 125 ft. long, the  
other 180 ft. Assays: Ore shipped av. 7% Sb. A sample across  
3 in. of highest grade part of vein at open pit showed 0.02 oz.  
Au, 2.0 oz. Ag, 13.4% Pb, 0.05% Zn, 6.0% Sb. A grab sample  
from vein in upper adit showed 0.03 oz. Au, 5.2 oz. Ag, 18.9% Pb,  
2.0% Zn, 14.1% Sb. Prod: Small shipment of antimony ore in  
1937. Ref: 30, p. 75. 130, pp. 58-59. 132, pp. 146-148. 141,  

Young America (18)  
(see under zinc)

WHATCOM COUNTY

Gold Hill (1)  
(see under silver)

Northern Cascade  
(see Gold Hill under silver)

Peterson  
(see Gold Hill under silver)

YAKIMA COUNTY

Richmond (1)  
(see under lead)
Properties—Arsenic has been variously classified as a metal, a metal-like solid, a semi-metal, and a nonmetal, but in its appearance and in some of its other physical and chemical properties it has the qualities of a metal. It is a steel-gray, very brittle, crystalline solid having a hardness of 3.5 and metallic luster. Some other properties are shown in the table on page 12. It sublimes easily to a yellowish vapor which has a garlic-like odor, and it catches fire at about 180° C. It displays two valences, 3 and 5, in its compounds with other elements. The free element is not considered poisonous, but all its soluble inorganic compounds are violent poisons.

Uses—Arsenic finds its greatest use in the form of its poisonous compounds, such as the calcium, lead, and sodium arsenates, lead arsenite, and Paris green, for insecticides and weed killers. Arsenic is used in making glass, enamels, wood preservatives, drugs, dyes, and as alloys with lead and copper. In copper it increases the corrosion resistance and raises the annealing temperature, and for shot metal it is added in amounts up to 1 percent to harden and improve the sphericity of the shot.

Production—Little arsenic is produced in the metal form; most of it is made in the form of white oxide, \( \text{As}_2\text{O}_3 \). Washington has the distinction of being the first state in this country to produce white arsenic on a commercial scale. Equipment to recover white arsenic at a smelter in Everett was built in 1901, and for several years it was the only producer in the United States. In its first 3 years of operation it produced 2,062 tons of white arsenic, valued at \$135,871, as a byproduct of smelting gold ores, primarily from the Monte Cristo district in Snohomish County.

The ore was treated in 1920 in a 15-ton mill at Reiter, Snohomish County. In its first 10 years of operation it produced 2,052 tons of white arsenic, valued at \$135,871, as a byproduct of smelting gold ores, primarily from the Monte Cristo district in Snohomish County. The copper smelter at Tacoma began recovering white arsenic in 1907, and it is reported to have produced 3,000 tons in 1920. This plant has produced arsenic intermittently to the present time, and in 1950 it was one of only five producers in this country. Domestic white arsenic is produced principally as a byproduct in smelting ores of copper and lead, and the amount of production depends primarily on the market demand rather than on existing plant capacity. The availability of relatively cheap byproduct arsenic makes it improbable that arsenic mining, as such, will ever be profitable in Washington in normal times, but in the past, two small plants operated briefly on straight arsenic ores. In 1906 a plant near Mineral, Lewis County, used realgar ore, and the same type of ore was treated in 1920 in a 15-ton mill at Reiter, Snohomish County.

Prices—The price history of arsenic is markedly different from that of the other metals in that the price has changed relatively little over a long period of years. Although the price for white arsenic rose from 8½ cents per pound in August 1922 to 15½ cents in December of that year, the price was 5 cents in 1925 and since then has been relatively stable with very little rise. In fact, the 10-year average from 1941 through 1950 was 4.8 cents, only 0.3 cents higher than the 4.0-cent average for the 10 years from 1925 through 1934. Although the price has been fairly stable, the market demand has varied greatly from year to year, depending upon the demand for arsenical insecticides.

Occurrences—Native arsenic is fairly common but has been reported in Washington only in the vicinity of Goat Lake in the Monte Cristo district, Snohomish County. The most common arsenic minerals are arsenopyrite, FeAsS, containing 46.0 percent arsenic, and the sulfides, realgar, AsS, containing 70.1 percent arsenic, and orpiment, \( \text{As}_2\text{S}_3 \), containing 61.0 percent arsenic. These are widely distributed throughout the mineralized districts of the state. Perhaps the district best known for its arsenical ores is the Monte Cristo camp in Snohomish County, where arsenopyrite was mined for its gold and silver content. Other, less common arsenic minerals are arsenolite, \( \text{As}_2\text{O}_3 \); tennantite, \( 3\text{Cu}_2\text{S} \cdot \text{As}_2\text{S}_3 \); proustite, \( 3\text{Ag}_2\text{S} \cdot \text{As}_2\text{S}_3 \); the arsenides, löllingite, \( \text{FeAs}_2 \); smaltite, \( \text{CoAs}_2 \); cholanthite, \( \text{NiAs}_2 \); nicolite, \( \text{NiAs} \); and many rare sulfarsenides of copper, silver, and lead.

Geology—Arsenopyrite is found in a wide variety of occurrences, as with tin and tungsten in pneumatolitic deposits; in quartz veins with gold, silver, galena, sphalerite, pyrite, chalcopyrite, tetrahedrite, calcite, siderite, and many other minerals; with cobalt and nickel ores; in contact-metamorphic deposits; in pegmatites; and disseminated in crystalline rocks, as schist, gneiss, limestone, and serpentinite; but it usually favors deep-zone conditions of origin. On the other hand, realgar, orpiment, and arsenolite are usually found at shallow depths. Arsenolite is always a secondary mineral, but realgar and orpiment may be either primary or secondary.
Inventory of Washington Minerals—Part II, Metallic Minerals

Doubtful (3)
(see under lead)

Ellen
(see Van Epps under antimony)

Esmeralda
(see under copper)

King Solomon (5)
(see under copper)

King Solomon (Van Epps)
(see Van Epps under antimony)

La Rica
(see Black Jack, also Peshastin under gold)

Moscow (4)
(see under copper)

North Star (15)
(see under gold)

Olympia (16)
(see under gold)

Orphan Boy (8)
(see under silver)

Peshastin (17)
(see under gold)

Phelps (18)
(see under gold)

Pole Pick No. 2
(see Alta Vista under gold)

Quien Sabe (1)
(see under lead)

Red Cap (9)
(see under gold)

Red Hill (10)
(see under gold)

Red Mountain (11)
(see under copper)

Royal
(see Red Mountain under copper)

Sandell (19)
(see under gold)

Snook and Ellen
(see Van Epps under antimony)

Van Epps (12)
(see under antimony)

Gwin (7)
(see under silver)

Hall Creek
(see Gwin under silver)

Juliet (9)
(see under lead)

Juno (5)
(see under silver)

Kentucky Belle (2)
(see under lead)

Little Tom
(see Juliet under lead)

Meteor (10)
(see under silver)

New York (11)
(see under lead)

Pin Money (1)
(see under gold)

Robert E. Lee (13)
(see under antimony)

Rover Bonanza (16)
(see under silver)

Silver Tip (6)
(see under silver)

Stray Dog (8)
(see under silver)

U. S. (14)
(see under lead)

KING COUNTY

Aces Up (10)
(see under silver)

Apex (2)
(see under gold)

Bear Basin (12)
(see under silver)

Bergeson (4)
(see under gold)

Black Diamond (20)


Bondholders Syndicate
(see Apex under gold)

Cleopatra (11)
(see under silver)

Coney Basin (7)
(see under gold)

Copper Plate
(see Seattle-Cascade under silver)

Damon and Pythias (1)
(see under gold)

Dawson (8)
(see under lead)

FERRY COUNTY

Apex
(see Big Chief under lead)

Big Chief (12)
(see under lead)

Blue Horse (3)
(see under silver)

Blue Jacket (4)
(see under silver)

Chief
(see Big Chief under lead)

Colorado (15)
(see under lead)
Arsenic Occurrences—King County

Dutch Miller (13)
(see under copper)

Extra (5)
(see under gold)

 Fathers Day (18)
(see under copper)

Franklin
(see Red Crystal)

Goat Mountain (17)
(see under lead)

Green River (21)

Last Chance (3)
(see under gold)

Lennox (16)
(see under gold)

Mona
(see Mono under copper)

Mono (6)
(see under copper)

Monte Carlo (14)
(see under gold)

Mount Phelps (15)
(see under zinc)

Normandie
(see Bergeson under gold)

Pythias
(see Damon and Pythias under gold)

Red Crystal (Franklin) (19)

Seattle-Cascade (9)
(see under silver)

Silver Dollar and Copper Plate
(see Seattle-Cascade under silver)

Sockless Jerry
(see Last Chance under gold)

Triple S
(see Seattle-Cascade under silver)

KITSAP COUNTY

Chico (1)
(see under tin)

Cook-Kitchen
(see Chico under tin)

Kitchen
(see Chico under tin)

KITTITAS COUNTY

American Eagle
(see under gold)

Aurora (1)
(see under gold)

Bob Canson (4)
(see under copper)

Bob (see under gold)

Edna R. (2)
(see under gold)

Little Kachess Lake (5)
(see under copper)

Lynch
(see Aurora under gold)

Maud O. (3)
(see under gold)

Paramount
(see Aurora under gold)

LEWIS COUNTY

Eagle Peak (2)
(see under copper)

Mineral Creek (1)
(see under zinc)

Paradise (3)
(see under copper)

OKANOGAN COUNTY

Abernathy (24)
(see under copper)

Antimony Gold
(see Abernathy under copper)

Antimony Queen (30)
(see under antimony)

Bellevue (5)
(see under gold)

Black Rock (29A)

Bolinger (32)
(see under gold)

Carquist (9)
(see under antimony)

Chesaw (12)
(see under gold)

Copper World (7)
(see under copper)

Copper World Extension (8)
(see under copper)

Crown Point
(see Imperial under gold)
Crystal Butte (13)
(see under gold)

Dixie Queen
(see Antimony Queen under antimony)

Friday (33)
(see under gold)

Gold Key (22)
(see under gold)

Golden Triangle
(see under gold)

Golden Zone (1)
(see under gold)

Heath (27)
(see under lead)

Homestake (16)
(see under lead)

Horn Silver (4)
(see under silver)

Imperial (19)
(see under gold)

Iron Cap and Snow Cap (25)
(see under gold)

Iron Mask
(see Copper World Extension under copper)

Mazama Pride (23)
(see under gold)

Mid Range (28)
(see under gold)

Montana (20)
(see under copper)

Mother Lode (14)
(see under gold)

New Deal
(see Antimony Queen under antimony)

Olentangy (10)
(see under gold)

Pyrargyrite
(see Ruby under silver)

Rainbow (6)
(see under gold)

Rattlesnake (28)
(see under gold)

Reco (11)
(see under gold)

Red Shirt (29)
(see under gold)

Reedy
(see Antimony Queen under antimony)

Rosalind (21)
(see under gold)

Ruby (2)
(see under silver)

Saint (3)
(see under gold)

Salmon River (17)
(see under silver)

Second Prize
(see under gold)

Shelby
(see under silver)

Sherman (18)
(see under lead)

Silver Ledge (31)
(see under gold)

Silver Seal
(see Antimony Queen under antimony)

Silver Star
(see under silver)

Silver Tip
(see Starr under molybdenum)

Snow Cap
(see Iron Cap and Snow Cap under gold)

Standard
(see Sherman under lead)

Starr (15)
(see under molybdenum)

Tom Hal
(see Friday under gold)

PEND OREILLE COUNTY

Alger and McCullough (2)
(see under copper)

Bead Lake (3)
(see under lead)

Blue Jim (1)
(see under silver)

Conquest
(see Kootenai Conquest under lead)

Kootenai Conquest (4)
(see under lead)

McCullough
(see Alger and McCullough under copper)

Snowbird and Stanley (5)
(see under lead)

Stanley
(see Snowbird and Stanley under lead)

West
(see Blue Jim under silver)

PIERCE COUNTY

Clipper (1)
(see under copper)

Mothers Day
(see Clipper under copper)

Silver Creek (2)
(see under gold)

SKAGIT COUNTY

Alta (6)
(see under lead)

Alverson (1)
(see under nickel)
Arsenic Occurrences—Skagit County

Boston (7)  (see under lead)

Cerrico  (see under lead)

Chicago (8)  (see under lead)

Clear Lake (2)

Cultus Mountain (4)  (see under nickel)

Higgins Mountain  (see Lawrence under copper)

Lawrence (5)  (see under copper)

Nookachamps Creek (3)
  Loc: Near S. line sec. 22, (34-5E), on the upper part of Nookachamps Cr. Ore: Arsenic. Ore min: Realgar. Deposit: Realgar float found as boulders in the stream is not much rounded and may be near the source. Ref: 158.

SKAMANIA COUNTY

Commonwealth (1)  (see under copper)

Perry (2)  (see under gold)

SNOHOMISH COUNTY

Ala-Dickson (27)  (see under copper)

Alleghany  (see Foggy under copper)

American Arsenic  (see Reiter)

Argonaut and Typo (49)  (see under gold)

Ben Lomond  (see Rainy under gold)

Big Four (24)  (see under lead)

Blue Rock (36)  (see under copper)

Bonanza  (see Mineral Center under gold)

Bonanza Queen (10)  (see under copper)

Border Queen (31)  (see under copper)

Boston  (see Butte and Boston)

Bullet (8)  (see under copper)

Butte and Boston

Calumet (32)  (see under gold)

Cassidy (50)  (see under gold)

Chickamun  (see Forest-Chickamun under copper)

Clara Thompson  (see Jasperson under gold)

Cleveland (13)  (see under copper)

Commonwealth  (see Jasperson under gold)

Consolidated  (see under gold)

Copper Chief (60)  (see under copper)

Copper Independent (14)  (see under gold)

Daisy (37)  (see under gold)

Dry Creek  (see under gold)

Eclipse (15)  (see under gold)

Edison (42)  (see under gold)

Eldred (33)  (see under copper)

Engdahl (61)  (see under copper)

Feldt (1)  (see under zinc)

Foggy (40)  (see under copper)

Forest-Chickamun (5)  (see under copper)

"48-55" (29)  (see under copper)

"45" (23)  (see under silver)

Garnet  (see "48-55" under copper)

Glory of the Mountain (35)  (see under gold)

Gold Eagle (43)  (see under gold)

Golden Chord  (see Justice under gold)

Granite and Maud (16)  (see under gold)

Great Scott (56)  (see under gold)

Hicks  (see Sultan King under copper)

Hustler (34)  (see under copper)

Imperial (17)  (see under copper)
Independent
(see Copper Independent under gold)

Index Gold Mines, Inc. (68)
(see under gold)

Iron Clad (69)
(see under gold)

Jasperon (62)
(see under gold)

Jim Dandy (63)
(see under gold)

Justice (51)
(see under gold)

Lida (44)
(see under copper)

Lily James (11)
(see under gold)

Lily of the West (37)
(see under gold)

Little Chief (28)
(see under copper)

Louise
(see Mineral Center under gold)

Lucky Strike (9)

Lulu (18)
(see under gold)

McCombs
(see Jasperon under gold)

Mackinaw (58)
(see under copper)

Magus
(see "45" under silver)

Martin Engdahl (64)
(see under lead)

Maud
(see Granite and Maud under gold)

Milwaukee (25)
(see under zinc)

Mineral Center (45)
(see under gold)

Mineral Mountain (46)

Monte Cristo (52)
(see under gold)

Mountain Cedar (30)
(see under copper)

Mystery (Monte Cristo, Pride)
(see Monte Cristo under gold)

Mystery (Mountain Cedar, Paystreak)
(see Mountain Cedar under copper)

National (47)
(see under copper)

Nemo (12)
(see under gold)

New York (19)
(see under copper)

North Star
(see Sunrise under gold)

O and B (41)
(see under copper)

Oldfield
(see Sunrise under gold)

Ore Recoveries (20)
(see under copper)

Paystreak
(see Mountain Cedar under copper)

Peabody (53)
(see under gold)

Pelican (3)
(see under gold)

Penn
(see Foggy under copper)

Perm
(see under gold)

Philo (54)
(see under copper)

Pride
(see Monte Cristo under gold)

Queen Anne (4)
(see under gold)

Rainy (55)
(see under gold)

Reiter (American Arsenic) (71)

Ruby King (65)
(see under gold)

Sam Strom (6)
(see under copper)

Silver Horseshoe (26)
(see under silver)

Silver Slipper (66)
(see under gold)

Sultan King (50)
(see under copper)

Sultan Queen
(see Sultan King under copper)
Sunrise (2)
(see under gold)
Sunset (38)
(see under gold)
Texas (70)
(see under gold)
Typo
(see Argonaut and Typo under gold)
Union (39)
(see under gold)
Vesper Peak
(see “48-55” under copper)
Virginia (21)
(see under copper)
Washington-Iowa
(see Mineral Center under gold)
Webster
(see Jasperson under gold)
Weden Creek
(see Mackinaw under copper)
Westland (67)
(see under copper)
White Gander (7)
(see under copper)
Wild Rose (48)
(see under copper)
Winter Coon (22)
(see under gold)

STEVENS COUNTY
Acme (4)
(see under lead)
Banner
(see Chinto under copper)
Centennial (2)
(see under copper)
Chewelah Consolidated (6)
(see under lead)
Chinto (7)
(see under copper)
Chloride (13)
(see under lead)
Cleveland (12)
(see under lead)
Daisy
(see Daisy-Tempest under silver)
Daisy-Tempest (5)
(see under silver)
Dora
(see Acme under lead)
Edna (11)
(see under copper)
Germania (15)
(see under tungsten)
Gold Bar (3)
(see under gold)

Juno-Echo (9)
(see under copper)
King
(see Edna under copper)
Orazada (16)
(see under silver)
Santa Rita
(see Cleveland under lead)
Silver Mountain
(see Daisy-Tempest under silver)
Tempest
(see Daisy-Tempest under silver)
Togo (14)
(see under copper)
United Copper (8)
(see under copper)
United Silver Copper
(see United Copper under copper)
Western Molybdenum
(see Juno-Echo under copper)
White Horse (1)
(see under copper)
Windfall (10)
(see under copper)

WHATCOM COUNTY
Allen Basin (4)
(see under gold)
Chancellor (2)
(see under gold)
Great Excelsior (1)
(see under gold)
Indiana
(see Chancellor under gold)
Lincoln
(see Great Excelsior under gold)
Mammoth (3)
(see under gold)
President
(see Great Excelsior under gold)
Quinn
Tacoma (5)
(see under gold)

YAKIMA COUNTY
Bird (4)
(see under tungsten)
Chinook (1)
(see under copper)
Copper Mining Co. (5)
(see under copper)
Garibaldi (6)  
(see under tungsten)

Keystone (3)  
(see under copper)

**BARIUM**

**Properties**—Barium is a soft silver-white metal that is like lead in appearance. It belongs to the alkaline earth group and resembles calcium chemically. Although the metal is not especially heavy, many of its compounds have high density, and many of their uses depend upon this property. The pure metal is unstable and is the most active of the alkaline earth metals except radium. It reacts vigorously with water to produce hydrogen and barium hydroxide. All soluble barium salts are very poisonous. They give a green color to the flame when placed in a fire. Other properties are given in the table on page 12.

**Uses**—The metal has few uses, but its compounds have several important uses, which are mentioned under barite in Part I of this report. A thin film of barium is used to lubricate the rotor operating at high speed in a vacuum in an X-ray tube, where ordinary lubricants fail. A high-nickel alloy is used in spark plugs, and alloys with lead have been made, but at the present time the only important use for barium metal is as an alloy with magnesium and aluminum as a "getter" in electronic tubes. (A "getter" is a volatile metal introduced into a vacuum tube for removing traces of undesirable gases.) A commonly used "getter" alloy contains one part barium, one part aluminum, and two of magnesium.

**Occurrences**

The occurrences of barite, the principal ore mineral of barium, are listed in Part I of this report.

**BERYLLIUM**

**Properties**—Beryllium, also called glucinum, is a steel-gray to silver-white nonductile metal which is brittle at room temperatures. It is similar to magnesium and aluminum in appearance and chemical composition. It weighs only about two-thirds as much as aluminum but is much harder (it will scratch glass but not quartz), has a much higher melting point, is more corrosion resistant, and is four times as elastic as aluminum and almost as elastic as steel. It is capable of taking a high polish. An interesting property is that of transmitting sound at a very high velocity, about 2.5 times that of steel, which apparently has the next highest sound-transmission velocity. The metal has a high melting point, but it distills rapidly at a temperature only slightly greater than its melting point. Other properties are given in the table on page 12.

**Uses**—Military uses during World War II accounted for approximately 99 percent of domestic consumption, but peacetime uses are increasing. The pure metal is used in neutron generators and for windows in X-ray tubes. The metal and its compounds are of major interest in the atomic-energy program for its moderating effect upon the fast neutrons emitted by the fission of U-235 and plutonium, and probably for other undisclosed applications. Beryllium oxide is used in ceramics such as spark plugs and is receiving much attention in the field of cermets, combined metals and ceramics, for such superduty refractory applications as jet engines and gas turbines. Beryllium compounds are used in fluorescent screens and lights, but since mid-1949 this use has declined sharply due to the use of substitutes. The high velocity of sound in pure beryllium metal may bring applications in the field of acoustics. The major use for the metal is in alloys with iron, aluminum, magnesium, zinc, nickel, and copper, but especially with copper, where it develops properties somewhat analogous to those imparted to steel by carbon. Addition of up to a few percent of beryllium to copper produces a series of alloys that are heat treatable, high strength, highly conductive, corrosion resistant, fatigue resistant, and nonsparking. These alloys have many exacting uses in the manufacture of electrical and other instruments and equipment.

**Production**—A large part of this country's beryllium supply is imported, and the demand may be expected to increase in the future, so the pressure for discovery of new domestic supplies probably will increase. The only production to date in Washington was a few hundred
ounds of beryl mined from the Cannon (Calispell Peak, Railway Dike) pegmatite deposit in central-eastern Stevens County in 1952.

**Prices**—The price for beryllium usually is quoted as price per short ton unit (20 pounds) of BeO in beryl ore containing 10 to 12 percent BeO. For many years beryl ore was quoted at $3.00 per short ton unit, but after 1940 the price rose to $7.50 in 1942 and $14.50 in 1944. The following year the price dropped to $9.00, but by 1948 it had risen to $24.00. In September 1952 it was $38.50, and in March 1953 it was at a record high of as much as $50.00 for the best grades.

**Ore minerals**—The only commercial ore mineral of beryllium is beryl, a complex beryllium aluminum silicate, Be₃Al₂(SiO₄)₄. When pure it contains 13.9 percent BeO, but it is seldom pure, and the usual range is from 9 to 11 percent BeO. Other beryllium minerals, which if found in sufficient quantity could be sources of the metal, are phenacite, Be₃SiO₄, containing 45.5 percent BeO; chrysoberyl, Be₃O₅, containing 19.7 percent BeO; helvite, 3(Mn,Fe)₂Be₂SiO₆·2MnS, containing 12.6 to 13.5 percent BeO; gadolinite, Be₂Fe₃Si₂O₁₀, containing 10.7 percent BeO; and beryltonite, NaBePO₄, containing 19.7 percent BeO. Of these minerals, only beryl is known to occur in Washington.

**Geology**—Beryl occurs almost exclusively in pegmatite deposits in granite, in which it seldom constitutes more than 1 percent of the total. It occurs as distinct hexagonal crystals or as irregular masses, some of which may weigh as much as several tons. It is distributed sparsely and erratically, but in some pegmatites it is concentrated in recognizable zones. Most of the other potential beryllium ore minerals also occur in pegmatites, but helvite has been found in contact-metamorphic deposits.

**Occurrences**

The beryl occurrences in Washington are described in Part I of this report. The Cannon (Calispell Peak, Railway Dike) deposit is described in a little more detail on page 356 here in Part II under uranium, Stevens County. Another reported occurrence of beryl, not included in Part I, is described in Part II, page 37, under the name of Gemini, under chromium, Ferry County.

**BISMUTH**

**Properties**—Bismuth is a crystalline metal having a hardness of 2.0 to 2.5, a high lustre, and white color with a reddish tinge. It is brittle, but when heated to 100° C. is slightly ductile. Recent research has resulted in the manufacture of ductile bismuth which can be made into wire and ribbon and which will not age-harden or crystallize. Like antimony and gallium, bismuth expands for making sharp castings of objects which would be objectionable rather than adding to the value of the ore.

**Uses**—The recently developed ductile bismuth wire and ribbon are being used in electrical instruments, and bismuth has been used as an additive in stainless steel. The largest use as a metal is in alloys with lead and, to a lesser extent, with tin and cadmium. These alloys have some valuable properties in common with pure bismuth, particularly that of expanding when solidifying and of having low melting points—as low as 100° F. (38° C.). The low-melting point alloys are used for special solders, safety fuses, automatic sprinklers, dental amalgams, and for making sharp castings of objects which would be subject to damage by high temperatures. Because of its low absorption cross section for thermal neutrons, bismuth has attracted attention as a possible coolant for nuclear reactors. The greatest use (about 80 percent) is in the nonmetallic state, as compounds in medicine and industrial chemistry.

**Production**—The United States is about 50 percent self-sufficient in bismuth. The metal is reported to have been produced at four plants in this country in 1950. All this production was a byproduct of smelting lead and copper ores. No production has been reported from Washington.

**Prices**—For many years the bismuth market was effectively controlled by agreements among the relatively few foreign producers, and the United States market closely followed that of London. The New York price ranged between $1.70 and $2.15 per pound in 1910, rose as high as $4.00 in 1916, had returned to the earlier level by 1921, and has remained at about that level ever since, with a low of $1.00 in 1930 and a high of $3.35 in 1926. Since 1930 the price has remained at about the level ever since, with a low of $1.00 in 1930 and a high of $3.35 in 1926. Since 1930 the price has been steady, rising intermittently by small increments from $1.00 per pound in 1930 to $2.25 in September 1950, at which price it has remained to June 1955. Bismuth ores have rarely been marketable as such in the United States, but at times lead or copper ores containing 3 percent or more of bismuth have received payment for their bismuth content. In general, bismuth ores should contain at least 10 percent of bismuth metal, and ores as rich as 65 percent are available from foreign countries. It is customary for the lead and copper smelters to consider the bismuth content of ore received as being objectionable rather than adding to the value of the ore.

**Ore minerals**—Bismuth commonly occurs native. The native metal and the sulfide, bismuthinite, Bi₂S₃, containing 81.2 percent bismuth, are its principal ores. The only bismuth minerals reported in Washington are the lead-bismuth sulfide, cosalite, 2PbS·Bi₂S₃, containing 43.5 percent bismuth, and the basic carbonate, bismutite, Bi₂O₅·3CO₂·H₂O, containing 79.0 percent bismuth. Other relatively rare bismuth minerals are two silicates, the oxides, carbonate, molybdate, vanadate, arsenate, and several sulfoaluminates and tellurides.
Geology—In quartz veins bismuth occasionally is the principal ore, but generally it occurs as an accessory in many minerals and ores of copper, gold, silver, lead, and zinc. In places it is associated with tin, elsewhere with cobalt and uranium, and with tungsten. In addition to vein deposits, it is found in contact-metamorphic deposits and in pegmatites. In Washington, bismuth minerals have been found in a pegmatite, in several wolframite-bearing quartz veins, and in mixed copper-gold-silver-lead-zinc ores.

**OCCURRENCES**

The map showing the numbered bismuth occurrences is plate 3, on page 11 in volume 2.

**CHELAN COUNTY**

**Keefer Brothers (1)**  
(see under molybdenum)

**FERRY COUNTY**

**Talisman (1)**  
(see under copper)

**GRANT COUNTY**

**Black-Rosauer (1)**  
(see under silver)

**KING COUNTY**

**Pedro**  
(see under copper)

**OKANOGAN COUNTY**

**Boundary**  
(see Wolframite under tungsten)

**Ferris R. Ford**  
(see Wolframite under tungsten)

**Hatfield**  
(see Wolframite under tungsten)

**Key (3)**  
(see under silver)

**SNOHOMISH COUNTY**

**Lucky Strike (1)**  
(see under copper)

**Silver Coin (2)**  
(see under gold)

**STEVENS COUNTY**

**Calispell Peak**  
(see Cannon under uranium)

**Cannon (2)**  
(see under uranium)

**Germania (5)**  
(see under tungsten)

**Maple Leaf**  
(see Melrose under silver)

**Melrose (1)**  
(see under silver)

**Paragon**  
(see Melrose under silver)

**Railway Dike**  
(see Cannon under uranium)

**S. L. (4)**  
(see under tungsten)

**Tungsten King (3)**  
(see under tungsten)

**BORON**

Properties—Boron is generally considered a nonmetallic element, but sometimes it is classified as a metal, and in some respects it does act as a metal. Chemically, boron is similar to silicon and carbon and is markedly nonmetallic in its reactions. It acts as a reducing agent, and with few exceptions it is trivalent. In some physical properties it slightly resembles the metals. It forms black crystals nearly as hard as diamonds but also occurs in an amorphous form. The melting point is very high and the heat resistance is high, as is also the resistance to an electric current, although electrical resistance decreases with increased temperature. Other properties are given in the table on page 12.

Uses—Boron is added to melts of copper and other metals to deoxidize the metal before casting. Boron master alloys are added to medium- and high-carbon steels to confer depth hardenability and to intensify the effects of other ferro-alloys used, allowing large reduction in the amounts of other ferro-alloys needed to produce the desired effects. Boron carbide is the hardest commercial synthetic substance known; it is used for abrasives, for certain heavy-duty wear-resistance applications, and, because of its excellent refractory qualities, in jet engines. Metallic boron has only limited uses, but the nonmetallic compounds, borax and boric acid, have a very wide range of important uses as oxidation resistant coatings on metals, in glass manufacture, as fluxes, in soap, as trace-element plant food, and in industrial chemical processes; also, they have a large number of minor uses.

Production—Practically all of the minerals from which boron is extracted are produced in the desert areas of southern California. None has been produced in Washington, and no production may be anticipated in the future.

Prices—Elemental boron was quoted in 1955 at $10 to $13 per pound for metal of 90 to 92 percent purity and $12 to $15 per pound for metal of 95 to 97 percent purity.
Technical grade borax sold at $41.50 per ton during World War II, rose to $44.50 in 1946, and was selling at $33.25 per ton in the latter part of 1950.

Ore minerals—Boron minerals which have been produced commercially are borax, Na₂B₄O₇·10H₂O, containing 39.8 percent B₂O₃; kernite, Na₂B₄O₇·4H₂O, containing 51.0 percent B₂O₃; colemanite, Ca₂B₆O₁₁·5H₂O, containing 59.9 percent B₂O₃; ulexite, NaCaB₂O₄·6H₂O, containing 43.0 percent B₂O₃; sassolite, H₂BO₃, containing 56.4 percent B₂O₃; and boracite, Mg₆Cl₂B₁₁O₂₂, containing 62.4 percent B₂O₃. At least four boron-bearing silicate minerals are known in Washington, but none of these is now considered as an even remotely possible ore of boron. These are dumortierite, 8Al₂O₃·B₂O₃·6SiO₂·H₂O, containing 5.5 percent B₂O₃; tourmaline, H₃Al₃(BO₃)₂·Si₃O₁₀, about 6.6 percent B₂O₃; axinite, HCa₅(Mn,Fe)(Al,Si)₂O₁₀, about 5.2 percent B₂O₃; and ludwigite, (Mg,Fe)₆O₂·FeBO₃, about 7.7 percent B₂O₃.

Geology—The commercial borates occur in solution and in saline crusts around and in the muds of playa lakes and in older sedimentary rocks which represent ancient playa lake deposits. The borosilicate minerals are widely distributed in igneous rocks, particularly the granitic rocks.

Occurrences

The Washington occurrences of borates, tourmaline, and dumortierite are discussed under miscellaneous nonmetallic minerals in Part I of this report. Axinite has been found in the Blewett district in Chelan County and near Anacortes in Skagit County. Ludwigite has been reported in considerable quantity at the Read iron deposit in Stevens County, described here in Part II on page 204.

BORON OCCURRENCES

Cadmium

Properties—Cadmium is a soft bluish-white malleable and ductile metal. It is similar chemically and in appearance to zinc, with which it is usually found associated, but it is more malleable and ductile than zinc. It is easily fusible, is corrosion-resistant, and capable of taking a high polish. In most of its compounds it is bivalent. Other properties are shown in the table on page 12.

Uses—The largest use is as a protective coating on iron and steel, and in most respects it is better for this purpose than is zinc. In alloys with nickel, copper, and silver, cadmium is used in important quantities as bearing metal for heavy-duty applications. The third most important use is in the form of its compounds with sulfur and selenium as pigments in paint, rubber, ceramics, ink, and other products. Some of the cadmium alloys, such as Woods metal (12.5% cadmium), have very low melting points and are used in applications where this property is required, such as for electric fuses and automatic sprinklers. The metal has uses in atomic energy technology, in aluminum solder, and in electrical conductor wires. Small additions of cadmium increase the strength of copper wire without sacrificing conductivity. Cadmium compounds are used as insecticides, in medicine, photography, ceramics, and as phosphors. They also have other minor uses.

Production—All cadmium production is as a byproduct of smelting zinc-bearing ores. In 1950 there were 13 plants producing the metal in the United States. In Washington, cadmium has been found in zinc-lead ores in Pend Oreille, Stevens, and Ferry Counties, and although no records are available it is known that smelter payments have been made, in part, on the basis of the cadmium content of some of these ores which were shipped primarily for their zinc values.

Prices—Cadmium was quoted at $3.20 per pound in Germany in 1875. The price was $1.00 in the United States in 1906, when production first started in this country. The price continued to drop to 52 cents by 1909, then rose to $1.56 in 1916, and dropped to an average of 55 cents for the period 1931 to 1934. It rose to $1.22 in 1937, only to drop back to 59 cents in 1939, and then start a rise to the high of $2.55 in 1950 and 1952. In December 1953 the price was $2.00 per pound, but shortly thereafter it dropped to $1.70, where it remained through June 1955.

Ore minerals—Only the rare sulfide, greenockite, CdS, containing 77.8 percent cadmium; the oxide, cadmium oxide, CdO, containing 87.5 percent cadmium; and the carbonate, octavite, contain cadmium as the chief constituents.

Geology—No deposits of cadmium ore are known, but greenockite is fairly commonly associated with sphalerite as a greenish-yellow earthy coating. As such it is a secondary deposit, the cadmium probably being derived from alteration of cadmium-bearing sphalerite. Any ore in which there is sphalerite might also contain cadmium. The zinc concentrates from the Tri-State district average about 0.35 percent cadmium, but western zinc concentrates seldom contain more than 0.2 percent.

Occurrences

PEND OREILLE COUNTY

**American Zinc, Lead and Smelting Co.**

(see under zinc)

**Bella May** (new adit) (3)

(see under zinc)

**Clark**

(see Josephine under zinc)
Properties—Calcium is a lustrous silver-white malleable and ductile metal which is nearly as soft as lead. It is light in weight, being only about one and a half times as heavy as water. Calcium is the fifth most abundant element in the earth’s crust, comprising 3.6 percent of the outer 10-mile shell. It is one of the alkaline earth elements, chemically similar to strontium and barium. It has a strong affinity for oxygen, tarnishes readily, reacts with water, and burns with a brilliant crimson flame. Other properties are shown in the table on page 12.

Uses—Metallic calcium and calcium-silicon, calcium-manganese, and other alloys are used as deoxidizers and scavengers in steel making. The element has some use as an alloy constituent with ferrous and nonferrous metals. Up to 0.35 percent of calcium is added to magnesium to reduce heat-treating time and improve the surface of castings. In additions of up to 0.5 percent it hardens and strengthens lead, and in this use it is an important substitute for antimony. It also substitutes for tin in some lead alloys. Calcium is used as a “getter” in vacuum tubes, and is used as a reducing agent in processes for the recovery of uranium, titanium, and vanadium from their ores. Calcium minerals and compounds have many important large-scale uses in industry, the building trades, and agriculture, but these uses are all in the classification of industrial, or nonmetallic, minerals.

Production—The first commercial production of metallic calcium in this country was in 1936. In 1950 there were only two producers, one in Michigan and one in Connecticut. Since calcium minerals are extremely abundant and widely distributed throughout the United States, it is obvious that factors other than occurrences of the “ore” control the amount of the metal produced and the location of the producing plants.

Prices—Up to 1918 the price of metallic calcium was at or above $20 per pound, thus restricting the metal to only minor uses. Later the price dropped to $1.50, and in 1938 to 65 cents a pound. In 1941 it was $1.25, in 1944 it rose to $1.85, in 1948 to $1.95, and in 1949 to $2.05, where it remained through June 1955.

Ore minerals—Calcium never occurs free in nature but is combined most commonly as the carbonates, calcite, CaCO₃, containing 40.0 percent calcium, and dolomite, CaMg(CO₃)₂, containing 21.7 percent calcium; less commonly as the sulfates, gypsum, CaSO₄·2H₂O, containing 23.2 percent calcium; and anhydrite, CaSO₄, containing 29.4 percent calcium; and the fluoride, fluorite, CaF₂, containing 51.1 percent calcium. Calcium is an essential constituent of many abundant rock-forming silicate minerals, especially anorthite and the other plagioclase feldspars, the amphiboles, the pyroxenes, garnet, epidote, and scapolite.

Geology—Calcite and dolomite, which might be considered the principal ores of calcium, are two of the most common of minerals, occurring in all three major rock classes—sedimentary, igneous, and metamorphic. The calcium sulfate minerals likewise are widely distributed, and the silicate minerals containing calcium are extremely common and abundant in almost all rock types.

Occurrences

The occurrences of dolomite, calcium carbonate rocks (under limestone), and gypsum are listed in Part I of this report.
Cerium Occurrences

CERIUM

Properties—Cerium is the commonest of the group of 15 rare-earth elements. Pure cerium is seldom produced, except experimentally, as the properties of the rare earths are so similar, and they can be separated only with difficulty. Commercial cerium usually includes five rare-earth elements, in the following approximate percentages: cerium, 45; lanthanum, 25; neodymium and praseodymium, 15; and samarium, 10. Cerium is a lustrous iron-gray malleable and very ductile metal which is about as soft as lead. Of all the metals it has the greatest coefficient of expansion. It conducts electricity poorly and heat fairly well. It is a powerful reducing agent, and is attacked slowly by cold water and more rapidly by hot water. Other properties are shown in the table on page 12.

Uses—The best known use of cerium is as misch metal, alloyed with iron to give a brittle product which emits copious sparks when abraded and which is used for lighter flints. Another well-known, but declining use is as a minor constituent with thorium in treating gas mantles. Cerium is used in the cores of carbon electrodes for arc lights, and its compounds are used in optical glass, in the ceramic and textile industries, and in medicine. Cerium is alloyed with aluminum and magnesium for strength and hardness, it is added to special kinds of nodular cast iron, and in steel it confers hot workability and strength. In the past, only a few hundred pounds per year of cerium metal were consumed in this country, but the discovery in 1949 of very large reserves (one estimate gives 3 billion pounds) of high-grade rare-earth ores in California has opened up the possibility for development of entirely new large-scale uses. Large expansion of production should bring the price down, and lower prices for the metal may be expected to result in a large increase in its use in steel manufacture.

Production—In 1950 there were only three important producers of cerium or misch metal in this country, and these were all located in New York or New Jersey. The domestic ore is largely monazite from placers in Idaho and Florida, but the California bastnaesite ores may be in production in the near future. Although monazite is known to occur in placer sands in Washington, and as a minor constituent of pegmatitic phases of granite in the Sherman Pass region of Ferry County, none has yet been produced.

Prices—The prices of cerium metal, misch metal, and cerium alloys have not changed greatly in recent years. In 1928 ferrocerium sold at from $5.75 to $8.00 per pound, and in 1950 the price was $8.00. In 1935 ferrocerium and misch metal sold at $8.00 to $10.00, and in 1950 misch metal was $4.50 per pound. Cerium metal was quoted at $25.00 per pound both in 1935 and 1950.

Ore minerals—The principal ore of cerium has been monazite, a phosphate, \((\text{Ce,La,Di})\text{PO}_4\), containing about 32 percent \(\text{Ce}_2\text{O}_3\), and about 65 percent rare earths; but large deposits in California of bastnaesite, a fluorcarbonate of cerium and other rare earths, \((\text{Ce,F})\text{CO}_3\), containing up to 40 percent rare-earth oxides, probably will be an important source of ore in the future. Allanite (orthite), a complex silicate of thorium, cerium and other rare earths, aluminum, iron, and calcium has been reported in Washington. There are several dozen rare-earth fluorides, carbonates, silicates, fluosilicates, phosphates, titanates, tantalates, and columbates.

Geology—The rare earths are not really as rare as they seem. In reality they are more abundant than zinc, lead, or arsenic, but they are widely and sparsely disseminated, mostly as monazite, in igneous rocks, especially granites, gneisses, and pegmatites. They rarely make up more than a very small fraction of 1 percent of the containing rock. The only common type of concentration is in placer stream gravels and beach sands. Bastnaesite associated with barite and fluorite has been found in commercial-grade concentrations in lode deposits.

Occurrences

The map showing the numbered cerium occurrences is plate 3, on page 11 in volume 2.

DOUGLAS COUNTY

Columbia River Placer
(see under gold, placer)

FERRY COUNTY

Sherman Creek Pass (2)
(see under uranium)

Wilmont Bar Placer (1)
(see under gold, placer)

GRAYS HARBOR COUNTY

Moclips Placer (1)

KING COUNTY

Seattle Placer
(see under gold, placer)

Snoqualmie
(see under thorium)

OKANOGAN COUNTY

Happy Hill (1)
(see under uranium)

PEND OREILLE COUNTY

Dry Canyon (1)
(see under thorium)
Properties—Chromium is a bluish-white metal which has a high luster and is capable of taking a brilliant polish. It is tough, resistant to corrosion, and fairly ductile. At temperatures up to 300° C. chromium is not oxidized or corroded by air, oxygen, or chlorine. Electrolytic chromium is malleable, but metal produced by chemical reduction is brittle. Likewise, cast chromium has a hardness of 4 to 5, but chromium plating (electrolytic) has a hardness of 9, which is harder than case-hardened steel. The soluble compounds are very poisonous. Other properties are given in the table on page 12.

Uses—The uses of chromium may be listed under three categories—metallurgical, refractory, and chemical—which normally account for about 47, 37, and 16 percent respectively of the total. Perhaps the best known application, chrome plating on steel, actually uses only insignificant quantities of the metal. Chromium is the most commonly used of all the alloying elements. Increasing quantities are being used in aluminum and copper alloys, but by far the greater portion of the metallurgical chromium is used in steels. More than 30 kinds of stainless steels, with chromium as the chief alloy element, are currently made in the United States. Other chromium currently made in the United States.

Production—Most of the chromite consumed in this country normally is imported, but during World Wars I and II domestic production increased greatly, only to drop back to negligible amounts after the wars. Very small shipments have been made from deposits in Washington (200 tons prior to 1932), but most of the domestic production comes from southern Oregon and northern California.

Prices—Chromium metal in 1946 was quoted at 89 cents per pound, in 1948 at 93 cents to $1.05 per pound, and in 1951 at an average of $1.07 per pound. In March 1953 chromium metal, 97-percent pure, sold at $1.25 per pound, and 99-percent pure electrolytic metal at from $3.00 to $4.50 per pound. Chromite is sold in three grades. Metallurgical grade should contain a minimum of 49 percent Cr₂O₃, have a chrome-iron ratio of not less than 3 to 1, and have a hard lumpy structure, with pieces ranging from ½ inch to 6 inches in size. Refractory and chemical grades may contain less Cr₂O₃ and have lower chrome-iron ratios. These grades sell for about one-half to two-thirds the price of metallurgical chromite ores. Chromite rose from $11.20 per ton in 1915 to a high of $48.00 in 1918, then dropped back to $10.28 by 1921. From 1922 through 1939 the price remained very close to $20.00. During World War II the price rose to a maximum of $52.80, but by 1948 had dropped to $25.00 to $45.00 per ton, depending upon the grade of the ore. Turkish chromite was quoted in March 1953 at $55.00 per long ton, 48 percent Cr₂O₃, 3 to 1 chrome-iron ratio, but Rhodesian ore of the same grade was quoted at only $44.00 per ton, and Rhodesian chromite containing 48 percent Cr₂O₃ but having 2.8 to 1 ratio sold for $40.00. Domestic chromite delivered to the Grants Pass, Oregon, depot of the General Services Administration was bought by the government in 1953 at $115 per ton for lump ore and $110 for fines and concentrates containing 48 percent Cr₂O₃ and having a chrome-iron ratio of 3 to 1.

Ore minerals—The only commercial source of chromium is chromite, FeCr₂O₄. The pure mineral contains 98 percent Cr₂O₃, but it is rarely found in nature. Magnesium and aluminum commonly replace part of the iron and chromium, so that commercial chromite ores seldom contain more than 50 percent Cr₂O₃, and they may contain up to 20 percent each of MgO and Al₂O₃. Chromium-bearing minerals other than chromite which occur in Washington are the green garnet, uvarovite, 3Ca·Cr₂O₄·8SiO₃, containing 30.6 percent Cr₂O₃; the lavender-colored chrome chlorite, kammererite; a chrome-bearing amphibole; and a chrome-bearing clinopyroxene.

Geology—Chromium deposits may be classified as (1) layered, (2) pods, (3) lateritic iron, and (4) placer. The layered deposits are those in which chromite occurs in layers in the lower parts of sheet-like peridotite bodies whose areas commonly are measured in tens of square miles. The chro-mite layers are from a few inches to several feet thick and from a few hundred feet to several miles long, and they may contain 20 to 22 percent Cr₂O₃, as at Stillwater, Montana, up to 40 to 45 percent, as in the African deposits. The pod deposits are lenticular masses or individual grains of chromite randomly scattered in peridotite or serpentine. The pods may vary from a few pounds to more than a million tons. There are several deposits of this type in Washington, as well as several lateritic iron deposits which contain up to 3 percent Cr₂O₃. The lateritic iron deposits form by tropical weathering of serpentine or peridotite and may cover large areas. Chromite occurs as a constituent of black sands, most commonly in beach placers, but few, if any, such deposits have been of high enough grade to be workable at a profit.
The map showing the numbered chromium occurrences is plate 4, on page 13 in volume 2.

CHelan COUNTY

Blewett (5)
(see under iron)

Davenport
(see Nigger Creek under iron)

Hardcash (1)
(see under nickel)

Keefer Brothers
(see under molybdenum)

Lucky Queen (4)
(see under gold)

Nigger Creek (2)
Loc: SW \( \frac{1}{4} \) sec. 12, (22-16E), just E. of the divide between Nigger and Stafford Creeks. Elev: 5,800 ft. Access: About 4 mi. of trail from the end of Nigger Cr. road. Prop: No claim or lease on the property. Ore: Chromium. Ore min: Chromite. Deposit: No ore has been found in place, but several pieces of nearly pure chromite float weighing about 3 lb. each were found in 1942. Ref: 67, p. 15.

Nigger Creek (Davenport) (3)
(see under iron)

Washington Nickel
(see Blewett under iron)

CLallAM COUNTY

Cedar Creek Placer
(see under gold, placer)

Starbuck Placer
(see Cedar Creek Placer under gold, placer)

DouGLAS COUNTY

Columbia River Placer
(see under gold, placer)

FERRY COUNTY

Danville (1)

Gemini (2)

Keller (3)

KING COUNTY

Baring (1)
Loc: N\( \frac{1}{4} \)SE \( \frac{1}{4} \) sec. 10, (26-10E), 1\( \frac{1}{4} \) mi. S. of Baring. Owner: W. R. Anderson (1944). Ore: Chromium. Ref: 158. 165. sec. II-C, p. 23.

Seattle Placer
(see under gold, placer)

KITTITAS COUNTY

Balfour Guthrie
(see Cle Elum River under iron)

Bean Creek (8)
(see under iron)

Boulder Creek (Burke) (2)
Loc: SE \( \frac{1}{4} \)NE \( \frac{1}{4} \) sec. 35, (23-14E), on W. slope of Mt. Hawkins. Elev: 3,500 ft. Access: \( \frac{1}{2} \) mi. by trail from Cle Elum R. road. Owner: Frank Bryant, Cle Elum, Wash., had option to buy from the Northern Pacific Railway Co. (1942). Ore: Chromium. Ore min: Chromite. Deposit: Small lens mined out during World War I. A few hundred pounds of ore on the dump. Chromite occurs in serpentinized peridotite. Dev: Two short adits, some open cuts. Assays: About 50% \( \text{Cr}_2\text{O}_3 \). Prod: 1 carload of mixed ore from this and the Crowe property in sec. 33. Ref: 123, p. 65. 130, p. 62. 158.

Burke
(see Boulder Creek)

Cle Elum River, north deposit (1)
(see under iron)

Cle Elum River, south deposit (4)
(see under iron)

Crowe
(see Mount Hawkins)

Denney (3)

Devine
(see under iron)

Gallagher Head
(see Mount Hawkins)

Iron Peak (6)
(see under iron)

Kittitas Placer
(see under gold, placer)

Mount Hawkins (Crowe, Gallagher Head, Skipper) (5)
Loc: SW \( \frac{1}{4} \)NW \( \frac{1}{4} \) sec. 33, (23-15E), in Drew Cr. drainage on SE. slope of Mt. Hawkins, near small lake. Elev: 6,000 ft. Access: 24 mi. by road from railroad at Ronald, 6 mi. of which is steep mountain road. Prop: 9 claims: Chrome Compass, Don, Scoop, Last Wagon, Hope, Mary Ann, Homestake, Vision, June. Owner: Skipper Chrome Mining Co., Seattle, Wash., leasing from Jack Crowe, Cle Elum, Wash. (1942). Richard Denney

Red Rock (11)
(see under nickel)

Skipper
(see Mount Hawkins)

Stafford Creek (10)
(see under iron)

Standup Creek (9)

Teanaway (7)
(see under iron)

OKANOGAN COUNTY

Blackbird (5)

Brown Lake (7)

Cabin
(see Stepstone under nickel)

Chopaka (1)

Defense
(see Little Chopaka)

Dorian (6)

Double Eagle
(see Dry Bone under lead)

Dry Bone (see Dry Bone under lead)

Duke of Windsor
(see Dry Bone under lead)

Funkhauser
(see Johnson Creek)

Johnson Creek (Funkhauser, Omak) (8)
Loc: NE¼ sec. 5, (34-26E), near intersection of Riverside cut-off with the Omak-Conconully highway. Elev: 1,750 ft. Access: 8 mi. from Omak by road. Owner: Chrome Cliff Mining Co., Prosser, Wash. (1955—). Frank Funkhauser, Spokane, Wash. (1951—). Ore: Chromium. Ore min: Chromite. Gangue: Serpentine. Deposit: Chromite disseminated sparsely through ultrabasic rock. Near the ultrabasic-dolomite contact is a tabular body of nearly solid chromite 7½ ft. by 6 ft. by 3 ft. A small stringer about 2 in. wide and 18 in. long is about 10 ft. N. of the main pod. Assays: Chip sample across 5-ft. face of ore showed 26.88% Cr, 12.03% Fe, which gives a Cr/Fe ratio of 2.23. Another 5-ft. channel sample showed 42.65% Cr2O3, 10.65% Fe, which gives a Cr/Fe ratio of 2.75. A 5-ft. channel sample in the serpentine showed 11.35% Cr2O3. Prod: 8.9 tons assaying 42% Cr2O3 and having Cr/Fe ratio of 2.9 (1955). Ref: 157. 158. 171, pp. 21, 23, 30.

Jumbo (9)
(see also Stepstone under nickel)


Little Chopaka (Defense) (2)
(see also Peerless under copper)


Mohawk (11)
(see under zinc)

Okanogan

Omak
(see Johnson Creek)

Peerless (3)
(see under nickel)

Stepstone (10)
(see under copper)

Tonasket

Worthington (4)
(see also Peerless under copper)

Chromium Occurrences—Okanogan County

SKAGIT COUNTY

Anacortes (8)


Anacortes Placer

(see under gold, placer)

Bellingham (11)


Cultus Mountain (10)

(see under nickel)

Cypress Lake (1)


Devils Mountain

(see Mount Vernon under nickel)

Fidalgo Island


Last Chance (2)


Leader (12)

(see also Three Lakes)


McMaster (15)


Meadow (13)

(see also Three Lakes)


Mexican Bay

(see under nickel)

Mount Vernon (9)

(see under nickel)

Nellie Kelly (3)


Olive Hills (7)


P & H

(see Three Lakes)

Pacific

(see Mount Vernon under nickel)

Ready Cash (4)

Smith (Mexican Bay) (5)


Smith open cut (6)


Three Lakes (F & H, Wild) (14)

(see also Leader, Meadow)

Loc: Secs. 3 and 4, (36-7E), in area around Three Lks. Elev: 2,500 to 4,000 ft. Access: 5½ mi. by trail from end of old logging grade. 25 mi. to railroad at Hamilton. Prop: 26 claims, including: Shaft, Alamether, Gora, Leader, Meadow, Howard. Owner: Twin Sisters Chrome and Magnesium Corp., Seattle, Wash. (1954—). A 15-yr. lease (1940–1955) by Alwyn H. Wild from Industrial Mining, Inc. Ore: Chromium. Ore min: Chromite. Gangue: Dunite. Deposit: On Leader and Meadow claims is banded and disseminated chromite in a zone up to 145 ft. wide and lenses of pure chromite in dunite. Six chromite lenses from 2 to 8 in. wide occur in a 7½-ft. section of dunite in one place. Other places show lean chromite bands 8 to 16 in. wide. On Alamether claim is a band of disseminated chromite, est. to av. 13\% Cr\textsubscript{2}O\textsubscript{3}, exposed in cliff to width of 80 ft. and height of 100 ft. On Gora claim is a lens, est. to av. 25\% Cr\textsubscript{2}O\textsubscript{3}, from 3 to 20 ft. thick exposed in cliff to height of 300 ft. A band est. to av. 7\% Cr\textsubscript{2}O\textsubscript{3} is exposed on Shaft claim for less than 20-ft. width and about 300-ft. height. Dev: Open cuts, diamond dril. holes. Improv: Cabin (1961). Assays: Crude ore from the Leader had a Cr/Fe ratio of 2.35. From Meadow contained 4.95\% to 25.52\% Cr\textsubscript{2}O\textsubscript{3}, and had a Cr/Fe ratio of 2.9. Ref: 10, pp. 23-28. 70-A. 157. 158.

Twin Sisters


Wild

(see Three Lakes)

SNOHOMISH COUNTY

Florence Rae (2)

(see under copper)

Mountain Rae (1)

(see under copper)

Mystery

(see Mountain Cedar under copper)

Pay streak

(see Mountain Cedar under copper)

STEVENS COUNTY

Mally (1)

(see under iron)

WHATCOM COUNTY

Alaska (31)


Amos 'n Andy

(see Galbraith)

Anne

(see Robert and Anne)

Bates and Kraemer (28)


Boulder Creek (3)

Loc: On Boulder Cr. near Maple Falls. Ore: Chromium. Ore min: Chromite. Deposit: Chromite float is reported to have been found in Boulder Cr. Ref: 158.

Bumper (14)


Button


Crater

(see Thunder Mountain)

Cultus

(possibly part of Thunder Mountain property)

Loc: Near a branch of Skookum Cr. at NW. end of Twin Sisters Mtns. Prop: 1 claim, part of a group of 6 claims. Ore: Chromium. Ore min: Chromite. Deposit: Outcrop of disseminated ore is 5 ft. wide, 200 ft. long, and shows in bluff to depth of 30 ft. Assays: 18.4\% Cr\textsubscript{2}O\textsubscript{3}. Cr/Fe ratio is 2.78. Ref: 158.

Danny (21)


Dare

Chromium Occurrences—Whatcom County

Diablo (32)


E. N. H. (24)


Eight Hundred Kings (9)


Ford


Galbraith (Amos 'n Andy) (17)


Good Hope (20)


Government (27)


Grant


Hardscrabble

(see Thunder Mountain)

Harrington (10)


Hildebrand (18)


Hornet (25)


Joan

dunite 6 ft. wide and 40 to 60 ft. long contains 10 or 12 discon-

tinuous chromite schlieren, which are composed of 60% chro-
mite and 40% dunite. Ref: 158.

**Partner**

**Lode:** Headswaters of S. Fk. Nooksack R., T. 37 N., R. 6 E.

**Owner:** Washington Chrome Co., Seattle, Wash. Ore: Chromite.

**Ore min:** Chromite. Ref: 158.

**Pat**

**Lode:** E. slope of Twin Sisters Mtns., on headwaters of S. Fk.


**Rainbow**

**Lode:** 9 mi. N. of Hamilton, in Twin Sisters Mtns. Owner:

**Elev:** 3,875 ft. **Access:** Trail. **Prop:** 2 claims, part of a group of 6 claims. **Ore:** Chromium. **Ore min:** Chromite. **Deposit:** 2 parallel stringers of chromite 1 to 2 ft. wide and 20 ft. long. Ref: 158.

**Ranger (15)**

**Lode:** Near S. Fk. Nooksack R., sec. 13, (37-6E). Owner:

**Elev:** 3,875 ft. **Access:** Trail. **Prop:** 2 claims: Ribbon, Button. **Owner:** Washington Chrome Co., Seattle, Wash. (1934). Ore: Chromium. **Ore min:** Chromite. **Deposit:** Lenses of chromite in dunite. One lens on Ribbon claim was 20 ft. long and had a max. width of 3 ft. It was mined to a depth of 15 ft. **Dev:** Open cut. **Assays:** Crude ore assayed 52.2% Cr₂O₃ with a Cr/Fe ratio of 3.06. **Prod:** 20 tons of ore from Ribbon claim were sacked and shipped to Bellingham. Ref: 70-A. 158, 171, pp. 11-30.

**Robert and Anne**

(possibly part of Thunder Mountain property)

**Lode:** Near a branch of Skookum Cr., at NW. end of Twin Sisters Mtns. **Prop:** 2 claims, part of a group of 6 claims. **Ore:** Chromium. **Ore min:** Chromite. **Deposit:** Chromite stringers 1 to 6 in. wide and 5 to 20 ft. long. Ref: 158.

**Second Basal (30)**

**Lode:** W½ sec. 29 and E½ sec. 30, (37-7E), near divide be-

 tween Second Basin and Third Basin, Twin Sisters area. **Elev:**

4,300 to 4,500 ft. **Access:** Trail. **Prop:** Group of claims. **Ore:**

Chromium. **Ore min:** Chromite. **Gangue:** Dunite. **Deposit:**

3 exposed chromite lodes. Ref: 70-A.

**Seymour Creek**

(see Trappers Pride)

**Sister Creek**

(see M & M)

**Sisters**

(possibly part of Thunder Mountain property)

**Lode:** Near a branch of Skookum Cr., at NW. end of Twin

Sisters Mtns. **Prop:** 1 claim, part of a group of 6 claims. **Ore:**

Chromium. **Ore min:** Chromite. **Deposit:** Largest band of solid chromite is 1 to 2 ft. wide and 20 ft. long. Other smaller showings. **Assays:** 44.8% Cr₂O₃. Ref: 158.

**Skookum**

(possibly part of Thunder Mountain property)

**Lode:** Near a branch of Skookum Cr., at NW. end of Twin

Sisters Mtns. **Prop:** 1 claim, part of a group of 6 claims. **Ore:**

Chromium. **Ore min:** Chromite. **Deposit:** Outcrop 80 ft. long is

30 ft. wide at S. end and 10 ft. wide at N end. **Assays:** 25.5% Cr₂O₃. Ref: 158.

**Stein**

(see Sumas Mountain)

**Sumas Mountain (Stein) (2)**

**Lode:** Sec. 36, (40-5E), on N. end of Sumas Mtn. One occurrence in center, another said to be in NE¼ of the section. **Elev:**

2,500 ft. **Access:** Trail. **Owner:** Leased for 20 yr. in 1952 to

Yamate Trading Co., Ltd., San Francisco, Calif. Nooksack Min-
ing Co. (1949). Ore: Chromium. **Ore min:** Chromite. **Gangue:**

Serpentine. **Deposit:** A small stringer of chromite in ser-
pentine exposed in center of the section. Said to be a larger

body in the NE¼ of the section. **Dev:** An adit at 2,500 ft. altitude

near center SE¼NW¼ sec. 30. **Assays:** 38.8% Cr₂O₃ in the

ore. Cr/Fe ratio is 2.11. Ref: 70. 158. 171, pp. 13-30.

**Sumner (29)**

**Lode:** NW¼ sec. 31 and S¼SW¼ sec. 30, (37-7E), Twin Sis-
ters area. **Access:** Trail. **Prop:** 19 claims. **Owner:** John W.

Brisky, Mount Vernon, Wash. (1943). Ore: Chromium. **Ore min:**

Chromite. **Gangue:** Dunite. Ref: 158.

**Thunder Mountain (Odmark) (12)**

**Lode:** Near W. ½ cor. sec. 11, (37-6E), on headwaters of Oro-
sino Cr. **Elev:** 5,000 ft. **Access:** Trail. **Prop:** 10 claims including the Hardscrabble and Crater. **Owner:** Albert Odmark (1934). **Ore:** Chromium. **Ore min:** Chromite. **Gangue:** Dunite. **Deposit:** Small stringers and streaks of chromite in dunite over an area

50 by 60 ft. in extent. **Assays:** 7 samples of crude ore taken from different places av. 16.2% Cr. Ref: 70-A. 158.

**Trappers Pride (Seymour Creek) (13)**

**Lode:** SW¼ sec. 2, (37-6E), at head of Seymour Cr., Twin Sis-
ters area. **Elev:** 5,100 ft. **Access:** Trail. **Prop:** 1 claim.

**Owner:** L. E. Bradley (1937). Ore: Chromium. **Ore min:**

Chromite. **Gangue:** Dunite. **Deposit:** 2 parallel stringers of chromite 48 ft. long. Stringers are 1½ to 2 in. wide and separated by 4 to 5 in. of dunite. Ref: 158.

**Warren**

(possibly part of Thunder Mountain property)

**Lode:** Near a branch of Skookum Cr., at NW. end of Twin

Sisters Mtns. **Prop:** 1 claim, part of a group of 6 claims. **Ore:**

Chromium. **Ore min:** Chromite. **Deposit:** Several irregular

showings of low-grade ore 5 to 10 ft. wide. Ref: 158.

**Wells Creek (4)**

**Lode:** On Wells Cr. about 8 mi. E. of Glacier. **Access:** Said to be very inaccessible. **Ore:** Chromium. **Ore min:** Chromite. **Deposit:** Chromite is reported to have been found on Wells Cr. Ref: 158.

**Whistler (23)**

**Lode:** Near center sec. 17, (37-7E), on S. side of S. Fk. Nook-
sack R. **Elev:** 3,200 ft. **Access:** Trail. **Prop:** 1 claim: Whistler.

**Owner:** Washington Chrome Co., Seattle, Wash. (1934). Ore:

Chromium. **Ore min:** Chromite. **Deposit:** Chromite is banded

disseminated in saxonite. **Assays:** Most of the ore is low grade, but one sample of ore showed 32.8% Cr₂O₃ and had a Cr/Fe ratio of 2.06. Ref: 70-A. 158.

**Willie**

**Lode:** E. slope of Twin Sisters Mtns., T. 37 N., Rs. 6 and 7 E.

**Owner:** Washington Chrome Co., Seattle, Wash. **Ore:**

Chromium. **Ore min:** Chromite. **Deposit:** Ref: 158.

**Zoanne**

**Lode:** E. slope Twin Sisters Mtns., T. 37 N., Rs. 6 and 7 E.

**Owner:** Washington Chrome Co., Seattle, Wash. **Ore:**

Chromium. **Ore min:** Chromite. **Deposit:** Ref: 158.
COBALT

Properties—Cobalt is a silver-white metal which has a pinkish tinge. It is tough and has a hardness of 5.5, slightly harder than iron or nickel. It strongly resembles nickel in appearance and properties, especially in its resistance to corrosion. Cobalt is strongly magnetic, being exceeded in this property only by iron, and it retains its magnetism up to 1150°C. Other properties are shown in the table on page 12.

Uses—The most important use (35 percent in 1950) is as alloys with iron for permanent magnets. The second most important use (27 percent in 1950), and formerly the chief use, is as stellite-type alloys containing 45 to 55 percent cobalt, with chromium, molybdenum, tungsten, and iron. These alloys are hard and strong at high temperatures, even at red heat. They are used for facing machine parts subject to high abrasion and for high-speed tools, surgical instruments, jet-engine parts, and other high-heat uses. Cobalt oxide is a necessary ingredient in nearly all porcelain enamel ground coats, although this use formerly accounted for a larger percentage of consumption than now. Cobalt compounds are used in blue pigments, as driers in paints, and as catalysts in the chemical industries. Small amounts of cobalt are used for plating other metals, and an increasing amount is used as a binder in cemented carbides. A new and increasing use for cobalt is in making the radioactive isotope, cobalt 60, a potent radiotherapeutic agent.

Production—Although the United States is the largest consumer of cobalt, domestic production has remained small and sporadic, but planned production from the Blackbird area in Idaho would supply a sizable portion of the current demand in this country. Most of the imported cobalt now comes from the Belgian Congo, where it is recovered as a byproduct from copper ores. All foreseeable needs for cobalt can be supplied for many years by known reserves in the principal deposits, and few small producers can hope to compete. No cobalt ore has been produced in Washington.

Prices—Cobalt compounds were very rare and expensive until the New Caledonian ores came on the market. The price for cobalt oxide remained between $1.60 and $2.00 per pound for many years between the 1880’s and 1909, when the price jumped to $2.50, only to drop to $1.40 in the same year and to continue the decline to as low as 50 cents in 1912. Cobalt and its compounds remained a drug on the market until after 1915, when increased demand brought a strengthening of the market. Cobalt metal sold for as little as $1.00 per pound when the Canadian metal came on the market about 1909. By 1915 the metal price was $1.60. It rose from $1.25 to $2.25 in 1917, and from $2.50 to $6.00, an all-time high, in 1920. After dropping to about $3.00 a pound and remaining there from 1921 to 1923, the price declined to $2.50 and remained near that level through the early 1930’s. In 1940 the price for the metal, 97- to 99-percent purity, in kegs of 550 pounds, was $1.50 per pound, and it remained at that price through 1946, but rose to $1.65 in 1948, and was $1.80 in 1949 and 1950. In 1951 the price rose again to $2.40 per pound and remained there through the early part of 1953. By June 1955 the price was $2.60 per pound.

Ore minerals—The principal ore minerals of cobalt are the sulfarsenide, cobaltite, CoAsS, containing 35.5 percent cobalt; the arsenide, smaltite, CoAs3, containing 28.1 percent cobalt; and the sulfide, linnaeite, Co,S4, containing 55.8 percent cobalt. Smaltite and linnaeite have been found in Washington, as has also the less common sulfarsenide of cobalt and iron, glaucodot, (Co,Fe)AsS. Near Silverton in Snohomish County is an occurrence of the distinctive pink-colored earthy secondary mineral, erythrite (cobalt bloom), Co,As3O8+8H2O. This hydrous cobalt arsenate is seldom abundant enough to make ore, but it frequently serves to call attention to other less easily recognized cobalt ore minerals.

Geology—Cobalt never occurs native (except in meteorites) and never occurs as the only constituent of an ore. It is very commonly associated with nickel and is found in ores of copper, silver, gold, iron, lead, and zinc. As an arsenide it occurs with nickel in ores that in many places carry high values in silver and gold. As a sulfide cobalt occurs with copper and iron minerals. This type of occurrence is exemplified by the deposits in the Blackbird district in Idaho, which contain 0.4 to 1.0 percent cobalt along with 1 to 2 percent copper, 10 to 15 percent iron, 0.5 to 1.5 percent arsenic, and 3 to 13 percent sulfur. Cobalt ores are found as veins in and near igneous rocks and in residual rocks formed by weathering of basic igneous rocks.

OCCURRENCES

The map showing the numbered cobalt occurrences is plate 5, on page 15 in volume 2.

CHelan COUNTY

Black Republican
(see under copper)

Blue Jay (2)
(see under copper)

Chelan
(see Dick under nickel)

Dick (6)
(see under nickel)

Keefer Brothers (4)
(see under molybdenum)

King Solomon (1)
(see under copper)

Monarch (18)
(see under gold)

Ontario (16)
(see under gold)

Red Butte (19)
(see under gold)

Red Cloud and Tralee
(see under copper)
Inventory of Washington Minerals—Part II, Metallic Minerals

FERRY COUNTY
Congress (4) (see under nickel)
Pin Money (1) (see under gold)

KITTITAS COUNTY
Bonanza (see Dolphin under copper)
Dolphin (7) (see under copper)

LEWIS COUNTY
Eagle Peak (1) (see under copper)

MASON COUNTY
Black and White (1) (see under copper)

OKANOGAN COUNTY
Pthomigan (1)

PEND OREILLE COUNTY
Bromide (see La Sota under silver)
Fissure (see under silver)
La Sota (3) (see under silver)
Silver Crest (see La Sota under silver)

SNOHOMISH COUNTY
Asbestos (3) (see under nickel)
Big Copper (7) (see under copper)
Feldt (2) (see under copper)
Hancock (11) (see under copper)
Little Chief (6) (see under copper)
Mackinaw (8) (see under copper)
Non Pareil (13) (see under copper)
Weden Creek (see Mackinaw under copper)
Wild Rose (12) (see under copper)

STEVENS COUNTY
Daisy (see Daisy-Tempest under silver)
Daisy-Tempest (7) (see under silver)
Maki (3) (see under lead)
New England (2) (see under zinc)
Rainbow (see under silver)
Silver Crest (see under silver)
Silver Mountain (see Daisy-Tempest under silver)
Stone (see New England under zinc)
Tempest (see Daisy-Tempest under silver)

COLUMBIUM (NIOBium) and TANTALUM

Columbium and tantalum are described together because they usually occur associated in the same ore deposits, many of their properties are similar, and some of their uses are the same. Despite the fact that the name columbium, commonly used in the United States, has more than 40 years' priority, the International Union of Chemistry in 1949 recommended that the name niobium, favored in some other countries, be adopted for this rare element. However, the name columbium is so well established it likely will continue in common use at least in this country.

Properties—Both columbium and tantalum when polished look like platinum but when unpolished are darker and bluer. They both are very ductile, malleable, tough, and strong. They may be welded, and both are remarkably resistant to corrosion by acids and other chemicals. They commonly have a valence of 5 in their compounds. Tantalum is about equal to mild steel in tensile strength, elasticity, hardness, and thermal conductivity. It has the highest melting point of the metals other than tungsten, and is about twice as heavy as columbium. Other properties are shown in the table on page 12.

Uses—Columbium and tantalum have their most important uses in special steels. They impart high-temperature strength and creep resistance to the low-iron super­duty alloys used for jet-engine parts which are exposed to extreme heat and strain. Both elements are used as additions to ordinary stainless steels to improve ductility
and reduce their tendency to air-harden. Added to austenitic stainless steels they inhibit intergranular corrosion at high temperatures, making the steel more weldable, more ductile, and more easily drawn and spun. Both columbium and tantalum are used as “getters” or gas removers in electronic vacuum tubes, and tantalum is used, in addition, for tube electrodes. Prior to 1928 columbium metal was rare and had no industrial uses; and even now, although more than five times as much columbium as tantalum is used in the United States, columbium metal is few uses as the pure metal. It has been used a little for jewelry and tableware, but the principal uses are in alloy steels. On the other hand, tantalum metal and its compounds have several interesting uses, some of them unique. For example, tantalum is used in surgery as a substitute for bone, because it is inert, and flesh will cling to it as to no other foreign substance. The first important use for tantalum, later replaced by tungsten, was as electric-light filaments. Later it was used in equipment to rectify alternating to direct current, but in this use it has been partially displaced by other substances. Tantalum metal, because of its corrosion resistance, is used to line tanks, pipes, and other equipment in certain chemical industries. It has had minor use in pen points and surgical and dental instruments, and has been used as electrodes in electro-refining certain metals. Tantalum carbide is extremely hard and has been used for dies and cutting tools, and the oxide is used in making special lens glass and as a catalyst in making synthetic rubber.

Production—Very little columbium or tantalum ore is produced in the United States. The peak World War II production in this country was in 1943 and amounted to 5,777 pounds of columbite and 9,411 pounds of tantalite, as compared to imports in that year of 2,383,050 and 643,080 pounds, respectively. Essentially all the columbium and tantalum ores produced in 1960 were used by two companies, one in Chicago and the other at Niagara Falls, New York. No ore has been produced in Washington.

Prices—Columbium metal remained at $560 per kilogram ($250 per pound) for rod and $500 per kilogram ($227 per pound) for sheet from 1940 through 1945, and at $280 per kilogram for rod and $250 for sheet from 1948 through 1950. In 1946 columbite ore having a columbium-tantalum ratio of 10 to 1 or greater was paid for at the rate of 55 cents per pound of contained \( \text{Cb}_2\text{O}_5 \), and in 1955 the government was paying $3.40 per pound of contained \( \text{Cb}_2\text{O}_5 \) plus \( \text{Ta}_2\text{O}_5 \) in ore containing 50 percent or more of the combined oxides. Tantalum metal sold at $160 to $200 per kilogram in 1929, at $91 in 1931, $65 to $73 in 1940, $100 to $500 in 1943, and at $1000.60 for rod and $143.00 for sheet from 1948 to 1953.

Ore minerals—The only important ore minerals of columbium and tantalum, and the only ones occurring in Washington, are those of the isomorphous series which has for its end members the iron columbate, columbite, \( \text{Fe} \left( \text{Cb}_2\text{O}_5 \right) \),, containing 82.7 percent \( \text{Cb}_2\text{O}_5 \), and the iron tantalate, tantalite, \( \text{Fe} \left( \text{Ta}_2\text{O}_5 \right) \), containing 86.1 percent \( \text{Ta}_2\text{O}_5 \). There is an almost complete gradation from one end member to the other, and neither is found pure. In some varieties the iron is largely replaced by manganese, and in many varieties part of the iron is replaced by small amounts of titantium, tin, and tungsten. Struverite, a tantalum-iron-bearing variety of the titanium oxide, rutile, has been found in large deposits in Malaya. Other columbium-tantalum minerals are the columbo-tantalates, microlite, samarskite, and fergusonite. Microlite contains also calcium and fluorine, and samarskite contains also iron, calcium, and uranium, as well as cerium and other rare earths. Fergusonite is one of many rare earth columbo-tantalates, none of which is known to occur in minable quantities.

Geology—Columbium and tantalum are widely distributed but occur in few deposits of commercial importance. Deposits from which their ores have been recovered are limited to pegmatities in granites and to placers derived from them. However, columbium occurs in very small amounts (0.00003 to 0.0031 percent) in many rock types as a substitute for titanium in the titanium accessory minerals, the highest concentrations being in alkalic rocks such as nepheline syenites. Bauxites derived from such rocks are enriched in columbium, and Arkansas bauxites have been found to average 0.05 percent columbium. Of the many pegmatite dikes in the world only a few contain columbite-tantalite and fewer yet in receivable amounts. The most favorable pegmatites seem to be those in which the feldspar is albite, and within the pegmatite bodies the most favorable zones seem to be those rich in beryl and spodumene.

Occurrences

The map showing the numbered columbium and tantalum occurrences is plate 3, on page 11 in volume 2.

OKANOGAN COUNTY

Arnold Peak
(see Horseshoe Basin under molybdenum)

Horseshoe Basin (1)
(see under molybdenum)

MacPherson
(see Horseshoe Basin under molybdenum)

STEVENS COUNTY

Calispell Peak
(see Cannon under uranium)

Cannon (1)
(see under uranium)

Railway Dike
(see Cannon under uranium)
Inventory of Washington Minerals—Part II, Metallic Minerals

COPPER

Properties—Copper is the only metal that is red in color. It has a bright metallic luster, is soft (hardness = 2.5 to 3), is highly ductile and malleable, and has good though variable tensile strength, depending on the physical condition of the metal. Copper is resistant to corrosion and has excellent heat and electrical conductivity. It has a higher electrical volume conductivity than any metal other than silver, but aluminum has double the electrical mass conductivity of copper. The metal is an excellent reflector of infrared radiation. Chemically, it exhibits valences of 1 and 2. All the soluble copper salts are poisonous. Other properties are shown in the table on page 12.

Uses—Copper is one of the most widely used metals, both in its pure form and as a base for many alloys, as well as in its compounds. Most of its uses depend upon its good conductivity of electricity and heat, and its strength, durability, and easy workability. About one-third of the consumption is for electrical manufacture, with other uses following in approximately this order: electrical wire and cable, automobile parts, building materials, household appliances, ammunition, and others. The shapes most commonly used are wire, sheet, and tube, but much of the metal is cast, especially as alloys. Copper is alloyed with zinc to make brass, with tin to make bronze, gun metal, and bell metal, with aluminum to make aluminum-bronze, with zinc and nickel to make German silver, with nickel, gold, and silver to make coinage metals, and with these and other metals for other special alloys. Beryllium added to copper gives an alloy of great strength and excellent high-temperature characteristics. Copper oxide and salts are used in special paints, as coloring agents in glass and ceramic glazes, and as antiseptics and insecticides.

Production—Copper production is seventh in value among the metals produced in the United States. Domestic production exceeded consumption for many years prior to 1938, (with the exception of 1932 to 1936) and the excess was exported, but each year since 1939 we have imported copper in substantial quantities. Peak United States production was 1,090,818 tons of metal in 1943, but the 1952 production of 928,000 tons was only about 15 percent less than this figure. Yearly production has varied greatly, depending upon general economic conditions. For example, prior to 1942 the peak production was 997,555 tons of copper in the boom year of 1929, but, during the depression year of 1933, only 4 years later, production had dropped by 81 percent to only 190,543 tons.

The first recorded production in Washington was 39,785 pounds of copper in 1894, after which no copper output was recorded for 5 years until 1899. Since that date production has been continuous but quite variable, ranging from a minimum of less than 3 tons of metal in 1932 to a maximum of 9,812 tons in 1940. Total production in the state through 1952 was 105,605 tons, valued at $32,369,845. In 1950 Washington ranked eighth among the states in production, but 92 percent of the United States total came from the first five states: Arizona, Montana, Utah, Nevada, and Michigan, in that order. The 1952 production of 4,357 short tons of copper, valued at $2,108,788, accounted for 14 percent of the value of metallic ore mined in Washington in that year. Of the large copper mines in this country, the Howe Sound mine in Chelan County ranked eighteenth in 1950, and it contributed 98 percent of the copper mined in the state. In 1950 there were 26 copper smelters and refineries operating, of which 1, owned by the American Smelting & Refining Co., is in Washington, at Tacoma.

Prices—In the past half century the trends in the price of copper have generally paralleled those for lead and zinc, but copper prices have maintained a higher level and have fluctuated more widely, averaging about 14 cents per pound. The highest yearly average price since 1897 was reached in 1917 at 29.2 cents, and the lowest was 5.6 cents in 1932. Between these extremes the yearly average price has risen to peaks 11 times, with an equal number of lows, in the period from 1897, when the price was 11.3 cents, to 1953, when the price was 28.6 cents. After government price ceilings were lifted early in 1953 the price rose rapidly, so that by April of that year it was at a high of 30 cents per pound, where it remained through 1954. Early in 1955 the price rose rapidly to 35.7 cents, a price which was exceeded only in 1917 at 37 cents. In September 1955 the price rose to an all-time high of 50 cents per pound.

Ore minerals—Copper occurs native and as a principal constituent of more than 160 minerals in the form of sulfides, oxides, and carbonates, and less commonly as antimonides, arsenates, phosphates, silicates, and sulfates. Of these minerals, about 18 are of commercial importance, and 6 have accounted for most of the copper mined in North America. The important ore minerals are sulfides, of which the most abundant and widely distributed is chalcocpyrite, CuFeS₂, containing 34.5 percent copper. Other sulfides are: bornite, Cu₉FeS₈, containing 63.3 percent copper; chalcocite, Cu₉S, containing 79.8 percent copper; covellite, Cu₅S₄, containing 66.4 percent copper; enargite, Cu₃AsS₄, containing 48.3 percent copper; tetrachalcocite, (Cu₃Fe)₁₂Sb₂S₁₃, containing about 52.1 percent copper; and tennantite (Cu₃Fe)₁₂As₂S₁₃, containing about 57.0 percent copper. Some of the more important oxidized copper minerals are: cuprite, Cu₂O, containing 88.8 percent copper; tenorite, CuO, containing 79.8 percent copper; malachite, Cu₂CO₃•Cu(OH)₂, containing 57.3 percent copper; azurite, 2Cu₂CO₃•(OH)₂, containing 55.1 percent copper; and chrysocolla, CuSiO₃•2H₂O, containing 36.0 percent copper. Native copper is the ore mineral in a few deposits, especially in Michigan. All these minerals except enargite and tenorite have been reported in Washington, but far the commonest here is chalcocpyrite.

Geology—Copper is the most abundant of the base metals. Its minerals are numerous and widely though irregularly distributed, and they are associated with many different metals in deposits in various rock types ranging in age from pre-Cambrian to Quaternary. Gangue minerals in the deposits may include quartz, calcite, siderite, barite, rhodochrosite, fluorite, sericite, or tourmaline. The types of deposits in which copper is found include mag-
Copper Occurrences—Chelan County

CHelan County

Arizona (27)

Loc: Sec. 11, (31-18E), between Cascade and Meadow Creeks. Ore: Copper, gold, silver. Ore min: Chalcopryite, pyrrhotite. Assays: 0.49 oz. Au, 1.4 oz. Ag, 1.92% Cu. Ref: 67, p. 31. 114, no. 5, p. 84.

Aurelia Crown

(see Crown Point under molybdenum)

Bald Eagle and Gray Eagle


Big Elephant

(see under gold)

Bismarck (32)

(see under zinc)

Black Republican


Black Warrior (9)


Black and White (66)

(see under gold)

Blankenship (20)


Blewett

(see Peshastin under gold)

Blinn (55)

(see under gold)

Blue Jay (28)


Blue Jay Extension (33)


Bryan (42)


Butte


Caledonia (64)

(see under gold)

Canada (29)


Chelan

(see Dick under nickel)

Copper King

(see Robischaud under molybdenum)

Copper King (Pickwick)

(see Pickwick)
Inventory of Washington Minerals—Part II, Metallic Minerals

Crown Point (38)
(see under molybdenum)

Crown Power
(see Crown Point under molybdenum)

Crown Prince and Free Coinage

Davenport (4)

Defender (1)

Diamond Dick
(see Black and White under gold)

Dick (47)
(see under nickel)

Doubtful (13)
(see under lead)

Eagle and Iowa (56)
(see under gold)

Emma Lee
(see under gold)

Esmeralda
(see under gold)

Falls (14)
(see under lead)

Flamingo (17)

Free Coinage
(see Crown Prince and Free Coinage)

Galena (5)
(see under lead)

Gem (34)

Golden Wedge (67)
(see under gold)

Grace (30)

Grand View (50)

Gray Eagle
(see Bald Eagle and Gray Eagle)

Hidden Treasure (46)
(see under gold)

Holden (Howe Sound, Irene) (40)

Horseshoe Basin (10)
(see under lead)

Howe Sound
(see Holden)

Humbug (see under lead)

Hummingbird (59)
(see under gold)

Hunter (35)
(see under silver)

Idaho (21)
Copper Occurrences—Chelan County


Indiana
(see under lead)

Iowa
(see Eagle and Iowa under gold)

Irene
(see Holden)

Ivanhoe
(see Wilder under gold)

Keefe Brothers (41)
(see under molybdenum)

King Solomon (21)
Loc: SE 1/4 sec. 36, (32-18E), on Meadow Cr. Elev: 5,000 to 5,800 ft. Access: Trail from mouth of Meadow Cr. Prop: 3 patented claims. Owner: John Gray, Chelan, Wash. (1897). Ore: Copper, silver, gold, zinc, cobalt. Ore min: Pyrrhotite, chalcopyrite, pyrite, sphalerite, arsenopyrite. Deposit: Hydrothermally altered zone or zones in granite gneiss 2 to 6 ft. wide. Solid sulfide lenses in the zone are 2 to 8 in. wide and consist mostly of pyrrhotite. Dev: 832-ft. adit, 2 caved adits each about 200 ft. long, and a 10-ft. adit. Assays: 3 assays across sulfide stringers from 2 of the adits showed tr. Au, 0.60 to 1.80 oz. Ag, 0.49% to 2.38% Cu, and 0.18% to 1.05% Zn. Ref: 67, p. 33. 114, no. 5, 1909, p. 82-158.

King Solomon (Pickwick) (see Pickwick)

Kingman
(see Galena under lead)

Lake Shyall (19)

La Rica
(see Peshastin under gold)

Leo

Little Jap (24)
(see under silver)

Logan (7)
(see under lead)

Lottie S. (18)

Marlin (8)

Meadow Creek Strike (25)

Meridian (52)
(see under gold)

Minneapolis (2)
(see under gold)

Moscow (22)

Mountain Sheik

Nebraska (23)

Nelson
(see Pickwick)

New York (56)
(see under gold)

North Pole (53)
(see under gold)

Olympia (50)
(see under gold)

Ontario (54)
(see under gold)

Peshastin (61)
(see under gold)

Phipps (62)
(see under gold)

Phyllis (26)

Pickwick (Copper King, King Solomon, Nelson, Van Epps Copper) (48)
Loc: Ssees. 9 and 10, (23-15E), in basin at head of Jack Cr., a tributary to Icicle Cr. near its source. Elev: 5,316 ft. at open pit. Access: 10 mi. by trail and about 18 mi. by road to railroad at Leavenworth or 3 1/4 mi. by trail and 30 mi. by road to railroad at Cle Elum. Prop: 7 unpatented claims. Owner: S. J. Holden

Quien Sabe (15) (see under lead)

Rainier (57) (see under gold)

Red Cap (43) (see under gold)

Red Cloud and Tralee

Red Hill (44) (see under gold)

Red Mountain (Royal) (45)
Loe: Secs. 15 and 22, (30-16E), at S. end of Phelps Ridge (Red Mtn.), Chiwawa dist. Elev: 2,800 and 3,650 ft. Access: Good road. Prop: 112 claims, 22 of which are patented. Owner: Jessie Smith, Seattle, Wash. (1952--). North Star Mining Co. (1902-1907). Royal Development Co. (1917-1946). Ore: Copper, silver, gold. Ore min: Pyrrhotite, chalcopyrite, sphalerite, pyrite, galena, arsenopyrite, scheelite. Gangue: Quartz, chlorite, biotite, sericite. Deposit: Mineralized breccia zone at contact of gneiss and diorite as much as 250 ft. wide. Dev: 700-ft. St. Francis adit, 11,000-ft. Trinity crosscut with several hundred ft. of drifts 850 ft. below St. Francis adit, and connecting raise and 3 intermediate levels. Improv: Sawmill and 400-ton mill sold for junk in 1946. Assays: Tr. to 1.93% Cu, 0.61 to 5.38 oz. Ag, and a little Au. Company records indicate only 1 or 2 very small areas with more than 1% Cu. One area on Trinity level 20 ft. wide, 100 ft. long avg. 0.65% Cu, 1.2 oz. Ag, and another area 2 or 3 times this size av. 0.5% Cu, 0.8 oz. Ag. Only traces of tungsten. Prod: 1918-1926. Ref: 67, p. 54, 98, 1918-1926. 112, p. 167, 114, no. 5, 1909, p. 68.

Spokane Boy and Girl (11)

Stehekin Mining Co.

Sunset (65) (see under gold)

Texas Jack (6)

Tiger (Galena) (see Galena under lead)

Tiger (3) (see under gold)

Tralee (see Red Cloud and Tralee)

Twin Falls (12)

Van Epps Copper (see Pickwick)

Velma (51) (see under mercury)

White Elephant (see Wilder under gold)

White Star (see under lead)

Wilder (63) (see under gold)

Winesap (see Dick under nickel)

CLALLAM COUNTY

Angeles Star (3) (see under zinc)
Crescent (2)  
(see under manganese)

Deer Park  

Gregory-Savage
(see Angeles Star under zinc)

Kathryn (1)

Winter
(see Angeles Star under zinc)

CLARK COUNTY

Silver Star (1)
Loc: Secs. 14, 15, 22, and 23, (3-4E), on W. slope of Silver Star Mtn. Elev: 1,500 ft. Access: 9 mi. by road to railroad at Yacolt. Prop: 1,040 acres. Owner: Silver Star Mining Co., R. DeMott, Portland, Oreg. (1930-1953). Ore: Copper, gold, silver, lead, zinc, nickel. Ore min: Chalcopyrite, pyrite, siderite, sphalerite, galena, magnetite. Gangue: Quartz and altered country rock. Deposit: Mineralized extrusive rock. About 2 tons of ore on the dump. Dev: 125-ft. adit, 227-ft. adit. Assays: 0.08 to 0.24 oz. Au, 0.50 to 2.08 oz. Ag, 2.32% Cu, 3.6% to 12.8% Zn, and 0.34% to 0.4% Pb. A 3.8-ft. channel sample showed 0.9% Zn, 0.3% Cu, and 0.9 oz. Ag. Ref: 111, p. 10. 158.

COWLITZ COUNTY

Green Mountain (1)  
(see under gold)

FERRY COUNTY

Abe Lincoln (48)

Addie B (52)

Addison (Pacific Mutual) (56)

Advance (40)
(see under silver)

Albert Hall (26)

American Granby

Apollo
(see California under gold)

Belcher (18)
(see under iron)

Belcher (57)

Big Lake (25)
(see under lead)

Blevins
(see Meadow Creek)

Blue Bell-Belcher
(see Belcher under iron)

Blue Bird (49)

Blue Mountain
(see Jennie under gold)

Bodie (66)

Boston and New York (13)
(see under silver)

Brimstone
(see Paul and Brimstone under gold)

Cabin
(see Advance under silver)
California (Apollo) (23)
(see under gold)

California (67)
(see also Consolidated Mines and Smelting Co., Ltd.)

Loc: NW 1/4 sec. 5, (29-33E), Keller dist. Elev: 1,900 ft.

Campbell (79)
Loc: Near center sec. 30, (29-33E), Keller dist. Owner: Dave Campbell (1913). Ore: Copper. Ore min: Chalcopyrite, pyrite, chrysocolla. Gangue: Epidote, garnet, hornblende. Deposit: Slightly mineralized silicified shear zone in schist. Prod: 140-ft. crosscut. Assays: Sample representative of several feet of the material exposed in the adit assayed 1% Cu, 2.2 oz. Ag. Ref: 122, p. 120.

Clay (50)

Cold Spring (30)
(see under lead)

Constock (La Fleur) (2)
(see also Walla Walla)


Congress (45)
(see under nickel)

Consolidated Mines and Smelting Co., Ltd.
(see also Iconoclast and California under copper. Advance under gold, and Golden Cord under silver)


Copper Key (19)

Copper Prince (see under silver)

Cougar (76)

Cuba (see Big Lake under lead)

Danville (see under gold)

Delphi (28)

Dewey (54)

Dick Creek (80)

Faithful Surprise (see Morning Star under gold)

Galena (28)
(see under silver)

Gold Crown (see under silver)
### Gold Cup

**Loc:** Danville dist. **Ore:** Copper. **Prod:** 1939. **Ref:** 97, 1940, p. 477.

### Golden Cord (58)

(see under silver)

### Grand Forks

**Loc:** Danville dist. **Ore:** Copper. **Prod:** 1939. **Ref:** 97, 1940, p. 477.

### Gray (60)

(see under silver)

### Gwin (29)

(see under silver)

### Hall Creek

(see Gwin under silver)

### Hall Creek Basin (27)

**Loc:** Sec. 5, (33-35E), on Hall Cr. **Ore:** Copper. **Ore min:** Malachite stain. **Gangue:** Quartz, siderite, chlorite. **Deposit:** Large composite vein consisting chiefly of barren quartz. Here and there a little green discoloration due in part to copper minerals and in part to chlorite. **Dev:** 40-ft. adit and 40-ft. open cut. **Ref:** 122, p. 175.

### Handspike (68)

(see also Walla Walla)

**Loc:** Near center NE¼ sec. 5, (29-33E), Keller dist. **Elev:** 1,800 ft. **Prop:** 1 claim in Walla Walla group. **Owner:** Walla Walla Copper Mining Co. (1915-1924). **Ore:** Copper, molybdenum. **Ore min:** Pyrite, chalcopyrite, molybdenite. **Deposit:** 3-ft. lode of sheared altered granite partly replaced by quartz and ore minerals. **Dev:** 150-ft. adit. **Ref:** 98, 1918-1925, 112, p. 299, 122, p. 118.

### Handy Andy (64)

**Loc:** NE¼ sec. 1, (29-35E), ½ mi. SW. of Summit prospect. **Ore:** Copper. **Ore min:** Chalcopyrite, pyrite. **Gangue:** Quartz. **Deposit:** Lode 6 to 18 in. wide in schist. Lode composed of closely spaced quartz veinlets separated by schist sparsely mineralized. **Dev:** 200-ft. crosscut, inclined shaft said to be 85 ft. deep, and some open pits. **Ref:** 122, p. 132.

### Hawkeye (17)

(see under gold)

### Hercules (5)

**Loc:** Near center sec. 9, (40-34E). **Elev:** 1,800 ft. **Access:** 1 mi. S. of Danville by road. **Ore:** Copper. **Ore min:** Pyrite, chalcopyrite. **Gangue:** Quartz, calcite, siderite. **Deposit:** A number of irregular veinlets in serpentine. Some dioritic rock occurs close by. **Ref:** 7, p. 200.

### Humboldt (69)

**Loc:** NE¼NE¼ sec. 5, (29-33E), 1½ mi. above Keller. **Prop:** Several claims. **Ore:** Copper, lead, zinc. **Ore min:** Sphalerite, galena, pyrite, chalcopyrite, rhodochrosite, malachite. **Gangue:** Quartz porphyry. **Deposit:** Granite cut by quartz porphyry dike. Several fractures in the porphyry along a zone 13 ft. wide contain lenticular bunches of ore from 1 to 6 in. wide. **Dev:** 380-ft. adit, open cuts. **Ref:** 46, p. 151. 88, p. 31. 122, pp. 122-123.

### Iconoclast (70)

(see also Consolidated Mines and Smelting Co., Ltd.)

**Loc:** Near center NE¼ sec. 6, (29-35E). **Elev:** 2,450 ft. **Access:** 1¼ mi. NW. of Keller by road. **Prop:** Several unpatented claims. Part of Consolidated Mines and Smelting Co., Ltd. property. **Owner:** Consolidated Mines and Smelting Co., Ltd., Wenatchee, Wash. (1940—). **Ore:** Copper, molybdenum. **Ore min:** Pyrite, chalcopyrite, molybdenite, malachite. **Deposit:** A zone of severely sheared, crushed, bleached, and sericitized granite contains a network of minute mineralized quartz veinlets. Surface indications are that the zone is 150 ft. wide and ¾ mi. long. **Dev:** 250-ft. adit from which a 50-ft. drift and 125-ft. crosscut have been driven. **Assays:** Low-grade ore. Richest portions contain est. 5% pyrite and chalcopyrite together. Sample taken across 60-ft. outcrop assayed tr. Au, 0.4 oz. **Ref:** 122, pp. 120-121. 158.

### Illinois (Oregon) (71)

**Loc:** SW¼ sec. 5, (29-33E), ½ mi. S. of the California group, Keller dist. **Elev:** 2,100 ft. **Prop:** Several claims. **Owner:** Illinois Copper & Silver Mining & Milling Co. (1915-1926). **Ore:** Copper, molybdenum, zinc, lead, gold, silver. **Ore min:** Pyrite, chalcopyrite, molybdenite, galena, sphalerite. **Gangue:** Quartz, calcite. **Deposit:** Irregular veins and bunches of mineralized quartz in granite and schist. Also sparsely disseminated ore minerals. **Dev:** 500-ft. adit. **Assays:** Body as a whole is low grade. **Ref:** 33, 1908, p. 804. 58, p. 32. 98, 1918-1926. 112, p. 183. 116, no. 4, 1908, p. 91; no. 5, 1908, p. 117. 122, pp. 121-122.

### Iron Creek

(see Shamrock under nickel)

### Java

(see Sunflower)

### Jennie (10)

(see under gold)

### Johnny Boy (31)

**Loc:** SW¼ sec. 31, (32-37E), Covada dist. **Ore:** Copper. **Ore min:** Chalcopyrite, pyrite. **Deposit:** Many small quartz veins in argillite show a little pyrite and chalcopyrite. **Dev:** Explored to "moderate depths." **Ref:** 122, p. 167.

### Josie (47)

**Loc:** E½SW¼ sec. 25, (30-32E), Keller dist. **Prop:** 1 claim. **Ore:** Copper. **Ore min:** Pyrite, chalcopyrite, specularite. **Deposit:** Shear zone in granite silicified and mineralized. **Dev:** Small pit. **Ref:** 122, p. 126.

### Jumper (72)

(see also Walla Walla)

**Loc:** Near center NE¼ sec. 5, (29-33E), 700 ft. NW. of Handspike, Keller dist. **Elev:** 2,000 ft. **Prop:** 1 claim of Walla Walla group. **Owner:** Walla Walla Copper Mining Co. (1915-1924). **Ore:** Copper, silver, zinc, molybdenum. **Ore min:** Chalcopyrite, pyrite, sphalerite, molybdenite, malachite, copper sulfate. **Deposit:** A 3-ft. lode composed largely of altered granite, but quartz veinlets containing finely divided sulfides are numerous and closely spaced. **Dev:** Open cut. **Assays:** A lenticular mass 6 in. wide from footwall of the lode assayed 7.5% Cu. and 11.4 oz. Ag. Test sample of 1 ton of ore is said to have yielded $39 in Cu and Ag. **Ref:** 98, 1918-1925. 112, p. 209. 122, pp. 118-119.

### Kelly Camp (14)

(see under tungsten)

### Keystone (39)

(see under silver)

### King Richard

(see Meadow Creek)
Nez Perce Creek (44)


Number Seven
(see under silver)

Oregon
(see Illinois)

Oversight (20)
(see under iron)

Pacific Mutual
(see Addison)

Panama (12)
(see under gold)

Patterson
(see Jennie under gold)

Paul and Brimstone
(see under gold)

Pin Money (21)
(see under gold)

Polepick (73)

Loc: NW¼ sec. 5, (23-33E), 1 mi. N. of Keller on E. side of the ridge W. of Sanpoil R. Elev: 1,860 ft. Ore: Copper, zinc, lead, silver. Ore min: Chalcopyrite, sphalerite, galena, subordinate pyrite, and a little tetrahedrite. Molybdenite in some fractures of the granite. Deposit: Quartz veins along the contact of granite and porphyry. Veins have total width of several feet and are sparsely mineralized. Dev: 700 ft. of workings on one level and some surface cuts. Prod: No large shipments reported. Ref: 7, pp. 186-187.

Poor Man's Hope (65)
(see under lead)

Quilp (22)
(see under gold)

Railroad (9)


Robert E. Lee (42)
(see under antimony)

Rosario (32)


San Poil Monarch


San Poil Monitor
(see Meadow Creek)

Several (35)
(see under lead)

Shamrock (46)
(see under nickel)

Shonee


Silver Bell (33)
(see under lead)

Silver Hill (61)

Loc: Sec. 6, (29-34E), Keller dist. Ore: Copper, silver, gold. Ref: 114, no. 5, 1909, p. 69.

Silver King (62)
(see under silver)

Silver Leaf (34)
(see under silver)

Silver Pick
(see under silver)

Skeffington


Stray Dog (36)
(see under silver)

Summit (63)
(see under zinc)

Sunflower (Java) (38)


Talisman (Laurier) (8)


Teddy
(see Zipp and Teddy)

Umattilla (74)
(see also Walla Walla)

representing a width of 14 ft. assayed 2.75% Cu, $2 Au, $3 Ag. Ref: 98, 1918-1925. 112, p. 209. 122, p. 119.

Veda W. (see under silver)

Virginia (see Morning Star under gold)

Walla Walla (La Fleur) (4) (see also Comstock)


Walla Walla (75) (see also Handspike, Jumper, Umatilla)


Washington (see Lone Star and Washington)

Welcome (see Boston & New York under silver)

Willmot


Winnipeg (16) (see under gold)

Yaki (see Winnipeg under gold)

Zalla M (15) (see under silver)

Zipp and Teddy (55)


JEFFERSON COUNTY

Big West


Elwha


Tubal Cain (1) (see under manganese)

KING COUNTY

Aces Up (27) (see under silver)

Anderson (2) (see under iron)

Annex (3)


Annie (44)


Apex (8) (see under gold)

Arizona and Washington (see under gold)

Baring (see Anderson under iron)

Bear Basin (30) (see under silver)

Bear Creek (see Robinson under gold)

Big Chief (see under gold)

Black Jack (see under gold)

Bottail (29)


Bonanza Queen (see under gold)

Bondholders Syndicate (see Apex under gold)

Bridal Veil (see under gold)

Brooklyn (16)


Brown Bear (52)

Loc: NW ¼ sec. 33, (22-10E), across Bear Cr. from Earhart property, Cedar River dist. Ore: Copper, silver. Ore min: Chalcopyrite, argentite, pyrite, bornite. Deposit: 4- to 16-in. quartz vein in granite. Ref: 55, p. 47.

Carmack (49)

(see under gold)

Chair Peak (see under iron)

Chicago (10)


Christina

Loc: T. 22 N., R. 10 E., Cedar R. dist. Ore: Copper, gold. Ore min: Chalcopyrite. Deposit: 15-ft. brecciated zone in slate,
Copper Occurrences—King County

filled with ore and quartz. Assays: $6 to $20 Au; 5% to 75% Cu. Ref: 83, p. 48.

Cleopatra (32)  
(see under silver)

Cleveland (41)  

Climax (7)  

Clipper (45)  
Loc: Sec. 1, (23-11E), sec. 3, (23-12E), sec. 36, (24-11E), and secs. 27 and 34, (24-12E), on Middle Fk. of Snoqualmie R. Elev: 3,500 to 5,800 ft. Access: 4 mi. by trail a few hundred yards. Prop: 1 claim. Owner: John Gilbreath of the United Cascade Mining Co., Inc. (1942—). Ore: Copper, gold, molybdenum. Ore min: Largely pyrite, some chalcopyrite, pyrrhotite, molybdenite. Deposit: Cross fractures in granodiorite mineralized with pyrite and some chalcopyrite. Dev: Short adit. Assays: Highest Cu assay in 7 samples was 0.88% Cu across a width of 5 ft. Other assays show 0.015 to 0.04 oz. Au. Ref: 91, 1906, p. 247. 133-B, pp. 28-29. 158.

Commonwealth  
(see under silver)

Coney Basin (17)  
(see under gold)

Copper Bell  
(see under gold)

Copper Chief  

Copper Chief (46)  

Copper Duke (4)  
(see under gold)

Copper Plate  
(see Seattle-Cascade under silver)

Damon and Pythias (9)  
(see under gold)

Dawson (19)  
(see under lead)

Devils Canyon (24)  
(see under molybdenum)

Dutch Miller (33)  


Emma (47)  

Etta  

Eureka (53)  

Eureka  

Fathers Day (39)  

Foss River (24)  

Geo. W. Tinkle (51)  
Loc: Secs. 7 and 8, (22-10E), Snoqualmie dist. Ore: Copper. Deposit: Similar to Carmack property. Ref: 158.

Goat Mountain (36)  
(see under lead)

Gold Mountain (5)  
(see under silver)

Golden Tunnel (1)  
Loc: Sec. 6, (26-11E), near head of Eagle Cr. Ore: Copper, gold, silver. Ref: 58, p. 25. 63, p. 33.

Hawkeye  
(see under gold)

Ironstones  

Jack Pot (35)  
(see under zinc)

Joamco (37)  

John Stevens  
(see Una)

Katie  
(see under lead)
Kelley (48) (see under iron)

King David


King and Kinney (20)


Kinney (see King and Kinney)

Langer (15A) (see under zinc)

Last Chance (50) (see under gold)

Legal Tender (42) (see under gold)

Lennox (14) (see under gold)

Le Roi (28) (see under gold)

Leta (43) (see under gold)

Little Una (see under gold)

Lucky Boy


Lucky Strike (18) (see under gold)

Lynn (21)


Mastodon (see under silver)

May Earhart (see Robinson under gold)

Middle Fork


Mono (see Mono)

Mono (Mona) (6)


Monte Carlo (12) (see under gold)

Mount Phelps (13) (see under zinc)

Online (56) (see under gold)

Pedro


Portland (25)


Pythias

(see under gold)

Quartz Creek (38) (see also Rainy under gold)

Loc: Sec. 8, or sec. 16, (24-10E), Taylor R. dist. Access: 18 mi. by road from railroad at North Bend. Prop: Patented claims. This appears to be the same property which is described under the name "Rainy" under gold. Ore: Copper, gold, silver. Ore min: Chalcopyrite, pyrite, arsenopyrite, bornite, molybdenite, scheelite, covellite. Gangue: Quartz, tourmaline. Deposit: Disseminations and replacement in granodiorite breccia. Massive pyrite body 30 ft. in diameter in altered zone 200 ft. by 40 ft. containing also chalcopyrite; 800 ft. W. is a 200-ft. by 100-ft. stockwork zone of quartz veinlets containing arsenopyrite, chalcopyrite, and a little molybdenite; 800 ft. N. in road cut is a 40-ft.-wide sheeted zone with fracture planes lined with chalcopyrite, arsenopyrite, a little molybdenite and scheelite. Dev: 50-ft. adit with 40-ft. winze, caved adit, 80-ft. adit. Improv: 50-ton flotation mill (1953). Assays: One sample showed 0.6% Cu, 0.2 oz. Ag, tr. Au; another sample showed 1.2% Cu, 0.4 oz. Ag, 0.04 oz. Au. Ref: 11-A, pp. 233-240. 108, 2/53, p. 103. 111, p. 5.

Rainbow (15)


Rainy (40) (see under gold)

Robinson (54) (see under gold)

Romeo (see under gold)

San Francisco (11) (see under gold)

San Jose (55) (see under gold)

Seattle-Cascade (22) (see under silver)
Silver Dollar and Copper Plate  
(see Seattle-Cascade under silver)

Snoqualmie (31)  

Sphinx  

Square Deal  
(see under gold)

Stevens  
(see Una)

Sunday  
(see under silver)

Surprise  

Tinkle  
(see Geo. W. Tinkle)

Triple S  
(see Bob Canson)

Twin Lakes  
(see under gold)

Una (John Stevens) (23)  

Unicorn  

Victoria  
(see under gold)

War Eagle (26)  
(see under gold)

Washington  
(see Arizona and Washington under gold)

Western States Copper  
(see Rainy under gold)

Woodline (57)  
(see under gold)

KITSAP COUNTY

Chico (1)  
(see under tin)

Cook-Kitchen  
(see Chico under tin)

Kitchen  
(see Chico under tin)

KITTITAS COUNTY

Aurora (1)  
(see under gold)

Beaver (5)  
(see under gold)

Big Bug  

Big Dome (15)  

Blue Bonnet (8)  

Bob Canson (6)  

Bonanza  
(see Dolphin)

Boyles (10)  
Loc: Sec. 31, (23-15E), Cle Elum dist. Ore: Copper, gold, silver. Ref: 58, p. 10. 63, p. 64.

Canson  
(see Bob Canson)

Cascade Mining (18)  

Copper King  

Copper Queen (20)  
Dolphin (Bonanza) (13)


Durrwachter
(see Mineral Creek)

Fish Eagle


Grandview (Lost) (14)


Granite King (21)
(see under silver)

Grizzly Bear
(see under gold)

Huckleberry (17)


Ilias (Williams) (11)


Johnson

Lco: Near Mt. Hawkins, Cle Elum dist. Ore: Copper. Ref: 63, p. 64.

King Solomon (2)


Last Chance
(see under gold)

Legal Tender


Liberty Lode
(see Mineral Creek)

Little Kachess Lake


Lost
(see Grandview)

Lynch
(see Aurora under gold)

Majestic
(see under gold)

Mammoth
(see under gold)

Mary
(see under gold)

Mildred


Mineral Creek (Durrwachter, Liberty Lode) (19)


Morning Star (9)

Lco: Sec. 24, (23-14E), Cle Elum dist. Ore: Copper, gold, silver. Ref: 58, p. 46. 63, p. 65.

Mountain Belle (3)

Lco: Extension of Mountain Chief, 1 mi. above mouth of Fortune Cr., Cle Elum dist. Ore: Copper, gold. Ref: 63, p. 63.

Mountain Chief (4)

Lco: 1 mi. above mouth of Fortune Cr., Cle Elum dist. Ore: Copper, gold. Ref: 63, p. 63.

Navidad


Paramount
(see Aurora under gold)

Ruby King
(see under gold)
Silver Bow

Silver Bullion (12)

Silver Dump (7)
(see under silver)

Taneum Creek (22)

Teanaway (16)
(see under nickel)

Thorp
(see under gold)

Tip Top
(see under gold)

Tip Top No. 1
(see under gold)

Twin
(see under gold)

Whippoorwill
(see under gold)

Williams
(see under lodes)

LEWIS COUNTY

Big Falls (3)

Eagle Peak (1)
Loc: Near NW. cor. sec. 27, (15-8E), on W. slope of Eagle Peak, Mt. Rainier area. Elev: 3,275 to 3,515 ft. Access: 1½ mi. by road above Longmire. 18 mi. to railroad at Ashford. 60 mi. by road to smelter at Tacoma. Prop: 2 unpatented claims: Aldula, Paradise. Owner: Eagle Peak Copper Mining Co., R. H. Wheelock, Ashford, Wash. (1908——). Ore: Copper, gold, silver, cobalt, uranium (?). Ore min: Chalcopyrite, pyrite, bornite, arsenopyrite, covellite, scheelite, molybdenite, sphalerite, limonite. Deposit: Mineralized joints or slip planes in granite. One zone is 6 in. to 5 ft. in width and carries a streak of high-grade ore 1 to 14 in. wide. Gold values are in the arsenopyrite. Ore from near portal of old drift about 15 ft. above present drift level was slightly radioactive. Dev: 300-ft. drift, 630-ft. crosscut. Assays: 18-ton shipment yielded 8.05% Cu, 0.09 oz. Au, 1.87 oz. Ag. 1% to 5% Co in some samples. Prod: 100 tons in 1919. Produced also 1925, 1928. Not over 200 tons total. Ref: 56, p. 19, 97, 1919, p. 493; 1925, p. 559; 1928, p. 701. 98, 1918-1926. 129, pp. 310-312. 157.

Green River (5)
crocite, chalocotrilithe, malachite, azurite. **Gangue:** Jasper. **Deposit:** 3 lenses of ore along altered basalt-phyllite graywacke contact. 1 lens has max. width of 8 ft. but pinches and swells. **Dev:** 200-ft. adit, 40-ft. shaft, and several open cuts and pits. 5-ton shipment contained 0.40 oz. Ag, 7.85% Cu, 3.2% Fe, 65% insol. Composite sample of 125 tons contained 5.63% Cu, 0.12% Ni and Co, 19.72% MnO, 7.44% FeO, 3.84% CaO, 5.15% H2O, 57.2% insol., tr. Zn and Mg. **Prod:** 5,012 dry tons of ore 1915. **Ref:** 48-A, pp. 40-41. 94, p. 23. 124, pp. 239-240. 127, pp. 453-454. 141, pp. 81, 83. 158.

**OKANOGAN COUNTY**

**Abernathy (Antimony Gold) (144)**  
**Loc:** Sec. 31, (35-19E). **Access:** 13 mi. by road NW. of Republic. **Prop:** 6 claims. **Owner:** Abernathy (Antimony Gold)  

**American Flag (86)**  
**Loc:** NE 1/4 sec. 36, (38-31E), Wauconda dist. **Elev:** 4,500 ft. **Access:** 13 mi. by road NW. of Republic. **Prop:** 1 claim. **Owner:** American Flag Mining Co.  
**Ore:** Copper, silver, gold, zinc. **Deposit:** A 6-ft. shear zone in andesite is bounded on each side by quartz veins up to 14 in. wide. **Dev:** 40-ft. drift, shaft, and an open cut. **Assays:** 0.3 to 1.0 oz. Au. **Ref:** 158.

**Alder (190)**  
**Access:** (see under gold)

**Alta Lake (224)**  
**Location:** (see under nickel)

**American Flag (86)**  
**Loc:** Sec. 31, (35-19E). **Access:** 13 mi. by trail from Gilbert at the terminus of the Twisp R. road. **Owner:** R. Abernathy, Los Angeles, Calif. (1946). **Ore:** Copper, gold, silver. **Min:** Chalcopyrite, arsenopyrite, pyrite. **Gangue:** Quartz. **Deposit:** A 6-ft. shear zone in andesite is bounded on each side by quartz veins up to 14 in. wide. **Dev:** 40-ft. drift, shaft, and an open cut. **Assays:** 0.3 to 1.0 oz. Au. **Ref:** 158.

**Adams**  
**Access:** (see Moncosilgo)

**Alger (190)**  
**Access:** (see under gold)

**Apache (118)**  
**Access:** (see under silver)

**Apex (Ben Harrison) (65)**  
**Loc:** Near SW. cor. sec. 17, (40-30E). **Access:** ½ mi. N. of Chessow. **Prop:** 6 claims. **Owner:** Apex Gold Mining Co. (1911-1926). **Ore:** Copper, gold & Copper Mining Co. (1908-1918), British Columbia Copper Co. (1908 and 1918). **Ore:** Copper, gold, silver. **Min:** Chalcopyrite, pyrite, lesser amounts of galena and sphalerite. **Deposit:** Quartz vein as much as 6 ft. wide enclosed in schist and quartzite. Ore occurs in joints and crevices in the quartz. **Dev:** 286-ft. inclined shaft, several small surface openings. Short drifts and a crosscut at bottom of the shaft. **Assays:** Carefully hand-sorted ore said to run about 2 oz. Au. Gold occurs in the pyrite and chalcopyrite. **Ref:** 33, 108, p. 413. 98, 1916, 1922. 112, 1918, p. 166. 154, p. 49.

**Arizona**  
**Access:** (see Horn Silver under silver)

**Auberton**  
**Access:** (see Windiate-Auberton under tungsten)

**Aztec (72)**  
**Access:** (see under iron)

**Baltimore (42)**  
**Access:** (see under gold)

**Bellevue (49)**  
**Access:** (see under gold)

**Ben Harrison**  
**Access:** (see Apex)

**Bergman**  
**Access:** (see Shaw-Bergman)

**Billy Goat (3)**  
**Loc:** Near SW. cor. sec. 15, (38-20E), on S. slope of Billy Goat Mtn., NW. of Winthrop. **Elev:** 5,300 ft. **Access:** Road up Eightmile Cr. 80 mi. from railroad at Pateros. **Prop:** 4 claims: Billy Goat and Billy Goat Nos. 2 to 4. **Owner:** W. F. Berg, E. E. Johnson, Clint Hanks, Fred Haase, and Mrs. Charles (Della) Graff (1946). **Ore:** Copper, gold, silver, zinc, molybdenum, lead. **Min:** Molybdenite, pyrite, chalcopyrite, sphalerite, galena, tetrahedrite. **Gangue:** Quartz, ankerite. **Deposit:** Mineralized quartz veinlets ¼ in. to 2 in. wide lace through altered volcanic rock. A large area is mineralized. **Dev:** Three shafts 20, 40, and 60 ft. deep; three adits 60, 15 ft., and one of unknown length; and a 700-ft. drift. **Assays:** Copper generally less than 1% but in places as much as 2% over minable widths. Gold also low but as much as 0.5 oz. per ton in places. **Ref:** 46, p. 176. 104, 8/30/34, p. 22. 106, 7/34. 158.

**Bi-Metallic (84)**  
**Access:** (see under molybdenum)

**Black Bear (38)**  
**Access:** (see under gold)

**Black Huzzar (72)**  
**Access:** (see under gold)

**Black Jack (200)**  
**Access:** (see under gold)

**Black Warrior**  
**Access:** (see under gold)

**Blue Grouse (172)**  
**Access:** (see under lead)
Blue Lake (151)


Bolinger (199)

(see under gold)

Bonanza (88)


Buckeye (45)


Buckeye (see Peacock)

Buckhorn (see under silver)

Bunker Hill (see Silver King under lead)

Caaba (see Kaaba under lead)

California (13)


Campbell (see Holden-Campbell under gold)

Caribou (83)

(see under gold)

Carr (4)


Castle Creek (90)

(see under lead)

Catherine (14)

(see under silver)

Central (Trinidad) (154)

(see under silver)

Central (American Flag) (see American Flag under gold)

Chicago (204)

(see under gold)

Chicago and New York (see under gold)

Chickamin (195)


Chief Sunshine (168)

(see under silver)

Chloride (see under silver)

Chopaka (63)

(see under silver)

Climax (129)


Continental (see Mazama Queen under gold)

Controller (125)


Copper Glance (8)


Copper King (23)


Copper King (157)

(see under lead)

Copper Queen (73)

shear zone in quartzite and garnet-epidote rock carries disseminated ore minerals. Dev: 100-ft. adit, 30-ft. adit, deep shaft, 8 or more open cuts. Assays: Scheelite constitutes only a fraction of 1% of the zone. Ref: 158.

**Copper Queen**


**Copper World (24)**


**Copper World Extension (Iron Mask) (25)**


**Copper Zone**


**Crescent (147)**


**Crystal Butte (Mother Lode) (70)**

(see under silver)
Copper Occurrences—Okanogan County

Favorite (62)
(see under lead)

First Thought (179)
(see under silver)

Floyd (Schoenfeld) (191)

Frosty

Goat Creek


Golden Zone (9)
(see under gold)

Goodenuf (102)
(see under silver)

Grand Coulee
(see Little Chief under silver)

Grand Summit
(see Palmer Summit under gold)

Grandview (Leadville)
(see Leadville under gold)

Grandview
(see under gold)

Grant
(see Roosevelt under iron)

Gray Eagle (220)
(see under gold)

Great Divide (111)
(see under silver)

Great Metals
(see Anchor under silver)

Grover Cleveland
(see under lead)

Grubscher
(see Gubser under lead)

Gubser (160)
(see under lead)

Hanks (7)

Hargrove
(see Silver King under lead)
Hart Stone  
(see Kelsey)

Henrietta  (208)  
(see under gold)

Hercules  (97)  
(see under lead)

Hercules  (34)  
(see under gold)

Hiawatha  (46)  
(see under gold)

Hidden Treasure  (100)  

Hidden Treasure (Highland)  (209)  
(see under gold)

Highland  (210)  
(see under gold)

Highland Light  
(see Highland under gold)

Hilo  
(see St. Paul under silver)

Holden-Campbell  (206)  
(see under gold)

Home Run  (103)  
(see under silver)

Horn Silver  (61)  
(see under silver)

Hotchkiss  
(see Mazama Pride under gold)

Hudnut (Hudnut)  (109)  
(see under zinc)

Hunter  (211)  
(see under gold)

I Just Live Here  (207)  

Imperial  (134)  
(see under gold)

Independence  (202)  
(see under gold)

Index  

International  

Iron Cap and Snow Cap  (145)  
(see under gold)

Iron Dike  (94)  
(see under zinc)

Iron Mask  
(see Copper World Extension)

Ironsides and Anna B.  (75)  

Jackpot  (76)  
(see under gold)

Japan  

John Judge  
(see Leadville under gold)

Jones  (143)  

Josie  
(see Hiawatha under gold)

Jumbo  (99)  
(see under chromium)

Jupiter  
(see Tip Top)

Kaaba  (17)  
(see under lead)

Kaaba-Texas  
(see Kaaba under lead)

Kalamazoo  (41)  

Kankakee  (115)  

Kansas  (173)  

Kelsey (Hart Stone, Stone)  (55)  
Copper Occurrences—Okanogan County

(1943). Detroit-Oroville Exploration Co. (1911). Ore: Copper, silver, gold. Ore min: Chalcopyrite, pyrite, magnetite, pyrrhotite. Gangue: Quartz, garnet, epidote. Deposit: Greensite, slate, and quartzite contain disseminated ore minerals and mineralized quartz stringers along joints and fractures. Apparently a large low-grade deposit. Also some tactite which carries magnetite, chalcopyrite, and pyrrhotite. Dev: Several small open cuts and shafts in addition to 6 diamond drill holes each about 100 ft. deep. Assays: Av. of 18 assays gave 2.62% Cu, 0.6 oz. Ag, 0.04 oz. Au. Ref: 33, 1908, p. 628. 154, pp. 85-87.

Key (161)
(see under silver)
Kimberly (45)
(see under lead)
King Solomon
(see under gold)
Lady of the Lake (167)
(see under silver)
Launa (see Leuena under silver)
Lakeview (see Prize under lead)
Last Chance (180)
(see under silver)
Launa (see Leuena under silver)
Lead Horse (2)
(see under lead)
Leadville (27)
(see under gold)
Leuena (169)
(see under silver)
Lilman (119)
(see under silver)
Little Chief (120)
(see under silver)
Little Chopaka (18)
(see under lead)
Lodge (see Dutch John under tungsten)
London (see Methow under gold)
Lone Pine (Fuller, Pateros) (see Fuller under iron)
Lone Pine (60)
(see under silver)
Lone Star (170)
(see under lead)
Louisa (see Standard and Louisa under gold)

Luke
(see Molly)
Lulu (see under silver)
MacLean (see Roosevelt under iron)
Magnetic (77)
(see under iron)
Maid of Erin (89)
Loc: Sec. 1, (34-31E), Park City dist. Ore: Copper. Ore min: Pyrite, chalcopyrite. Deposit: 2 parallel lenticular veins of white quartz 3 ft. in max. width in mica schist. Here and there in the quartz are small lenslike bunches of pyrite and chalcopyrite. Dev: Open cut. Ref: 122, p. 102.

Malott (187)

Mammoth (156)
(see under silver)
Manuel

Maquae (see under gold)
Marguerite (174)

Marshal Ney (see under gold)
Mazama Pride (139)
(see under gold)
Mazama Queen (131)
(see under gold)

Method (215)
(see under gold)

Mid Range (146)
(see under gold)

Midas No. 1 (28)

Mikelson (56)

Milwaukee (216)
(see under tungsten)
Mineral Hill (112)

Mineral Hill (Washington Consolidated, Seven Devils) (162)
(see under silver)

Mineralite (213)
(see under tungsten)

Minnie (196)
(see under gold)

Modoc (104)

Mohawk
(see under lead)

Molly (Luke) (156)

Moncosilgo (Adams) (51)

Monitor (163)
(see under lead)

Montana (135)

Monterey (78)

Montgomery (see Tonasket)

Mother Lode (see Crystal Butte under gold)

Mountain Beaver (5)
(see under gold)

Mountain Boy (92)
(see under lead)

Multnomah (105)

Myers Creek (79)
(see under iron)

Myrtle (see St. Paul under silver)

Neutral (see Magnetic under iron)

Nevada (175)
(see under silver)

New Deal (see Antimony Queen under antimony)

New Hope (1)

New London (see Methow under gold)

New York (see under lead)

New York (see under antimony)

Nina Lu (121)
(see under silver)

Nip and Tuck (80)
Number Nine (81)
(see also Magnetic under iron)


Number One (19)
(see under lead)

O. K. (57)

Ohio (58)

Okanogan Copper (150)
(see under gold)

Old Glory (96)

Olentangy (68)
(see under gold)

Opal
(see under lead)

Orient
(see under gold)

Oriental and Central
(see American Flag under gold)

Osila
Loe: Squaw Cr. dist. Ore: Copper, gold. Ref: 63, p. 89.

Palmer (186)

Palmer Lake (50)

Palmer Mountain Tunnel (37)
(see under gold)

Palmer Summit (29)
(see under gold)

Panama (124)
(see under silver)

Parallel
(see under gold)

Pateros (Fuller, Lone Pine)
(see Fuller under iron)

Pateros
(see Sullivan under gold)

Pay Day (148)
(see under gold)

Peacock (Bornite) (6)

Peacock (176)
(see under silver)

Peerless (10)
(see also Little Chopaka, Worthington under chromium)

Peoria (193)
(see under gold)

Phil Sheridan
(see Sheridan under copper)

Pinnacle (30)
(see under gold)

Pittsburg (116)
(see under silver)

Plant-Callahan (181)
(see under silver)

Prize (21)
(see under lead)

Phomigan
(see under cobalt)

Pyrrargyrite
(see Ruby under silver)

Q. S. (152)
Rainbow (31)  
(see under gold)

Ramore (98)  
(see under lead)

Ramsey (101)  

Rattlesnake (192)  
(see under gold)

Rebecca (128)  

Reco (66)  
(see under gold)

Red Bird (128)  

Red Shirt (194)  
(see under gold)

Reedy  
(see Antimony Queen under antimony)

Republic (177)  
(see under lead)

Review (67)  
(see under gold)

Rich Bar (59)  
Copper Occurrences—Okanogan County

Shaw-Bergman (83A)

Sheridan (85)
(see under copper)

Sherwood
(see under silver)

Sidewinder
(see Dutch John under tungsten)

Silver Belle
(see under silver)

Silver Bluff
(see under silver)

Silver Cliff (127)
(see under silver)

Silver King (Bunker Hill) (165)
(see under lead)

Silver King (Sharp) (140)

Silver Point (110)

Silver Seal
(see Antimony Queen under antimony)

Silver Tip
(see Starr under molybdenum)

Six Eagles
(see Little Chopaka under lead)

Snow Cap
(see Iron Cap and Snow Cap under gold)

Sonny Boy (184)
(see under silver)

Sooner (133)

Spokane (American Rand) (47)
(see under gold)

Spokane (Gold Crown) (188)
(see under gold)

Standard and Louisa (212)
(see under gold)

Star
(see Lone Star under lead)

Starr (153)
(see under molybdenum)

Stone
(see Kelsey)

Submarine
(see Lone Pine under silver)

Sullivan
(see under gold)

Summit (93)
(see under lead)

Summit (20)
(see under silver)

Sunrise
(see under silver)

Sunshine
(see Hidden Treasure under gold)

Sunshine Chief
(see Chief Sunshine under silver)

Swayne (141)

Teddy Roosevelt
(see Roosevelt under iron)

Texas Creek
(see Dutch John under tungsten)

Three Links
(see under gold)

Tip Top (Jupiter) (123)

Tom Hal
(see Friday under gold)

Tomlinson

Tonasket (Montgomery, Fluorspar) (155)
Inventory of Washington Minerals—Part II, Metallic Minerals

PEND OREILLE COUNTY

Abraham-Huff (20)


Ace High (6)

(see under silver)

Ackerlund (24)

Loc: SW¼ sec. 13, (33-44E), in saddle on top of ridge, Newport dist. Elev: 3,400 ft. Access: Near road. About 6 ml. from Usk. Prop: 240 acres deeded land. Owner: G. S. Ackerlund, Newport, Wash. (1948). Ore: Copper, zinc. Ore min: Chalcopyrite, pyrite, sphalerite. Gangue: Quartz, calcite. Deposit: 0 to 18-in. sparsely mineralized quartz vein in argillite. Dev: Caved adit and water-filled incline, totaling about 100 ft. Assays: 3 samples from widths of 1 to 4 ft. showed 0.06% to 0.49% Cu, 0.30% to 0.60% Zn, tr. Au, 0.20 to 0.25 oz. Ag. Ref: 139, p. 157.

Alger and McCullough (32)

(see also Fair Hope under copper, Key Fraction under lead and Meteor under silver)


Baker City (33)

(see under silver)

Bead Lake (34)

(see under lead)

Best Chance (34)

(see Rainbow)

Blue Jim (15)

(see under silver)

Bornite (Holneck) (42)


Box Canyon (16)


Bromide

(see La Sota under silver)

Callispell (26)

Loc: SE¼NW¼ sec. 19, (33-45E), Newport dist. Access: Road. Prop: 2 unpatented claims. Owner: Jack Gallagher and

Campbell (Star) (28)

Champagne-Hoosier (see Hoosier)

Comstock (35)
(see under lead)

Conquest (see Kootenai Conquest under lead)

Copper Hill

Copper Queen (11)

Copper Queen (1)

Cougar (8)

Eagle (see Ries under lead)

Fair Hope (36)
(see also Alger and McCullough)

Fairview Copper (see Skippy and Queen Bess under lead)

Fissure (see under silver)

Fluskey (see Fluskey-Hoopala under lead)

Fluskey-Hoopala (2)
(see under lead)

General MacArthur (43)
(see under lead)

Glass (see General MacArthur under lead)

Gold Arrow (see Ries under lead)

Gold Coin-Hardtack (37) (see under silver)

Golden Anchor (see Ries under lead)

Grandview (Reuther) (6) (see under silver)

Gray Eagle (see Hawkeye-Gray Eagle-Last Chance)

Gypsy (7)

Hansen (45) (see under gold)

Hardrock Thomas (22)

Hardtack (see Gold Coin-Hardtack under silver)

Hawkeye-Gray Eagle-Last Chance (29)

Holneck (see Bornite)

Hoosier (Champagne-Hoosier) (12)

Huff (see Abraham-Huff)

Independence (30) (see under silver)

Isabelle (21) (see under gold)

Kattydid (see Ries under lead)

Key Fraction (38) (see under lead)
Kootenai Conquest (39)  
(see under lead)  

Lakeside (31)  

La Sota (Silver Crest, Bromide) (17)  
(see under silver)  

Last Chance  
(see Hawkeye-Gray Eagle-Last Chance)  

Little Noisy (10)  
(see under zinc)  

Lloyd (46)  
(see under lead)  

McCann (23)  

McCullough  
(see Alger and McCullough)  

Meade (4)  
(see under lead)  

Meteor (40)  
(see under silver)  

Midas  
(see Ries under lead)  

Mount Pisgah (47)  
(see under lead)  

O. K. (14)  
(see under silver)  

Oriole (13)  
(see under zinc)  

Pindle (49)  

Queen Bess  
(see Skippy and Queen Bess under lead)  

Rainbow (Best Chance) (25)  

Reider (45)  

Reuther  
(see Grandview under silver)  

Reynolds Creek (18)  

Ries (44)  
(see under lead)  

Riverside (5)  
(see under lead)  

Rocky Creek (17A)  
(see under silver)  

Silver Crest  
(see La Sota under silver)  

Skippy and Queen Bess (19)  
(see under lead)  

Snowbird and Stanley (41)  
(see under lead)  

Snyder  
(see Gold Coin-Hardtack under silver)  

Stanley  
(see Snowbird and Stanley under lead)  

Star (Independence)  
(see Independence under silver)  

Star  
(see Campbell)  

Uncas (3)  
(see under zinc)  

Victory (27)  

West  
(see Blue Jim under silver)  

PIERCE COUNTY  

Blue Star  

Bunny (4)  

Carbon River (2)  

Chicago  
Loc: 9 mi. from Fairfax, a short distance from the trail leading to the Surprise property. Prop: 6 claims. Owner: Monte-

Clapper (Mothers Day) (5)


East Lake (7)


Eastlick (5)


Golden Rule (8)

(see under zinc)

Larigo

(see Tillie and Larigo)

Lone Star


Lorraine


Mashel (1)


Mothers Day (Day)

Mt. Rainier (see Storbo)

New Deal

(see Washington Cascade under gold)

Silver Creek (12)

(see under gold)

Silver Creek Gold & Lead (11)

(see under gold)

Storbo (Mt. Rainier) (10)


Surprise (6)


Tillie and Larigo (3)


Vanguard


Washington Cascade (13)

(see under gold)

Washington-Wonder


Wonder

(see Washington-Wonder)
Inventory of Washington Minerals—Part II, Metallic Minerals

Bornite
(see North Coast under gold)

Boston (10)
(see under lead)

British
(see Skagit Queen under silver)

Buchanan
(see Queen and Buchanan)

Cliff (12)
(see under zinc)

Dispassi
Loc: On Dispassi Cr., 5 mi. up Skagit R. from Marblemount.
Ore: Copper, gold. Ref: 63, p. 54.

Dorothy
(see Thunder Creek under lead)

Ella Bea and Flaim (16)
Loc: SE¼NE¼ sec. 15, (35-13E), W. of Soldier Boy Cr.
Ore min: Pyrite. Deposit: Altered and pyritized rock. Dev: 50-ft. adit. Assays: One assay showed no Au, 0.06% Cu. Another assay showed no Au, 0.07% Cu. Ref: 158.

Elsie (11)

Flaim
(see Ella Bea and Flaim)

Higgins Mountain
(see Lawrence)

Jackman Creek

Johnsburg (15)
(see under lead)

Lakeside
(see under lead)

Lawrence (Higgins Mountain) (5)

Logan No. 2 (7)
(see under silver)

Marine
(see under gold)

Matrix

Midas (13)
(see under silver)

Mountain Home
(see under manganese)

North Coast (6)
(see under gold)

Protection (8)
(see under lead)

Queen and Buchanan (17)

Skagit Queen (9)
(see under silver)

Soldier Boy (14)
(see under gold)

Standard
(see under silver)

Stephens (Fidalgo) (2)

Thunder Creek
(see under lead)

SKAMANIA COUNTY

Athens

Black Falls

Black Hornet
Copper Occurrences—Skamania County

Bronze Monarch (Martha Washington) (22)


Bumble Bee


Chicago (16)

Loc: NW¼ sec. 32, (10-6E), 2½ mi. NE. of Spirit Lk., Mt. St. Helens dist. Access: % mi. by trail E. of Norway Pass. Prop: Several claims. Owner: Mining Corporation, Ltd. of Portland (1902). Ore: Copper, gold, silver, zinc. Ore min: Pyrite, arsenopyrite, chalcopyrite, sphalerite, native copper. Deposit: An 8-in. quartz vein in granodiorite. Dev: 200-ft. adit. Assays: Two assays showed 0.3% to 2.0% Cu, tr. to 0.10% Pb, 0.3% to 1.8% Zn, 0.11 to 0.12 oz. Au, 0.04 to 0.09 oz. Ag. Ref: 63, p. 50. 68, pp. 95-96. 111. p. 5.

Chief

(see Ripper and Chief)

Cinnabar (3)

(see also Toledo)


Coe

(see Sweden)

Commonwealth Gold and Copper

(see Miners Queen)


Copper Bottom


Copper Canyon Mines

(see Yellow Jacket and Hoo Hoo)

Copper Dyke


Crystal (1)


Earl

(see Samson)

Germania (10)

(see under gold)

Goat Mountain


Golconda (12)

(see under gold)

Gold Creek

(see Zine Creek under zinc)

Grizzly Creek (13)

(see under gold)

Hoo Hoo

(see Yellow Jacket and Hoo Hoo)

Independence


Index (5)


Juanita


Last Chance (28)

Loc: SW¼SE¼ sec. 29, (3-5E), on Washougal R. Elev: 1,600 ft. Access: 14 mi. by road and 1 mi. by trail from railroad at Cape Horn. Owner: Leon Montchalin, Washougal, Wash. (1855—). H. S. McGowan, McGowan, Wash. (1943). Mable McGowan, Chinook, Wash. (1951-1953). Ore: Copper, vanadium, gold, silver, lead, zinc. Ore min: Bornite, chrysocolla, desolochite (?). Deposit: Shear zone in diorite contains several parallel veins of quartz. Main vein is 1 to 4 ft. wide. Zone as a whole is sparsely mineralized. Dev: Shaft reportedly 475 ft. deep, 930-ft. adit, and another adit caved at the portal. Assays: Ore av. $1.30 Cu, 7.2 oz. Ag, 7.5% Cu. Green and yellow material found coating druses at face of the adit was the material which showed V.O. content. Spectrographic analysis of the green and yellow coatings showed 1% to 10% V, 1% to 10% Pb, 8% Cu, 8% Zn. Ref: 158.

Last Hope (4)


Martha Washington

(see Bronze Monarch)

Maybee (24)

Miners Queen (Columbia Gold and Copper) (23)


Minnie Alice (2)


Minnie Lee (7)


Morning (14)


Mount Fairy (17)

(see under gold)

Mountain King


Northern Light


Northwestern


Norway (18)

(see also Sweden)


Polar Star (11)


4% to 15% Cu, 0.095 oz. Au, 2 to 5 oz. Ag. Prod: Small amount prior to 1934. Ref: 33, 1907, p. 452; 1908, p. 952. 58, pp. 55, 63, p. 50. 88, p. 96. 91, pp. 247-248. 98, 1918-1926. 114, no. 6, 1906, p. 79. 158.

Portland Elkhorn


Rainbow (27)

(see under vanadium)

Ripper and Chief


St. Helens

(see Sweden)

Samson (Earl) (9)

Loc: SE¼ sec. 8, (10-6E), at base of Goat Mtn., Mt. St. Helens dist. Prop: 20 claims. Owner: Mount St. Helens Consolidated Mining Co. (1907-1926). Mining Corporation, Ltd. (1901). Ore: Copper, gold, silver, vanadium. Ore min: Chalcopyrite, bornite, chalcocite, covellite, malachite, azurite, chrysocolla. Deposit: Leached vuggy quartz vein up to 5 ft. thick in granodiorite is sparsely mineralized with copper minerals. Dev: 2 adits, one 200 ft. long, the other about 1,000 ft. long, and a 425-ft. shaft near one adit portal. Assays: Av. of 4 samples showed 0.06 oz. Au, 3.29 oz. Ag. 4.59% Cu. Ref: 105, 1916, pp. 744-745. 158.

Skamania (26)


Sweden (Coe, St. Helens) (19)

(see also Norway)


Toledo (8)

(see also Cinnabar)


Washington

Copper Occurrences—Skamania County

### White Swan

**Loc:** Bald Mtn. area. **Owner:** Washougal Copper & Refining Co. (1916). **Ore:** Copper. **Prod:** Test shipment in 1916. Ref: 97, 1916, p. 613.

### Yellow Jacket and Hoo Hoo (Copper Canyon Mines) (26A)

**Loc:** NE¼ sec. 21, (3-5E), on Washougal R. **Access:** 16½ mi. by road from railroad at Cape Horn. **Prop:** 11 claims. **Owner:** Hugh Ringquist, Camas, Wash. (1953—). **Ore:** Copper, silver. **Assays:** 4½ tons shipped in 1953 ran 5½% Cu, 3.95 oz. Ag. Ref: 69-A, p. 9. 158.

### Yellow Metals (20)

**Loc:** Sec. 31, (10-6E), 2½ mi. NE. of Spirit Lk., Mt. St. Helens dist. **Access:** Trail over Norway Pass. **Prop:** Several claims. **Owner:** Mining Corporation, Ltd., of Portland (1901). **Ore:** Copper, gold, silver. **Deposit:** Similar to the Chicago. **Assays:** Max. 60% In Cu, Au. Ref: 88, pp. 95-96.

### Young America (21)

**Loc:** Sec. 6, (9-5E), adjoining Norway and Bronze Monarch properties on the NE., Mt. St. Helens dist. **Prop:** 5 claims. **Owner:** Mining Corporation, Ltd., of Portland (1901). **Ore:** Copper, gold, silver. **Deposit:** Mineralized zone 12 ft. wide is traceable for 2,000 ft. **Dev:** 50-ft. drift. Ref: 88, p. 95.

### Zinc Creek (25)

(see under zinc)

### Snohomish County

#### Ala-Dickson (78)

**Loc:** NE¼ sec. 7, (29-10E). **Elev:** 3,000 ft. **Access:** Near Williamson Cr. **Prop:** 2 unpatented claims. **Owner:** John H. and Robert J. Dickson (1943). **Ore:** Copper, lead, zinc, gold, silver. **Assays:** 4 parallel zones 2 to 3 ft. wide. Within an area 90 ft. wide, contain mineralized quartz-carbonate veins 2 to 12 in. wide. Wall rock is serpentinized peridotite. **Assays:** Presence of Ag. Au indicated by assays. Ref: 23, pp. 56-51.

#### Alleghany

(see Foggy)

#### Alpha

(see under gold)

#### Alta (140)

(see under gold)

#### Anaconda

**Loc:** 12 mi. above mouth of Beckler R., Index dist. **Prop:** 4 claims. **Owner:** J. Frank Bleakley and Charles Shepp. **Ore:** Copper, silver. **Assays:** Chalcopyrite, bornite. **Deposit:** Contact between porphyry and slate. Ref: 63, p. 35.

#### Arlington (67)

**Loc:** NE¼ sec. 11, (30-9E), about 2 mi. NW. of Silverton on Marten Cr. **Prop:** 4 claims. **Ore:** Copper, gold, silver, lead. **Assays:** Chalcopyrite, galena, pyrite. **Deposit:** Quartz vein with max. width of 75 ft. is more or less mineralized with sulfides. **Dev:** 20-ft. adit in ore, 1,000-ft. crosscut not reaching ore. **Assays:** $12.60 Au, $8.20 Ag, 35% Cu from the high-grade ore. Ref: 14, p. 40. 63, pp. 21-22.

#### Armament (Wayside) (175)

**Loc:** NW¼ sec. 30, (28-11E). **Access:** 7½ mi. from railroad at Index by road along the E. side of the N. Fk. of Skykomish R. **Prop:** 1 claim: Armament No. 1. **Owner:** Karl and Karin Elizabeth Paykull, Seattle, Wash., leasing from R. M. Brown, Pheom and Marjorie Boyle (1942-1948). Robert McDonald and John H. Cashier (1942). **Ore:** Molybdenum, copper. **Assays:** Molybdenite, chalcopyrite, pyrite, molybdite, scheelite, mala­ chute. **Deposit:** Stockwork in gneissoid quartz diorite of short discontinuous quartz veins containing molybdenite and chalcopyrite. The ore body has ex­ posed dimensions of 120 ft. by 140 ft. by a 20-ft. depth, but its limits are not known. Veinlets up to 3 in. wide and mostly at least 6 in. apart. **Dev:** Several small open cuts and 2 road cuts. **Assays:** Three 10-ft. channel samples from the better ore showed 0.06%, 0.24%, 0.11% MoS₂; 0.15%, 0.30%, 0.38% Cu. Ref: 14, p. 16. 158.

#### Bald Mountain (29)

**Loc:** 2 mi. N. of Silverton on W. side of Deer Cr., probably in sec. 1, (30–9E). **Access:** Old wagon road up Deer Cr. **Prop:** The Golden Chord claims and the Lakeview claim. **Ore:** Copper, gold, silver. **Assays:** 10.5 % Cu, $8 in Au, Ag. Ref: 63, p. 24.

#### Bangor Creek (Borinite) (44)

**Loc:** Sec. 26, (30–10E), on W. Fk. of Bangor Cr. at mouth of Deer Cr., 1 mi. E. of Silverton. **Elev:** 4,500 ft. **Prop:** 11 claims, 6 millsites. **Ore:** Copper, gold, silver. **Assays:** 10.5% Cu, 0.051 oz. Au, 4 oz. Ag. Ref: 14, p. 40. 63, p. 22.

#### Bell and Crown (73)

**Loc:** Sec. 30, (30–10E), on the divide at E. Fk. of Bender Cr. about 1 mi. S. of Silverton. **Access:** Trail up Bender Cr. **Prop:** 17 claims. **Ore:** Copper, gold, silver. **Assays:** Chalcopyrite, pyrite. **Assays:** 10.5% Cu, $6 in Au, Ag. High-grade ore runs as much as $30 per ton. Ref: 14, p. 41. 63, p. 19.

#### Big Bear and Butte (26)

(see under gold)

#### Beckler River

**Loc:** T. 27 N., R. 12 E., at the head of Beckler R., Index dist. **Ore:** Copper, gold, silver. **Assays:** Chalcopyrite, pyrite. **Ref:** 14, p. 16.

#### Bell and Crown (73)

**Loc:** Sec. 30, (30–10E), on the divide at E. Fk. of Bender Cr. about 1 mi. S. of Silverton. **Access:** Trail up Bender Cr. **Prop:** 17 claims. **Ore:** Copper, gold, silver. **Assays:** Chalcopyrite, galena, pyrite. **Gangue:** Quartz. **Deposit:** Main vein is from 8 to 30 ft. wide in porphyry and slate. Width of ore av. about 12 ft., chiefly on hanging wall. A cross vein 12 ft. wide carries 6 ft. of ore. 3 other small veins with 2 and 3 ft. of ore. **Assays:** Copper, gold, silver. **Assays:** 10.5% Cu, $6 in Au, Ag. High-grade ore runs as much as $30 per ton. Ref: 14, p. 41. 63, p. 19.

#### Big Bear and Butte (26)

(see under gold)

#### Big Copper (77)

**Loc:** NE¼ sec. 4, (29–10E), on S. side of Hall Peak, Sultan dist. **Prop:** 6 claims. **Ore:** Copper, cobalt, gold, silver. Ref: 14, p. 47. 63, p. 24.

#### Big Raymond (120)

(see under gold)

#### Bitter Creek (188)

**Loc:** Sec. 11, (27–10E), about 4½ mi. NE. of Index on Bitter Cr. **Elev:** 3,500 ft. **Access:** Trail up Bitter Cr. **Prop:** 6 claims: Wonder Nos. 1 and 2, Standard, Standard Nos. 1 and 2. **Ore:** Copper. **Assays:** Bornite, chalcopyrite, pyrite, hematite. **Gangue:** Crushed and altered granodiorite. **Deposit:** Mineral-
ized shear zone 2 ft. wide in granodiorite is impregnated with copper minerals. Dev: 200-ft. adit, 600-ft. adit. Assays: Av. ore is low grade. Ref: 14, p. 16. 173, p. 84.

Black Hawk (174)
(see under gold)

Black Hawk (56)

Blackman
(see Doris)

Blackstone

Blue Bird
(see under gold)

Blue Bell

Blue Bell (64)

Blue Bell (19)
(see under gold)

Blue Bell (87)

Bluebird
(see under gold)

Bolton

Broken Ridge (Silver Creek) (165)

Brown
(see Doris)

Buckeye (105)

Bullion King
(see under gold)

Bunker Hill
(see Copper Belle)
**Copper Occurrences—Snohomish County**

**Bunker Hill (57)**  
Loe: Sec. 4, (30-9E), Silverton dist.  
Ore: Copper.  
Ore min: Chalcopyrite, pyrrhotite.  
Deposit: 2-ft. vein of solid sulfides.  
Dev: Adit.  
Ref: 14, p. 4.  
158.

**Burns (15)**  
(see under gold)

**Bush and Curry**  
Loe: Index dist.  
Ore: Copper.  
Ref: 97, 1917, p. 504; 1918, p. 508.

**Butte and Big Bear**  
(see Big Bear and Butte under gold)

**Calumet (106)**  
(see under gold)

**Calumet (189)**  
Loe: Secs. 11 and 12, (27-10E), on the ridge between the N. and S. branches of Bitter Cr., Index dist.  
Elev: About 4,000 ft.  
Access: Trail up Bitter Cr.  
Prop: 4 claims.  
Owner: W. S. Dewey (1912).  
Ore: Copper, zinc.  
Ore min: Chalcopyrite, pyrite, sphalerite.  
Gangue: Quartz, calcite, altered granodiorite.  
Deposit: Mineralized shear zone as much as 8 ft. wide in granodiorite.  
Dev: 100-ft. adit, 500-ft. adit, several open cuts.  
Ref: 14, pp. 16-17. 162, pp. 82-83.

**Calumet**  
(see under Glacier Peak)

**Caplin-Holbrooke (129)**  
(see under gold)

**Cascade (Homestead) (187)**  
Loe: Sec. 12, (27-10E) and sec. 7, (27-11E), on the S. side of Trout Cr., Index dist.  
Elev: About 2,000 ft.  
Access: 1 mi. SE. of the Sunset mine by truck and bulldozer roads. 7 mi. from railroad at Index.  
Prop: 11 claims.  
Owner: W. Proper and O. T. Majors, Index, Wash. (1942).  
Homestead Copper Co. (1909).  
Cascade Copper Co. (1926).  
Ore: Copper, gold, silver.  
Ore min: Chalcopyrite, bornite, pyrite.  
Gangue: Quartz.  
Deposit: lenses of slightly mineralized nodules and stringers in a shear zone.  
Dev: Several short adits and a 310-ft. crosscut that fails to cut the ore.  
Assays: Ore is low grade.  
Ref: 14, p. 17. 58, p. 30. 98, 1922-1926. 111, p. 5. 112, p. 183. 130, p. 79. 158. 162, p. 79.

**Champion (139)**  
(see under gold)

**Charlotte (180)**  
Loe: SW 1/4 sec. 33, (28-10E). about 1/2 mi. SW. of the Ethel mine on NW. side of N. Fk. of Skykomish R., Index dist.  
Elev: 1,000 ft.  
Access: Reached by trail from Curry's ranch.  
Owner: Riley Curry, Index, Wash. (1942).  
Ore: Copper, gold, silver.  
Ore min: Chalcopyrite, pyrite, chalcocite.  
Deposit: Small lenses of ore along a shear zone in granodiorite.  
Prod: 2 carloads of high-grade ore.  
Ref: 14, p. 15. 158.

**Chattman**  
(see Jerry Chatman)

**Chickamun**  
(see Forest-Chickamun)

**Clara Thompson**  
(see Jasperson under gold)

**Cleveland (45)**  
(see also Ore Recoveries)  
Loe: SW 1/4 sec. 20, (30-10E), adjoining the Copper Independent property, Silverton dist.  
Access: Trail.  
Prop: 4 claims.  
Owner: Ore Recoveries Corp. (1941).  
Virginia-Agenda Co. (1922-1938).  
Ore: Copper, gold, silver, lead.  
Ore min: Chalcopyrite, arsenopyrite, galena.  
Deposit: Intersecting veins with several ore bodies 2 ft. wide.  
Dev: 72-ft. adit.  
Assays: $29 Cu, Au, Ag.  

**Cliff (58)**  
Loe: Sec. 1, (19-10E), near Marten Cr., Silverton dist.  
Elev: 3,925 ft.  
Ore: Copper.  
Ore min: Chalcopyrite, marcasite.  
Deposit: Several 2- to 4-in. stringers of fairly well mineralized rock and quartz in granodiorite.  
Dev: 30-ft. adit.  
Ref: 14, p. 42. 158.

**Colts (33)**  
Loe: SW 1/4 sec. 7, (30-10E), on a fork of Deer Cr., Silverton dist.  
Access: 1/2 mi. from wagon road up Deer Cr.  
Prop: 4 claims.  
Ore: Copper, silver, gold.  
Ore min: Chalcopyrite.  
Deposit: Vein or mineralized zone containing 3 ft. of rich ore and 7 ft. of concentrating ore.  
Dev: 14-ft. and 16-ft. adits on the vein and a 55-ft. crosscut that failed to contact the ore.  
Assays: 26% Cu, 18% oz. Ag. $3.40 Au for the high-grade ore.  
Ref: 14, p. 42. 63, p. 21.

**Columbia Mountain**  
(see under antimony)

**Commercial (178)**  
Loe: SE 1/4 sec. 32, (28-11E), Index dist.  
Ore: Copper, gold.  
Ore min: Chalcopyrite, pyrite.  
Deposit: 4-ft. vein traceable for 300 ft. on the surface.  
Assays: $12 to $20 Au, Cu.  
Ref: 63, p. 34.

**Commonwealth**  
(see Jasperson under gold)

**Commonwealth (see under gold)**

**Consolidated**  
(see under gold)

**Cooperative (Howard) (173)**  
Loe: SE 1/4 sec. 29, (28-11E) and secs. 4 and 5, (27-11E).  
Access: Trail up Howard Cr. from road on N. Fk. of Skykomish R.  
Prop: 16 claims.  
Owner: Cooperative Mining Syndicate (1912).  
Ore: Copper, gold, silver, lead, zinc.  
Ore min: Chalcopyrite, bornite, pyrite.  
Deposit: Mineralized shear zones in quartzite and granodiorite.  
Dev: Several adits aggregating about 1,500 ft., an old shaft of unknown depth, and several open cuts.  
Assays: Samples from old shaft assayed $1 to $6 Au.  
Ref: 14, p. 17. 63, p. 33. 162, pp. 78-80.

**Copper**  
(see Merchant)

**Copper Belle (Bunker Hill) (160)**  
Loe: Secs. 1, 2, 11, and 12, (27-9E), on S. slope of the mountain NE. of the old station of Reiter, Index dist.  
Elev: 1,500 ft.  
Access: 1 mi. by trail N. of Reiter.  
Prop: 16 patented claims.  
Owner: Wiatrak Mining & Developing Co., Inc., Seattle, Wash. (1955——).  
Bunker Hill Mining & Milling Co. (1902-1905).  
Copper Belle Mining Co. (1917). Western Copper Mining Co. (1918-1926).  
Shamrock Mining Co. (1927).  
Ore: Copper, gold, silver, tungsten.  
Ore min: Chalcopyrite, pyrite, bornite, magnetite, hematite.  
Gangue: Quartz, calcite, crushed and altered granodiorite.  
Deposit: Lens-shaped bodies of ore in shear zones in granodiorite. Main ore body was a lens 30 ft. wide.  
Dev: Main adit 2,000 ft. long with drifts and stopes. 7 other shorter

**Copper Chief (145)**

**Loc:** NW 1/4 sec. 7, (28-11E), on W. side of Silver Cr. **Prop:** 4 claims. **Owner:** Copper Chief Mining Co. (1901-1918). **Ore:** Copper, gold, silver, lead. **Ore min:** Chalcopyrite, galena, arsenopyrite. **Depos:** 8-ft. vein. **Dev:** 320-ft. adit. **Assays:** Au. $24 Cu, Au, Ag. **Ref:** 14, p. 30. 33, 1907, p. 511. 88, p. 75. 88, 1918, p. 73.

**Copper Cliff (46)**

(see under gold)

**Copper King (184)**

**Loc:** NW 1/4 sec. 1, (27-10E), 475 ft. N. of Sunset lode, Index dist. **Prop:** 1 patented claim. **Owner:** F. M. Jordan, Seattle, Wash. **Ore:** Copper. **Ore min:** Black copper oxide, bornite, chalcopyrite, malachite. **Depos:** Similar to Sunset. **Prod:** Has produced. **Ref:** 129, pp. 287-288. 158.

**Copper Lake (25)**

**Loc:** SW 1/4 sec. 36, (31-11E), on the mountains overlooking Deer Lk., Silverton dist. **Prop:** 10 claims. **Ore:** Copper. **Ore min:** Chalcopyrite. **Depos:** 4-ft. vein, 6-ft. vein. **Dev:** Two 60-ft. adits, 46-ft. adit, and two crosscuts of unknown length. **Ref:** 14, p. 42. 63, p. 21.

**Crown (69)**

(see under gold)

**Copper Queen (23)**

**Loc:** Sec. 13, (30-9E), N. of Silverton. **Elev:** 4,550 ft. **Ore:** Copper, gold. **Ore min:** Pyrrhotite. **Depos:** Mineralization in mafic dikes as masses and pods. **Dev:** Short adit. **Assays:** Less than 1% Cu, 40¢ Au. **Ref:** 14, p. 42. 158.

**Copperhead (34)**

**Loc:** SW 1/4 sec. 18, (30-10E), on Long Mtn., Silverton dist. **Prop:** 18 claims. **Ore:** Copper, gold, silver. **Ore min:** Chalcopyrite. **Depos:** Vein ranges from 2 in. to 5 ft. in width. **Dev:** Sixteen smaller veins and stringers known to occur. **Assays:** $10 to $70 per ton. **Ref:** 14, p. 42. 63, p. 19.

**Courtney (10)**

**Loc:** SW 1/4 sec. 27, (32-9E), on Jumbo Mtn., Darrington dist. **Ore:** Copper, silver, gold, lead. **Depos:** 3-ft. vein. **Dev:** 10-ft. adit. **Assays:** $8.50 Au, 14% Cu, 15 oz. Ag, 4% Pb. **Ref:** 14, p. 8. 63, p. 51.

**Covered Wagon (164)**

**Loc:** NW 1/4 sec. 19, (28-11E), on W. side of Silver Cr., 1/2 mi. N. of Galena. **Owner:** Lawrence V. Whitfield, Monroe, Wash. (1932). **Depos:** Formerly owned by C. F. Armstrong, Index, Wash. **Ore:** Copper, gold. **Ref:** 133, p. 32. 158.

**Crown (see Bell and Crown)**

**Curry (see Bush and Curry)**

**Dahl (see Eclipse under gold)**

**Damm (see Eclipse under gold)**

**Darrington (see Gold Mountain)**

**Darrington (Elwell-Darrington) (see Elwell-Darrington under gold)**

**Delta (132)**

**Loc:** Silver Cr. dist. **Owner:** Judge Denny, Everett, Wash. (1892). **Ore:** Copper, lead, gold, silver. **Ore min:** Galena, chalcopyrite. **Gangue:** Quartz. **Depos:** 5-ft. vein. **Ref:** 13, p. 159. 14, p. 31.

**Dewey (162)**

(see under gold)

**Diamond Hitch (124)**

**Loc:** Sec. 31, (29-11E), on W. Fk. of Silver Cr. **Ore:** Copper, gold, silver. **Ore min:** Chalcopyrite, pyrite. **Depos:** 4 in. of ore along a shear zone. **Dev:** 45-ft. adit. **Ref:** 14, p. 31. 63, p. 30.

**Dorris (Blackman, Brown) (112)**

**Loc:** E 1/4 sec. 34 and W 1/4 sec. 25, (29-10E), Sultan dist. **Elev:** 3,000 to 3,700 ft. **Ore min:** 5 unpatented claims. **Ore:** Copper, silver, gold. **Depos:** Chalcopyrite, pyrite, small amount scheelite and pyrite. **Gangue:** Quartz, brecciated mafic rocks. **Depos:** Mineralized fault zones 1 to 4 ft. wide in quartzite and hornfels. **Dev:** 250-ft. drift, 200-ft. crosscut, and two 6-ft. drifts. **Ref:** 23, pp. 60-62. 106, 9/1/28; 9/17/28, pp. 5-6. 158.

**Drum Lummond (59)**

**Loc:** Sec. 4, (30-9E), Silverton dist. **Prop:** 1 patented claim. **Ore:** Copper. **Ref:** 14, p. 43.

**Dry Creek (see under gold)**

**Eclipse (43)**

(see under gold)

**Edison (121)**

(see under gold)

**El Dorado (86)**

**Loc:** NW 1/4 sec. 13, (29-11E), 3/4 mi. SE. of Goat Lk., Monte Cristo dist. **Ore:** Copper, silver, gold. **Ore min:** Chalcopyrite, pyrite. **Depos:** Narrow mineralized fracture. **Dev:** Short adit. **Assays:** $6 to $21 Au, $2 to $7 Ag, as high as 21% Cu. **Ref:** 14, p. 5-6. 158.

**Eldred (81)**

**Loc:** Sec. 11, (29-10E), at headwaters of Stilaguamiash R. **Access:** 1/2 mi. from the main Sunrise trail. **Prop:** 1 claim. **Owner:** R. H. Spurlock and J. Sahlborn, Marysville, Wash. (1942). **Ore:** Copper, tungsten. **Depos:** Pyrite, arsenopyrite, minor chalcopyrite and scheelite. **Depos:** Quartz vein 12 to 16 in. wide in argillite and conglomerate. **Dev:** 40-ft. drift with a 15-ft. crosscut. **Ref:** 158.
Elmo
(see Gold Bar and Elmo under lead)

Elwell-Darrington (11)
(see under gold)

Empire
(see Merchant)

Ethel (Ethel Consolidated) (181)


Ethel Consolidated
(see Ethel)

Eureka (37)


Everett (47)


Evergreen (156)


Fanny (42)
(see under gold)

Feldt (72)
(see under silver)

Florence-Rae (185)


Florence Rae (Rudebeck-Florence Rae) (107)


Foggy (Alleghany, Penn) (88)

Loc: SW¼ SW¼ sec. 13, (29-11E), on the NE. slope of Cadet Peak, Monte Cristo dist. Elev: 5,500 ft. Access: Trail up Elliot Cr. from the Sauk R. road. Prop: 3 patented claims: Foggy Lode, New York, 95. Owner: Dr. W. J. Collings, Benton, Wash. (1949). Ore: Copper, gold, silver, lead, zinc, antimony, arsenic. Ore min: Arsenopyrite, pyrite, chalcopyrite, galena, sphalerite, stibnite, realgar. Gangue: Quartz. Deposit: A partially mineralized fracture zone can be traced for 5,000 ft. on the surface. Surface ores are galena, sphalerite, chalcopyrite, stibnite, and realgar. Ores at depths of more than 200 ft. are pyrite and arsenopyrite. Dev: More than 1,000 ft. of adit is reported to give a depth of 1,000 ft. below the surface. Assays: Av. 0.2 oz. Au, 8 oz. Ag, 3% to 5% Zn, 3% to 4% Pb, 3.15% As, 5.5% Sb. Prod: Amount not known. Ref: 14, p. 20. 63, p. 15. 132, pp. 134-135. 149, pp. 816, 842. 158.

Forest-Chickamun (20)


Forest Hope (16)

Loc: SE¼ sec. 18, (22-10E), Darrington dist. Prop: 3 claims. Ore: Copper, gold, silver, mercury. Ore min: Cinnabar, native mercury. Deposit: 8 ft. of ore for 1,000 ft. on the surface. This splits into 3 veins, 4, 5, and 6 ft. wide. Assays: $6 to $36 Au, tr. to 18 oz. Ag, 10% to 18% Cu. Ref: 14, p. 8. 63, p. 52.

“48-55” (Garnet, Vesper Peak) (79)

**Gold Eagle (122)**  
(see under gold)

**Gold Mountain (Darrington) (22)**  
Owner: Mr. Cornelius and associates, Mount Vernon, Wash. (1942). Ore: Copper, silver, gold. Ore min: Chalcopyrite, tetrahedrite (?), pyrrhotite, and minor amounts of sphalerite and galena. Deposit: Quartz veins in schist. One vein is traceable for 125 ft. and has a max. width of 8 ft. It narrows to a width of 1 ft, in a short distance, however. 2 other veins are about 1 ft. wide. Dev: Crosscut with 125 ft. of drift and another old adit in barren rock. Assays: $18 to $36 Au, tr. to 18 oz. Ag, $18 to $32 Cu. Ref: 14, p. 8. 58, p. 26. 63, p. 52. 158.

**Golden Chord (68)**  
(see under gold)

**Golden Eagle (110)**  
(see under molybdenum)

**Good Hope (130)**  
(see under gold)

**Good Luck (172)**  
Loc: SW¼ sec. 21, (28-11E), Index dist. Access: 11 mi. by road from railroad at Index. Prop: 4 or more claims. Owner: E. S. Turner, Tom Swaboda, and Fred Simmerer (1949). Dr. James Brannon and associates, Index, Wash. (1945). Ore: Copper. Deposit: Schist, quartzite, and granite, in which is a quartz pegmatite dike containing sparse mineralization. Dike can be traced for 500 ft. and is 50 to 100 ft. thick, but only a very small part of this is ore. Dev: Open cut. Ref: 68, p. 10. 157.

**Granite Mountain**  

**Gray Eagle (161)**  

**Great Northern (98)**  
(see under gold)

**Great Scott (135)**  
(see under gold)

**Green Crown (2)**  

**Grizzly**  

**Gunn Peak (190)**  
crite is slightly mineralized. Dev: 450-ft. adit, 10-ft. adit.

**Assays:** Av. samples said to run 11.4% Cu, $1.92 Ag, tr. Au.

**Ref:** 14, p. 17, 33, 1907, p. 699; 1908, pp. 768, 809. 88, p. 82. 114, no. 5, 1909. 162, pp. 85-86.

**Hammond**

(see Keystone)

**Hancock** (123)

**Loc:** Sec. 31, (29-11E), ½ mi. N. of Mineral City, Silver Cr. dist. **Ore:** Copper, gold, silver, nickel, cobalt. **Ore min:** Chalcopyrite, pyrite. **Deposit:** 15- to 30-ft. vein with 1½ to 3 ft. of ore. Dev: 40-ft. adit. **Ref:** 14, p. 23, 63, p. 29.

**Hannah** (24)

**Loc:** NW¼ sec. 31, (31-10E), Silverton dist. **Prop:** 8 claims. **Ore:** Copper. Dev: 40-ft. adit. **Assays:** $10 Cu. Ref: 14, p. 44, 63, p. 20.

**Hannah** (3)

**Loc:** NE¼ sec. 32, (32-9E), on Whitehorse Mtn., Darrington dist. **Prop:** 5 claims. **Ore:** Copper, gold, silver. **Deposit:** 3 ft. of ore in granite country rock. **Assays:** $19.65 Au, 41 oz. Ag, 30% Cu. **Ref:** 14, p. 9, 63, p. 51.

**Hare Pass** (113)

**Loc:** SE¼ sec. 36, (29-10E), on W. side of Sheep Gap Mtn., Susan dist. **Prop:** 1 claim. **Ore:** Copper, gold, silver. **Ore min:** Chalcopyrite, tetrahedrite. **Deposit:** 10-ft. adit. **Ref:** 14, p. 48, 63, p. 25.

**Hecla** (30)

**Loc:** Sec. 2, (30-9E), at the head of Marten Cr., Silverton dist. **Access:** About 5½ mi. from Silverton by trail and road. **Ore:** Copper, gold, silver. **Ore min:** Pyrite, chalcopyrite, marmasite. **Gangue:** Quartz. **Deposit:** Slightly mineralized joints in granodiorite. Small amounts of the ore minerals and quartz. Dev: Open cuts. **Ref:** 14, p. 44.

**Helena** (197)

**Loc:** NW¼ sec. 16, (27-10E), ¼ mi. NE. of Index. Elev: 2,500 ft. **Access:** Trail. **Prop:** 2 claims: Tillicum, Tillicum Hill. **Ore:** Copper, gold, silver. **Ore min:** Chalcopyrite, bornite, pyrite. **Gangue:** Quartz, calcite, altered granodiorite. **Deposit:** 4-ft. mineralized shear zone in granodiorite consists of 1-in. sulfide bands alternating with altered granodiorite. Dev: 3 short adits aggregating 255 ft. **Ref:** 14, p. 17, 162, p. 86.

**Helena** (23)

**Loc:** SW¼ sec. 30, (31-10E), about 5 mi. N. of Silverton, on the divide between Deer and Clear Creeks. **Access:** Old wagon road from Silverton to St. Louis mine, thence by trail along the divide. **Prop:** 6 claims. **Owner:** Deer Creek Gold & Copper Mining Co. (1902-1907). **Ore:** Copper, gold, silver. **Ore min:** Pyrite, chalcopyrite. **Gangue:** Sheared granite, quartz. **Deposit:** At least 2 sulfide-bearing quartz veins in shear zones in granite. Large low-grade bodies of ore. **Dev:** Main adit 124 ft. long with 125 ft. of drifts. Another adit 1,000 ft. lower. **Assays:** $10 to $32 per ton. **Prod:** 150 tons shipped to Tacoma smelter. **Ref:** 14, p. 40, 33, 1907, p. 584, 63, pp. 19-20. 88, pp. 69-70.

**Helena and Sadie** (114)

**Loc:** SW¼ sec. 36, (29-10E), on W. side of Sheep Gap Mtn., Susan dist. **Prop:** 2 claims. **Ore:** Copper, gold, silver. **Ore min:** Chalcopyrite. **Deposit:** 3 parallel shear zones in syenite, 2 of which are 30 in. wide with 18 in. of ore, and the third is 6 ft. wide with 40 in. of ore. The large zone is traceable for 2,000 ft. on the surface and the middle one for 300 ft. **Dev:** Several short adits. **Assays:** 16% to 20% Cu, $8 to $10 Au. **Ref:** 14, p. 48, 63, p. 25.

**Hicks**

(see Sultan King)

**Highland** (5)

**Loc:** Sec. 3, (31-9E), near the headwaters of Buckeye Cr. on White Horse Mtn., Darrington dist. **Prop:** 5 claims. **Ore:** Copper, gold, silver. **Deposit:** 18 in. of ore. **Assays:** $20 Au, 13 to 40 oz. Ag, 18% Cu. **Ref:** 14, p. 9, 63, p. 51.

**J. J. Hill**

(see under gold)

**Holbrooke**

(see Caplin-Holbrooke under gold)

**Homestead**

(see Cascade)

**Hoodoo** (48)

(see also Ore Recoveries)

**Loc:** SE¼ sec. 20, (30-10E), on Hoodoo Gulch, Silverton dist. **Access:** Wagon road ¾ mi. from the old railroad grade. **Prop:** 7 claims and 6 millsites. **Owner:** Ore Recoveries Corp. (1941). Stiliguamish & Sultan Mining Co. (1902-1918). **Ore:** Copper, gold, silver. **Ore min:** Chalcopyrite, pyrite, pyrrhotite, stannite. **Gangue:** Quartz, calcite, country rock. **Deposit:** Veins in conglomerate and slate. Dev: 420-ft. main adit and shorter adits totaling 200 ft. in length. **Assays:** $20 Cu, Ag, Au. **Ref:** 14, p. 44, 33, 1907, p. 1051, 46, pp. 164-165, 63, p. 18, 85, p. 66, 88, 1918, p. 136.

**Hope** (138)

(see under gold)

**Horseshoe and Treasure Box** (111)

(see under gold)

**Howard**

(see Cooperative)

**Hunter** (6)

**Loc:** NW¼ sec. 24, (32-9E), on Jumbo Mtn., Darrington dist. **Prop:** 2 claims. **Owner:** Messrs. Burns and Neste (1901). **Ore:** Copper, lead, silver, gold. **Ore min:** Chalcopyrite, galena. **Deposit:** Vein 3 ft. wide carries 9 in. of ore. Dev: 60-ft. adit, 3 open cuts. **Assays:** $20 Au, 8 to 40 oz. Ag, 10% Cu, 4% Pb. **Ref:** 14, p. 9, 63, p. 51. 88, p. 63.

**Hustler** (82)

**Loc:** Sec. 12, (29-10E), at head of Stiliguamish R. **Prop:** 2 claims: Hustler, Hustler Extension. **Ore:** Copper, molybdenum, tungsten. **Ore min:** Chalcopyrite, pyrite, molybdenite, scheelite, arsenopyrite. **Deposit:** Quartz vein from 3 to 12 in. wide. Dev: 50-ft. adit, 100-ft. adit. **Ref:** 158.

**Imperial** (49)

**Loc:** Sec. 20, (30-10E), about 1½ mi. E. of Silverton. Elev: 2,500 ft. **Prop:** 11 claims, most important of which are the Anacortes and Mountain View. **Owner:** Imperial Mining Co. (1902-1909). **Ore:** Copper, silver, lead, gold. **Ore min:** Chalcopyrite, arsenopyrite, galena. **Deposit:** Main vein is along contact of diorite and conglomerate. Dev: 400 ft. of development. **Assays:** Main values are in copper and silver with only a small amount of gold. **Ref:** 14, p. 44, 33, 1907, p. 688, 88, pp. 68-69. 105, 8/05, p. 183. 114, no. 5, 1908, p. 99.

**Independence** (152)

**Loc:** Sec. 6, (28-11E), at Mineral City. **Access:** 14 mi. from railroad at Index. **Ore:** Copper. **Ore min:** Chalcopyrite, bornite. **Deposit:** Fissure vein in granodiorite and slate. **Assays:** Est. 3 tons selected ore had 3% Cu. **Ref:** 111, p. 5.
Index
(see Lake Serene)

Index Bornite (194)

Index-Independent
(see Lake Serene)

Index Peacock (191)

Iowa (Mint) (105)

Iowa (Washington-Iowa)
(see Washington-Iowa)

Iron Mountain
(see under gold)

Isabell
(see Red Cross)

Jackson
(see St. Louis and Jackson)

Jamboree (146)

Jasper (103)
(see under gold)

Jerry Chatman (104)

Jesse (4)
(see under gold)

Jim Dandy (147)
(see under gold)

Johnson (101)

Jones
(see Kromona)

Jumbo (119)
(see under gold)

Jumbo
(see under gold)

Junie

Kelly Creek (103)

Kena and Troy (see Skrinde)

Keystone (Hammond) (97)

Keystone (93)
(see under gold)

Keywinder (12)

Kitanning (182)
Copper Occurrences—Snohomish County

87


Kromona (Scriber, Jones) (109)

Lost Creek (179)

Louise (see Mineral Center under gold)

Lucy (see gold)

Lucy (50)

Lucy (60)

M and H No. 2 (149) (see under gold)

McCombs (see Jasperson under gold)

Mackinaw (Weden Creek) (89)
Loc: SE¼SW¼ sec. 19, (29-11E), on W. Fk. Weden Cr., about 3 mi. from Monte Cristo. Elev: 3,000 to 3,600 ft. Access: 2 mi. road up Weden Cr.; 41 mi. to railroad at Hartford. Prop: 18 claims and 3 millsites. Owner: Mackinaw Metals Co., Donald Baker, Seattle, Wash. (1944, 1954—). E. C. Baker, Garrett Cleary, M. T. S. Comis (1880). Mackinaw Mining & Milling Co. (1916). Mackinaw Minerals Co. (1934). Utility Mining Co., R. D. Taft, Everett, Wash., lessee (1941-1947). Ore: Copper, nickel, cobalt, gold, silver, uranium (?). Ore min: Pyrite, chalcopyrite, malachite, chrysocolla, garnierite, erythrite, pyrrhotite, chloanthite, cubanite, pentlandite. Gangue: Quartz, carbonates, serpentine. Deposit: Mineralized fracture zone that can be traced for 3,000 ft. on the surface and that has a known depth of 125 ft. Ore body is from 11 to 30 ft. wide with a known length of 90 ft. Fracture zone occurs along a fault separating serpentine from arkoise. Ore minerals occur as disseminated grains and blebs in serpentine and may total as much as 20% of the rock in spots. The ore shoots are in small lenses. Ore reserves are not large. Dev: 4 adits; 255, 146, 686, and 24 ft. long. Also a caved adit and an open cut. Assays: 4-ft. sample from a raise in No. 2 adit showed 0.62 oz. Au, 0.25% Ni. Weighted av. of about 30 reliable assays of ore zone av. 12.8 ft. wide, 112 ft. long exposed in No. 3 adit is 2.30% Cu, 6.86% Ni, 0.13 oz. Au. Ore zone around No. 4 and No. 5 adits had a weighted av. of 3 samples of 1.12% Cu, 1.06% Ni, 0.16 oz. Au. The highest cut, 1,000 ft. beyond No. 5 adit, showed 0.20% Cu, 0.99% Ni from a grab sample. A 500-lb.

Lambert

Last Dollar (143)

Lida (118)

Little Chief (76)
metallurgical sample supplied by the owner and tested by the U.S. Bureau of Mines showed 2.7% Cu, 1.0% Ni, 0.05% Co, 8.9% Fe, 0.8% As, 3.9% S, 30.6% SiO₂, 0.2% CaO, 0.11 oz. Au, 0.39 oz. Ag. Slight radioactivity in some samples. **Prod:** A few tons shipped 1900-1910.  

**Molly**

(see "45" under silver)

**Mamie (75)**

**Loc:** Sec. 29, (30-10E), about 2 mi. S. of Silverton. **Ore:** Copper. **Prod:** Small amount in 1916.  

**Manley (13)**

**Loc:** SW¼ sec. 27, (32-9E), on Jumbo Mtn., Darrington dist. **Ore:** Copper, gold. **Ore min:** Chalcopyrite. **Deposit:** 3 ft. of chalcopyrite ore. **Dev:** 130-ft. adit. **Assays:** $8 Au.  

**Marguerite Mosher**

**Loc:** Sultan dist. **Owner:** Western Metals Corp. (1928). **Ore:** Copper, silver.  

**Martin Engdahl (150)**

(see under lead)

**Marvel (115)**

**Loc:** SW¼ sec. 2, (28-10E). **Elev:** 3,800 ft. **Access:** Reached by hiking up Elic Cr. from Sultan Basin road. **Prop:** 2 unpatented claims. **Owner:** C. F. Smith and Vance Curtiss (1937). **Ore:** Copper. **Ore min:** Chalcopyrite, small amounts of pyrrhotite, scheelite, sphalerite. **Gangue:** Quartz, serpentine. **Deposit:** 2 veins of nearly massive chalcopyrite, one 2 in., the other 1 in. wide separated by 2 in. of altered quartz diorite. **Dev:** 15 ft. of open cut work.  

**Merchant (Copper, Empire) (192)**

**Loc:** Center S½ sec. 18, (27-11E), on W. side of Trout Cr. about 4 mi. from its mouth, Index dist. **Elev:** 3,500 ft. **Access:** Trail and road up Trout Cr. **Prop:** 12 unpatented claims including: Fred P., Big Goat, Ore or No Go. **Owner:** J. N. Erlanden, Everett, Wash. (1950). **Elev:** 4,000 ft. Owner: E. H. Hubbart, T. D. Brown, and Thomas Lockwood (1892). Ivan Merchant, Salem, Oreg. (1942). **Ore:** Copper. **Ore min:** Chalcopyrite, bornite, pyrite, pyrrhotite, native gold, native mercury. **Gangue:** Quartz, crushed country rock. **Deposit:** 4 shear zones in granodiorite, slate, and quartzite. **Dev:** 15 ft. of open cut work. **Access:** Within 1 to 12 ft. in width. 80,000 tons of ore in sight. **Dev:** Main adit 1,700 ft. long with drifts. 9 other adits, 150 ft., 500 ft., and 175 ft. long. **Improv:** 2 cabins.  

**Milwaukee (53)**

(see under zinc)

**Mineral Center (131)**

(see under lead)

**Mineral Mines (154)**

**Loc:** SE½ sec. 6, (28-11E). **Access:** 3½ mi. by truck road up Silver Cr. from Galena. **Owner:** Mineral Mines, Inc., Seattle, Wash. (1941). **Ore:** Copper, gold, silver, lead, zinc. **Ore min:** Chalcopyrite, pyrite, galena, sphalerite. **Deposit:** Large mineralized shear zone in limestone. **Dev:** 375-ft. crosscut adit.  

**Mint**

(see Iowa)

**Molly (176)**

(see under uranium)
for hand samples. Av. values are very low. Ref: 14, p. 10. 111, p. 6. 158.

Nevada (85)

New Star Consolidated (see under silver)

North Star (Newfield, Sunrise)

New York (51)

New York-Snohomish County Copper Occurrences (1960)

New York-Snohomish County Copper Occurrences (1960)

Non Pareil (186)

North Star (Oldfield, Sunrise)
(see under gold)

North Star (Oldfield, Sunrise)

Northwest Consolidated (see under gold)

O and B (92)

Occidental (80)
(see under gold)

Oldfield (see Sunrise under gold)

Olson (54)

Ore Recoveries (40)
(see also Cleveland, Hoodoo, Virginia under copper, and Copper Independent, Eclipse under gold)

Oro Fino (167)

P. I. (165)

Penn (see Foggy)

Philo (94)
Pride
(see Monte Cristo under gold)

Pride of Index
(see Lake Serene)

Queen Anne (14)
(see under gold)

Red Cross (Isabell) (159)

Ruby King (151)
(see under gold)

Rudebeck-Florence Rae
(see Florence Rae)

Rustler (83)
Loc: Sec. 11, (29-10E), in a deep canyon, Monte Cristo dist.
Ore: Copper, molybdenum, lead, zinc. Ore min: Pyrrhotite, pyrite, chalcopyrite, molybdenite, galena, sphalerite. Deposit: Narrow pinching veins of quartz containing the sulfide minerals. A little molybdenite shows along seams of quartz in one adit. Dev: Several short adits and a shallow shaft. Assays: Est. 1% to 2% Cu over a width of 1 or 2 ft. In the shaft a 2-ft. width might avg. 10% combined Zn, Pb, Cu. Ref: 158.

S. M. P. (155)
(see under zinc)

Sadie
(see Helena and Sadie)

St. Cloud (62)
Loc: Sec. 4, (30-9E), Silverton dist. Ore: Copper. Ref: 14, p. 45.

St. Louis (156)
Loc: Sec. 6, (28-11E), on Cascade Gulch, Silver Cr. dist.

St. Louis and Jackson (27)

St. Theresa (108)
(see under molybdenum)

Sam Strom (21)

Scriber
(see Kromona)

Seattle
(see New York-Seattle)

Seattle
(see under gold)

Shirley (169)
(see under gold)

Sidney (96)
(see under gold)

Silver Coin (66)
(see under gold)

Silver Creek
(see Broken Ridge)

Silver Horseshoe (55)
(see under silver)

Silver Slipper (157)
(see under gold)

Skridne (Kena and Troly) (170)

Sloman
(see under gold)

Smith-Way (171)

Sterling
(see Monitor and Sterling)

Sultan King (Sultan Queen, Hicks) (117)
Loc: SW 1/4 sec. 36, (29-10E) and NW 1/4 sec. 1, (29-10E). Elev: 3,300 to 5,000 ft. Access: 3 mi. trail from end of Sultan Basin road, or old trail from Silver Cr. road 1 mi. to E. Prop: 8 patented claims, 8 unpatented claims. Owner: Sultan King Mining Co., Seattle, Wash. (1936-1943). Ore: Copper, gold, silver, molybdenum. Ore min: Chalcopyrite, pyrite, pyrrhotite, marcasite, magnetite, specular hematite, small amounts molyb-
Copper Occurrences—Snohomish County

Sunrise (102)

Loc: N. line sec. 15, (29-10E), near summit of Sunrise Mtn. Elev: 4,400 to 6,400 ft. Access: 2 mi. up Vesper Cr. by trail from Sultan Basin road, by which it is 20 mi. to railroad at Sultan. Prop: 4 unpatented claims: Wall Street, Occidental, Quaker City, Eldorado. Owner: George Startup, Startup, Wash., and Bob Curtis, Monroe, Wash. (1947). C. H. Kelly, Monroe, Wash. (1913-1943). Ore: Copper, gold, silver, molybdenum. Ore min: Chalcopyrite, molybdenite, pyrrhotite, bornite. Gangue: Quartz, siderite, brecciated metamorphics. Deposit: Several quartz veins along fault zones near contact of quartz diorite and metamorphics. One vein 12 to 72 in. wide at least 1,000 ft. long. Dev: 1,200 ft. of underground workings in one entry. Several shorter adits and open cuts. Assays: 56 assays across the main vein along 500 ft. of its length showed weighted av. of 0.93% to 2.73% Cu, av. 0.48 in. wide. Total production is 1,500 oz. Au, 156,000 oz. Ag, 84 tons ore. Dev: 45-ft. adit, 255-ft. adit, 35-ft. adit, 850-ft. adit, 3 open cuts. Assays: 2% to 4% Cu, 0.02 to 0.05 oz. Au, 0.4 to 4.8 oz. Ag from selected samples. Av. of deposit as a whole would be less than 1% Cu, 0.02% Mo. Ref: 14, p. 50, 23, pp. 68-70. 111, p. 9. 158.

Sunset (9)

(see under gold)

Sunset (153)


Sultan Queen

(see Sultan King)

Treasure Box

(see Horsehoe and Treasure Box under gold)

Troy

(see Skirnode)

Uncle Sam (193)


Vesper Peak

(see “48-55”)

Victory

(see under gold)

Virginia (39)

(see also Ore Recoveries)

Wayside (63)


Way

(see Smith-Way)

Wayside (Armanent) (177)

(see Armament)

Webster

(see Jasperson under gold)

Weden Creek

(see Mackinaw)
Westland (158)

Whaleback (128)
(see under gold)

Whistler (90)
(see under lead)

White Gander (8)

Whitehorse (1)
(see under zinc)

Wilbur Index
(see Lake Serene)

Wild Rose (133)

Winnie (127)

Winter Coon (38)
(see under gold)

Yankee Boy (65)

Zeta (134)
(see under gold)

STEVENS COUNTY

A and C (Smoky Bullion, Bruce Creek) (106)

Abe Lincoln (22)
(see under gold)

Admiral (193)

Agula (129)
(see under lead)

Aichan Bee (212)
(see under silver)

Aladdin (116)
(see under lead)

Aladdin (Blue Ridge, Sierra Zinc)
(see Sierra Zinc under zinc)

Alandale (185)

Alberta (213)

Alert
(see under gold)

Alice

Amazon (143)
(see also Chinto)
American Boy (95)  
(see under gold)

Anaconda (55)  
(see under lead)

Antelope (75)  
(see under gold)

Ark (125)  
(see under silver)

Audrey M. (94)  
Loc: Sec. 31, (39-37E), between Orient and Copper Butte properties, Orient dist.  
Prop: 1 unpatented claim.  
Owner: Abandoned (1941).  
Ore: Copper, gold.  
Ore min: Chalcopyrite, pyrite, pyrrhotite.  
Deposit: Calcareous argillite and quartzite cut by monzonite dikes. A fracture zone in the series is mineralized with pyrite, pyrrhotite, and chalcopyrite.  
Dev: 18-ft. shaft, open cuts.  
Assays: Reportedly $23 Cu, Au.  
Ref: 30, p. 139.

Avondale-Dome (111)  
(see under lead)

B and B (176)  
Loc: SW 1/4 se. 32 or NE 1/4 sec. 31, (32-40E), 1/2 mi. SE. of Browns Lk.  
Access: 11 mi. by road SW. of Chewelah.  
Prop: 40 acres of deeded land.  
Owner: Henry Brosier (1941).  
Ore: Copper, gold.  
Ore min: Chalcopyrite, pyrite.  
Deposit: Quartz stringer in argillite.  
Dev: 300-ft. adit, 195-ft. adit from which a 105-ft. shaft has been sunk.  
Assays: $26.76 Cu.  
Ref: 33, p. 190.

Bald Eagle (11)  
(see under gold)

Banner (see Chinto)

Banshee (171)  
Loc: Secs. 22 and 27, (31-41E), Chewelah dist.  
Owner: Admiral Mining Co. (1915).  
Ore: Copper, silver, lead.  
Prod: 1907, 1910.  
Ref: 97, 1908, p. 581; 1911, p. 788.

Baxter (see Snyder and Baxter under silver)

Bear Canyon (134)  
Loc: NW 1/4 sec. 12, (34-40E), Chewelah dist.  
Access: Poor road.  
Prop: Several claims.  
Ore: Copper, silver.  
Deposit: Quartz vein.  
Dev: 800 ft. of shaft and adit.  
Ref: 30, p. 41.

Beecher (20)  
(see under gold)

Belcher (141)  
Loc: Sec. 33, (33-41E), on W. spur of Eagle Mtn., Chewelah dist.  
Elev: 2,900 ft.  
Access: Road.  
Prop: 7 claims, now part of Chinto mine.  
Owner: Eagle Mountain Mining Co. (1949).

Benedict, John (126)  
(see under gold)

Big Bear (119)  
Loc: NE 1/4 sec. 4, (36-38E), on N. side of Pingstone Cr.  
Kettle Falls dist.  
Elev: 2,630 ft.  
Access: 5 mi. from Marcus.  
Prop: 1 claim, abandoned during 1941.  
Ore: Copper.  
Deposit: Quartz stringer in argillite.  
Dev: 300-ft. adit, 195-ft. adit from which a 105-ft. shaft has been sunk.  
Ref: 30, p. 56.  
164, p. 232.

Big Iron (38)  
(see under iron)

Big Jim (71)  
(see under gold)

Birtow (see under gold)

Black Horse  
(see Columbia Tungsten under tungsten)

Blanche  
(see under silver)

Bland (see under lead)

Bliss  
(see Galena Hill under lead)

Blue Bird (72)  
(see under gold)

Blue Creek  
Loc: About 1 1/2 mi. from the station of Blue Creek on the Great Northern Ry., Chewelah dist.  
Prop: 3 claims.  
Owner: Big Creek Copper Mining Co. (1902-1908).  
Ore: Copper.  
Deposit: 6-ft. vein.  
Dev: 300 ft. of underground workings.  
Assays: $26.76 Cu.  
Ref: 33, 1908, p. 383.  
88, p. 7.

Blue Goose (25)  
Loc: Sec. 29, (40-37E), Orient dist.  
Prop: 1 unpatented claim.  
Owner: Abandoned (1941).  
Ore: Copper, gold.  
Ore min: Pyrite and subordinate chalcopyrite.  
Gangue: Quartz.  
Deposit: Mineralized vein along quartzite-brecciated limestone contact.  
Dev: Small open cuts.  
Ref: 30, p. 124.  
164, p. 281.

Blue Grass (89)  
(see under gold)

Blue Ridge  
(see Sierra Zinc under zinc)

Blue Star  
(see Eagle under silver)

Bluebird  
(see Loon Lake Copper)

Bonanza (102)  
(see under lead)

Bonanza Copper (Maryland) (202)  
Loc: Sec. 32, (39-38E), about 1 mi. N. of the Germania mine, Cedar Canyon dist.  
Prop: Several unpatented claims.  
Owner: Bonanza Copper Co. (1916-1941).  
Ore: Copper,
Checops (Sprague) (1918-1926). Ore: Copper. Ore min: Shaft, short adit. Ref: siderite. Deposit: Zones in argillite and schist have been replaced by mineralized quartz veins. Widest zone was 5 ft. Quartz veins vary from a few in. to 2 ft. in width. Dev: 2 adits with drifts comprise 1,200 ft. of underground workings. Prod: One small shipment in 1916. Ref: 30, p. 74. 97, 1916, p. 616. pp. 151-152. 158.

Boundary Line (1)

Brooks (209)
(see under silver)

Brown's Lake (177)

Bruce Creek
(see A and C)

Bryant (17)

Buck Mountain
(see under silver)

Bullion (66)
(see under lead)

Burrus (115)
(see under zinc)

Centennial (78)

Churchill (39)

City View (124)
(see under gold)

Clara (53)
(see under gold)

Clugston
(see Silver Trail under lead)

Coffe (Copper-Gold) (87)

Columbia
(see Iroquois under zinc)
Columbia River (122)  

Columbia Tungsten (188)  
(see under tungsten)

Colville Queen  
(see Chloride Queen under lead)

Comstock (9)  

Contention  
(see Mountain View under silver)

Copper Butte  

Copper Butte (87)  

Copper Butte (Shallenberger) (186)  

Copper Cliff (167)  

Copper-Gold  
(see Coffer)

Copper Jack (26)  

Copper King (145)  
(see also Chinto)

Copper King (56)  
(see under lead)

Copper Queen (137)  

Copper Queen (147)  

Coyote  
(see Rightside)

Crescent  
(see Orient, Crescent, and Deadwood)

Daisy  
(see Daisy-Tempest under silver)

Daisy-Tempest (131)  
(see under silver)

Dead Medicine  
(see Silver Trail under lead)

Deadwood  
(see Orient, Crescent, and Deadwood)
Deer Trail (207)
(see under silver)

Deer Trail Monitor (200)
(see under molybdenum)

Defender (92)
(see under zinc)

Delmonico
(see Jay Dee under silver)

Denver (194)

Detroit
(see Wabash-Detroit)

Diamond C (161)

Dille
(see Pelkey and Dille)

Dora
(see Acme under lead)

Double Eagle (192)
(see under lead)

Double Standard (42)

Douglas
(see under tungsten)

E. M. C. (126)
(see under lead)

Eagle (153)
(see under silver)

Eagle-Newport
(see under silver)

Easter Sunday (35)
(see under gold)

Easy Money
(see Magma under zinc)

Edna (King) (190)

Eldorado
(see Magma under zinc)

Electric Point (63)
(see under lead)

Elmo (88)

Enterprise
(see under gold)

Enterprise (Jay Dee)
(see Jay Dee under silver)

Eureka (3)
(see under gold)

Eureka and Orient
(see Eureka under gold)

Express
(see St. Paul-Express)

Fidelity (44)
(see under gold)

Finley
(see under lead)

Fish (127)
(see under silver)

Flannigan
(see Iroquois under zinc)

Frisco Standard (61)
(see under silver)

Galena Farm (105)
(see under lead)

Galena Hill (16)
(see under lead)

Georgie (64)
Granite. Also smaller veins. Dev: 40-ft. crosscut; 100-ft. shaft.


Globe (96)


Gold Bar (103)

(see under gold)

Gold Reef (121)

(see under gold)

Golden Reef (see Gold Reef under gold)

Golden Seal


Graves (83)


Gray Eagle (see Rightside)

Great Republic (43)


Hartford (see Krug)

Hecla (154)


High Grade (Jay Dee)

(see Jay Dee under silver)

High Grade (see Turk)

Homeland Chief (73)

(see under silver)

Hoodoo (208)

(see under silver)

Hope and Twin Cabins (70)


Hubbard (45)

(see under lead)

Hunter (see Jackson under zinc)

Imperial Copper (157)


Independent Keystone (Keystone, Strobeck) (152)

(part of Chinto holdings, which see)


Indian (see Eureka under gold)

Inklers Point (175)


International (23)

(see under gold)

Iron Horse (see under gold)

Iron Horse (32)

(see under zinc)

Iron Mask (12)

(see under zinc)

Iroquois (58)

(see under zinc)
Jackson (54)
(see under zinc)

Jay Dee (150)
(see under silver)

Jay Gould (156)
(see under silver)

Jayhawk (27)

Jim Dandy (146)

John Duy (149)
(see under silver)

John Hays (130)
(see under silver)

Juno-Echo (Western Molybdenum) (160)

Kansas (156)
(see Independent Keystone)

King (see Edna)

Koyotte (see Rightside)

Krug (Hartford) (186)

Lake (see under gold)

Lakeside (7)

Lem (83)
(see under gold)

Liberty Copper (183)

Little Frank (206)
(see under lead)

Little Gem (see under silver)

Little Giant (14)
(see under lead)

Longshot (118)
(see under lead)

Lookout (see under lead)
Copper Occurrences—Stevens County

Loon Lake Blue Bird (172)

Loon Lake Copper (Kemp-Komar, Key West, Bluebird) (173)

Lottie (79)

Lucky Boy (109)
(see under lead)

Lucky Boy (Turk)
(see Turk)

Lucky Charlie (8)

Lucky Four (65)
(see under silver)

M. and C.
(see U.S. Copper Gold under silver)

McKinley (4)
(see under gold)

McNally (29)
(see also Pelkey and Dille, Regina)

McNess (35)
(see under gold)

Mackinaw

Magma (113)
(see under zinc)

Majorca (80)

Maple Leaf
(see Melrose under silver)

Maryland
(see Bonanza Copper)

Mayflower (170)
(see under lead)

Melrose (51)
(see under silver)

Mexico
(see Queen under silver)

Middleport (117)
(see under zinc)

Mineral Hill
(see Aichan Bee under silver)

Minnehaha (151)

Mint

Mogul (13)

Molly Gibson (40)
(see under gold)

Monahan (201)

Monitor (27)
(see under gold)

Montana (76)
(see under gold)

Montana and Washington (15)

Moraski (52)

Morning (114)
(see under silver)

Morning Star
(see under gold)

Mountain View (47)
(see under silver)

Mullen (165)
(see under lead)

Myeerah (60)
(see under lead)

Mystery (28)

Naboh (155)

Napoleon (100)
(see under iron)

Nellie S.
(see Chewelah Standard)

Nest Egg (90)
(see under silver)

Nevada (180)
(see under lead)

Newport (Eagle-Newport)
(see Aguila under lead)

Noble Four

Old Abe

O-Lo-Lim (214)

O’Neal-Schenk (see Rightside)

Ora


Orchid (195) (see under silver)

Orient, Crescent, and Deadwood (96)


Orient Eureka (see Eureka under gold)

Orpha (82)


Pacific Copper (182)


Paragon (see Melrose under silver)

Paymaster


Payne (162)


Pedro (77) (see under gold)

Pelkey and Dille (30) (see also McNally)


Perry (138)


Platsburg (Montgomery) (184)


Pomeroy (34) (see under zinc)

Pop (Silent Bell) (85)


Providence (46) (see under lead)

Providence (see Deer Trail under silver)

Quada (see under gold)

Quartzite Mountain (169)


Queen (210) (see under silver)

Queen and Seal (see Queen under silver)

Rambler (197)

also. Zone in which workings are located is near the surface and badly broken. No sizable or continuous ore body exposed. Dev: 265-ft. adit, several other short adits. Prod: 1916, 1917. Ref: 30, p. 210-211.

Read (199)
(see under iron)

Reardon Copper
(see Turk)

Red Cloud (Giant Silver) (204)

Red Sheaf (104)
(see under gold)

Red Top (57)
(see under lead)

Redemption

Redwood
(see Eagle under silver)

Regina (31)
(see also McNally)

Revenue

Rightside (Coyote, Gray Eagle, Koyotte, O'Neal-Schenk) (123)
Loe: Center sec. 17, (or NE¼ sec. 18) (?), (38-38E), on E. side of Roosevelt Lk., Kettle Falls dist. Elev: 2,600 to 2,825 ft. Access: Connected to Globe prospect by ½ mi. of trail. Prop: 2 patented and other unpatented claims.
Owner: Stevens County (1941). Ore: Copper, gold, iron. Ore min: Pyrrhotite, pyrite, chalcopyrite. Deposit: Ore minerals occur as seams and pods along joint planes in schist and quartzite. No well-defined veins. Deposits are small and siliceous. Dev: 150-ft. adit, 200-ft. shaft, large open cut, shallow shaft. Assays: Ore said to av. 40% pyrrhotite. Prod: Some shipments are said to have been made to a smelter as flux. Ref: 7, pp. 78-79. 30, p. 132. 114, no. 5, 1909, p. 61. 164, pp. 266-267.

Security Copper (158)

Shallenberger (see Copper Butte)
Short Wait (67)
(see under lead)
Sierra Zinc (112)
(see under zinc)
Silent Bell (see Pop)
Silver Basin
(see Queen under silver)
Silver Mountain
(see Daisy-Tempest under silver)
Silver Queen (Queen)
(see Queen under silver)
Silver Queen (Ark)
(see Ark under silver)
Silver Seal
(see Queen under silver)
Silver Summit (187)
(see under lead)
Silver Trail (107)
(see under lead)
Smoky Bullion
(see A and C)
Snyder and Baxter
(see under silver)
Sprague
(see Checops)
Squire
(see under lead)
Stemwinder (10)

Stockwell
(see Columbia Tungsten under tungsten)
Stroheck (see Independent Keystone)
W. B. Stuart
(see John Day under silver)
Sugar Loaf
(see Vanasse under silver)

Summit (6)

Sunset (50)
(see under lead)

Superior Copper (178)

Sure Thing (93)
(see under gold)

Sweet Home
(see Big Jim under gold)

Syndicate

Tempest (132)
(see under silver)

Tenderfoot
(see Avondale-Dome under lead)

Thomason Queen (136)

Togo (203)
Uncle Sam (86)

Loc: Sec. 27, (39-37E), on SW. slope of Jumbo Mtn., Orient dist.  
Prop: 2 unpatented claims, including Quartette.  
Owner: Abandoned (1941).  
Ore: Copper, lead, gold, silver.  
Ore min: Pyrite, chalcopyrite, and a little galena.  
Gangue: Quartz, siderite.  
Deposit: Breccia in a fracture zone in argillite and calcarceous argillite has been slightly mineralized.  
Dev: 80-ft. shaft, 12-ft. shaft, and some open cuts.  
Ref: 30, p. 134. 164, p. 274.

United Copper (United Silver Copper) (148)

Loc: E1/4NW1/4 sec. 32 and NE1/4 sec. 31, (33-41E), on W. slope of Eagle Mtn.  
Elev: 2,400 to 3,375 ft.  
Access: 5 mi. NE. of Chewelah by good truck road.  
Prop: 7 claims, 5 fractions.  
Owner: Chewelah Copper Co., Colville, Wash. (1951—).  
United Copper Mining Co. (1907-1920).  
United Silver Copper Mining Co. (1919-1924).  
United Mines Corp. (1926).  
Chewelah Union Mining Co. (1930).  
Ore: Copper, silver, gold.  
Ore min: Chalcopyrite, tetrachalcite (freibergite), pyrite, arsenopyrite, malachite.  
Gangue: Quartz, calcite, siderite.  
Deposit: Mineralized zone in fractured argillite 5 to 20 ft. wide (av. 8 ft.).  
Tetrachalcite forms a persistent streak 2 to 12 in. wide.  
Dev: Adit 4,200 ft. long, 500-ft. adit, 300-ft. shaft, considerable drifting and stoping.  
Assays: High-grade carries 75 to 300 oz. Ag.

United Silver Copper  
(see United Copper)

United Treasure (59)  
(see under silver)

Valley (174)

Loc: W1/4NW1/4SW1/4 sec. 16, (31-41E), on top of small isolated knob, near Valley.  
Access: A few hundred yards from road.  
Ore: Copper.  
Ore min: Malachite.  
Deposit: Quartz vein at contact of argillite and granite is copper stained in "honeycomb" phase of the vein.  
Dev: Open cut.  
Ref: 158.

Vanasse (120)  
(see under silver)

Venus  
(see Deer Trail under silver)

Victory  
(see Vanasse under silver)

Viking (19)

Loc: Sec. 36, (40-36E) and sec. 1, (39-36E), Orient dist.  
Elev: 1,575 to 2,525 ft.  
Access: Near road.  
Prop: 3 claims: Mountain Conn, Jasperell, Maid of Erin.  
Owner: Abandoned (1941).  
Ore: Copper, gold, silver.  
Ore min: Pyrite, chalcopyrite, few specks of galena.  
Gangue: Quartz.  
Deposit: Granitic gneiss cut by diorite dikes and overlain by latite flows. A quartz vein on the Mountain Conn claim is mineralized. Also a small mineralized zone on the Jasperell claim.  
Dev: 130-ft. adit, 80-ft. shaft, two 12-ft. shafts, several other shafts, total about 250 ft.  
Ref: 30, p. 130. 164, p. 291.

Vulcan (191)

Loc: Near center sec. 16, (31-38E), due S. of the Edna mine near headwaters of Meadow Cr., Chewelah dist.  
Elev: 3,059 to

Wall Street (68)

White Horse (41)
Loc: Sec. 19, (40-39E), on S. slope of Church Hill Mtn. Elev: 3,850 ft. Access: Near road, about 19 mi. NW. of railroad at Northport. Prop: 3 unpatented claims. Owner: B. J. Hofer and associates, Northport, Wash. (1941-1948). Ore: Copper, gold, silver. Ore min: Pyrite, chalcoprite, pyrrhotite, and some galena, sphalerite, arsenopyrite. Deposit: Several narrow quartz veins in schistose volcanics. Dev: 300 ft. of workings in 2 shafts, and a 90-ft. adit. Assays: Ore said to range from $18 to $80 per ton. Five samples gave a weighed av. of 2.4% Cu, 0.15% Pb, 0.45% Zn, 0.054 oz. Au, 1.91 oz. Ag for av. width of 1.8 ft. Ref: 30, p. 91. 157. 158.

Wilkie Lode (142)
(see under lead)

Williams Lake (108)

Windfall (168)

Young America (101)
(see under zinc)

THURSTON COUNTY

Skookumchuck (1)

WHATCOM COUNTY

Azurite (18)
(see under gold)

Beck (14)
(see under silver)

Bismarck (17)
(see under gold)

Boundary Red Mountain (5)
(see under gold)

Chain Lakes (11)
(see under zinc)

Conway (4)

Evergreen (9)
(see under gold)

Galena (see Veronia under gold)

Gargett (6)
(see under gold)

Glacier (1)
(see under silver)

Gold Run (see under gold)

Great Excelsior (3)
(see under gold)

Hyatt (1)

Lincoln (see Great Excelsior under gold)

Midas (Glacier) (2)
Loc: Secs. 4, 5, 8 and 9, (39-7E), Mt. Baker dist. Access: About 30 ft. off the Mt. Baker highway at a place 1½ mi. NE.

Northern Cascade
(see Gold Hill under silver)

Peterson

Peterson (Gold Hill)
(see Gold Hill under silver)

President
(see Great Excelsior under gold)

Red Mountain
(see Boundary Red Mountain under gold)

Saginaw (7)
(see under gold)

Shanghai (15)
(see under gold)

Short Grub
(see Beck and Short Grub under gold)

J. E. Sigh (8)

Silver Creek (13)
(see under molybdenum)

Silver Tip (10)

Veronia (12)
(see under gold)

Whistler (16)
(see under gold)

Yellow Aster
(see under nickel)

YAKIMA COUNTY
Bird (4)
(see under tungsten)

Black Jack (11)
(see under zinc)

Chinook (3)

Copper Mining Co. (5)
(see also New Find, Pasco under copper, and Bird, Garibaldi under tungsten)

Elizabeth Gold Hill (2)
(see under gold)

Gold Hill (1)
(see under gold)

Green
(see Black Jack under zinc)

Hidden Treasure (3A)
(see also Chinook)

Keystone (9)

New Find (6)
(see also Copper Mining Co.)
Loe: Near S. line sec. 19, (15-12E), Bumping Lk. dist. Elev: 4,300 ft. Access: A few hundred yards W. of Copper City, 70
Gallium is an unusual metallic element that is molten on warm days (86° F.) but does not boil below 3600° F. The only other metals that are liquid at similarly low temperatures are mercury, cesium, and rubidium, but none of these has a boiling point nearly so high as that of gallium. The metal is lustrous and grayish white. It is crystalline and hard and has low malleability. Unlike most other metals, it expands upon solidification. The electrical resistivity and coefficient of thermal expansion of gallium vary greatly with the directions of the three axes of its crystallographic structure. Its electrical resistivity is believed to vary more than that of any other metal. Gallium adheres to and spreads as a thin film on glass. It is nonpoisonous to animals. Gallium salts are similar to those of aluminum. Other properties are given in the table on page 12.

**Uses**—Although gallium has several unusual properties, no quantitatively important uses for the metal have been developed as yet. It is used in dental alloys, in selenium rectifiers, and as a liquid seal on the inlet system of mass spectrometers, where its liquid range and low vapor pressure make it superior to mercury. It is used in direct-reading high-temperature thermometers, as an excitant in phosphors, and experimentally as a catalyst; and radioactive gallium has been used in the diagnosis and treatment of bone cancer. Gallium has been used to put bright reflective film on glass, and to make low-melting-point industrial alloys. A fairly strong solder which melts at 57° C. is made by adding 10 percent mercury and 0.6 percent gallium to bismuth.

**Production**—In the past few years a few pounds of gallium have been produced annually in the United States as byproducts of smelting aluminum, copper, and zinc. In England the metal is recovered from flue dusts. Although total consumption of the metal for the year 1951 is estimated to be less than 100 pounds, much larger quantities could be produced as a byproduct if and when the demand exists. Production in 1950 came from plants located in Montana, Illinois, Missouri, and New York.

**Prices**—Gallium in 1932 was quoted at $2.50 per gram, and by 1936 it could be bought in lots of several pounds at $1.50 per gram, but in smaller lots the price was $3.00 a gram. Standard-grade metal for experimental use was still quoted at $3.00 a gram in 1955. Higher purity (99.9 percent) metal sold at from $3.00 to $4.50, depending upon the size of the order. Metal of 99.99-percent purity commanded a premium of 25 cents per gram.

**Ore minerals and geology**—The richest known source of gallium is the copper mineral, germanite, Cu₆(Ge,Ga,Fe,Zn)(As,S)₄, which contains up to 2 percent gallium, but it is never mined specifically for its gallium content. Gallium occurs in a variety of ores but usually in small amounts ranging from a trace to 0.1 percent, and usually less than 0.06 percent. The metal is commonly detected in sphalerite, and it is recovered as a byproduct of zinc smelting and refining. Likewise, it has been recovered from copper smelters and from flue dusts in which it accumulates from the burning of gallium-bearing coals. It is recovered from aluminum ores, in which it is a fairly common constituent. It also occurs in some high-alumina clays and ores of iron, chromium, and manganese, and in some pegmatites, almost always in amounts of less than 0.1 percent.

**Occurrences**

**FERRY COUNTY**

**Aavestrud (1)**

- **Loc:** Republic dist. **Owner:** Ole Aavestrud, Republic Wash. (1949). **Deposit:** A cone produced by panning contained a trace of gallium. **Ref:** 158.

**KING COUNTY**

**Pruter (1)**

- **Loc:** Sec. 27, (25-10E), N. Fk. of Snoqualmie R. **Owner:** Robert Pruter, North Bend, Wash. (1951). **Deposit:** Sample from a basaltic dike contained a trace of gallium. **Ref:** 158.
GERMANIUM

Properties—Germanium is a rare metal allied to tin. It is grayish white, lustrous, crystalline, light in weight, hard, and brittle. It is a semiconductor of electricity, a property which is utilized in the manufacture of electronic devices. Germanium expands upon solidification. It amalgamates with mercury and is known to form alloys with aluminum, copper, silver, magnesium, and some other metals. It is resistant to corrosion and is stable in air at temperatures up to 600° C. It has valences of 2 and 4 and forms two corresponding series of compounds. Other properties are shown in the table on page 12.

Uses—Germanium had very few uses for many years, having only minor use in medicine and as magnesium germanate for a phosphor in fluorescent lights. It has been used as a catalyst in the hydrogenation of coal, and as a substitute for silica in making a highly refractive optical glass. It has been used also in making a new type of photelectric cell. In 1950 the principal use was in the metallic form in diode rectifiers for high-frequency electrical currents in radar and television circuits. Probably the greatest potential use for germanium, and certainly the use in which the greatest interest was being shown in 1952, is in transistors, the three-element electronic devices which act like triode radio tubes for amplifiers. The transistors have advantages over radio tubes in being much smaller, lighter in weight, and longer lived, and in requiring no filament current.

Production—Commercial production of germanium began in this country about in 1941. In 1950 the principal production was as a byproduct of zinc refining at Joplin, Missouri, but small production was coming from at least two other plants in Pennsylvania and New York. Production was at the rate of 1,000 pounds per year in 1948 but had increased to 6,000 pounds in 1951 and was expanding rapidly. Germanium is recovered from flue dusts in England. Zinc concentrates from the Metline district in Washington are germaniferous, hence have been shipped to Mississippi Valley smelters, where the germanium is recoverable in horizontal-retort smelters.

Prices—Germanium metal was quoted in 1936 at $5.50 per gram, and in 1940 at $4.500 per pound, but by 1946 it had dropped to $180 per pound. The price then rose until it reached $340 per pound in 1952. In June 1955 the price was $295 per pound.

Ore minerals—Germanium occurs in amounts up to 10 percent in germanite, Cu₄(Ge,Ga,Fe,Zn)(As,S)₄. Renierite, similar to germanite except that it contains tin, carries from 6 to 8 percent germanium. Argyrodite, 4Ag,S•GeS₄, contains about 7 percent germanium but is very rare, as are all germanium minerals.

Geology—Germanium is widely distributed in nature as a very minor constituent in many common minerals, but rarely is it naturally concentrated enough to be recoverable. It is found in some coals to the extent of about 0.001 percent, and flue dusts from the burning of such coals contain up to 9 percent germanium. The metal is found in some zinc ores, and in the Tri-State district it occurs in amounts from 0.01 to 0.1 percent. It is found in like amounts in some ores of silver, tin, copper, and iron.