

INFORMATION CIRCULAR

DEPARTMENT OF COMMERCE - BUREAU OF MINES

Circular No. 6000

THE LEGENDARY "WHITE METAL" AND ITS "ORE"

By C. W. Davis ^{1/}

As a by-product of its investigational work, the Rare and Precious Metals Experiment Station, at Reno, Nev., of the Bureau of Mines, is from time to time requested to identify worthless rocks that are usually submitted in good faith by prospectors, miners, and others who think the rock may contain elements of value. Usually a cursory inspection or a few simple tests is all that is necessary to reveal the nature of the barren material, and the finder usually accepts the bureau's statement that the material is worthless. Sometimes it is not so easy to convince the hopeful searcher, and he may even visit the station in person and ask to be permitted to view a test, or even to demonstrate the qualities of the "rare" mineral that he has found. One of the most difficult fellows to convince is the seeker of "white metal."

There is a legend that Mexicans and other old settlers in the Southwest knew of an "ore" which was packed around pieces of iron or steel that they wished to harden. The metal was heated in a wood fire in contact with the "ore" and then quenched in water. Axles of springless wagons so treated were said to have been made "glass hard," and to wear two or three times as long as ordinary axles, and tires so treated were described as "ringing like a bell" when suspended and struck with a hammer. This action was said to be due to a "white metal" that was extracted from the "ore" and alloyed with the iron by the treatment.

Although this story has never been shown to have had any fact as a basis, it appears from time to time under slightly different guises. As a result, for over 20 years, various laboratories at different times have received many kinds of rocks (designated as "ores") which have been claimed to give remarkable properties to metals, such as making them "glass hard", extremely tough, or resistant to corrosion. Many of these rocks are basic igneous rock, such as altered diabase, olivine, pyroxenite, obsidian, basalt, amphibolite, also pyritic quartzite, aluminum silicate, magnetite, tourmaline, sandstone; in fact almost every known rock is represented. Most of the samples come from California and Nevada, but nearly all western States are included.

The claimant's method is usually to heat the metal in contact with the rock, supposing that a "white metal" is produced from the "ore" which alloys with the metal being treated. The temperatures used have ranged from 200° F to that of the electric arc. The favorite heating device is the blacksmith's forge. The extraction of the "white metal" itself (which, it was said, could be used directly in forming an alloy, as for example by putting a little on a knife blade and heating in a bunsen flame^{2/}) was described as having been performed in some cases by simply melting the "ore", in others by melting with fluxes, and in others by melting with fluxes and a reducing agent.

The bureau's laboratory at Reno has in the past few years received various samples of this sort, some of the claimants presenting their samples in person and endeavoring to demonstrate the virtues of their "process". As was to be expected, the results indicate

^{1/} Associate chemist, Rare and Precious Metals Experiment Station (Reno, Nev.) Bureau of Mines, Department of Commerce. In cooperation with the Mackay School of Mines, University of Nevada.

^{2/} A case investigated at the Mackay School of Mines.

that work along this line, and money put into propositions involving the "mysterious white metal" and its "ore", would be wasted.

The tests by the bureau and other laboratories, following the claimant's procedures, have usually shown no hardening of effect, although in a few tests some hardening of iron or steel was produced due either to case hardening from heating the metal in contact with carbon, protected from oxidation by a coating of flux, or in some instances to the formation of a crude silicon alloy. Many ordinary fusible rocks, and even fluxes without rock, will give these same results. The claim of "glass hardness" for treated metal is obviously caused by hard slag sticking to the metal being mistaken for hardened metal. The protection of the treated metal against corrosion was improved.

A certain basis for confusion lies in the fact that some rocks when mixed with soda (sodium carbonate or bicarbonate) placed in a crucible, and heated in a blacksmith's forge, give white pellets of very pure iron which are not readily attacked by acids, leading the experimenter to believe that he has one of the platinum metals.

For example, one claimant alleged that his "ore" when powdered and sprinkled on Norway iron and heated in a forge, would cause the surface of the metal to be coated with a lustrous, glass hard noncorrodible material, and the iron would change to steel. A treated specimen was submitted to the bureau station at Berkeley, Calif. 3/ An analysis showed the ore to be obsidian. A small bar of Norway iron was packed in the powdered mineral and heated electrically above the fusion point of the mineral in the absence of carbon. The submerged part acquired a brilliant silver-like luster, but was not hardened or changed in any other way. The effect was apparently nothing more than a thorough cleansing of the surface, which no doubt would be less corroded than a surface more or less coated with iron oxide. The alleged "glass hardness" of the submitted specimen was shown to be due to small masses of the fused mineral adhering to rough spots on the surface of the metal.

In another instance, the "ore" was basalt; the claimants were positive of the hardening effect, and attempted to demonstrate this by heating quarter-inch square bars of Norway iron to a bright red in a forge, dipping them in the powdered mineral, and repeating the process until the end of the bar was well coated with slag. On quenching in water the coated portion showed a lustrous surface, and on twisting the bar the treated part proved to be somewhat hardened. This, however, was found to be due to case hardening caused by particles of coke which were held in contact with the iron by the coating of fused mineral, this coating also excluded oxygen. Many other cases similar to these were all easily explained, and lead to the conclusion that the claimants were mistaken as to what could be accomplished by the "ores".

All attempts of investigators to extract "white metal" from "ore" following the directions of claimants, have usually failed to yield any metal whatever, except when the treatment called for the fluxing at high temperature with charcoal of a rock that happened to contain considerable iron. In this case a small amount of metallic iron was reduced from the iron mineral of the rock. The specimens of the "white metal" said to be "melted" from the "ore" are invariably impure metals, mostly lead, copper, zinc, and iron, or simply slag. In testing some of these, it was found that the lead had been introduced by fluxing the rock with charcoal in an old assay crucible that had contained a little slag high in lead, the slag being reduced and lead formed. Lead, copper or zinc in some specimens had been introduced as impurities in the fluxes used for treating the "ore" or by using a container in which they were present, as for example, zinc from galvanized iron.

3/ Investigated by L. M. Duschak.

One sample of pulverized "ore" (volcanic rock) was claimed to produce "white metal," by melting with flux in an electric arc with carbon electrodes, that would harden steel, iron and copper. A test 4/ of this method, using a carbon ladle as container, showed the "white metal" to be iron.

Another claimant stated that "white metal" could be produced by fusion in a carbon ladle as described above, also by reduction in crucibles using fluxes and carbon. The metal was said to harden copper or brass and to make cast iron malleable. In addition to the ladle test 5/ the rock was reduced in clay crucibles by fluxing with soda and borax, with and without the addition of carbon. Without carbon no metal was produced. With carbon a small amount of metallic iron, contained in the original ore, was produced.

In several other instances, the only metal produced from the "ore" proved to be iron reduced from the rock by heating with carbon. Many samples of metal claimed to have been produced from "ore" were lead which had been introduced during "extraction" of the metal either through impure fluxes, or by reducing lead from the slag retained in old assay crucibles that had been used by the claimants in making the tests.

A metal, said to be extracted from what proved to be a basic igneous rock, was found to be impure lead with a little tin and copper, and resembled skimmings from molten solder. 6/ Another metal was found to be impure lead, 7/ which the client admitted may have come from the forge where babbitt had been spilled. Still another was practically pure lead reduced from the fluxes used. 8/

White metal said to be produced from a rock that was limestone was found to be zinc, which probably came from a galvanized can that the claimant has used. Various rocks claimed to have "white metal" virtues, said to be due to platinum, vanadium, uranium, or some other rare metal, did not contain these metals, or only slight traces, but were simply good fluxes and cleaned iron just as any good flux will, and had no power in themselves to alter the properties of the iron. Any hardening action was probably due to case hardening of the iron by the coal, coke, wood, or other fuel used, or by carbonaceous matter in the rock. In one instance it was found that when the pulverized "ore" (basalt) was heated as requested, in contact with iron in an electric arc, the iron became hard, because it had been partly converted to a crude alloy of iron and silicon. Also, a piece of iron on repeated dipping in a powdered "ore" as directed, quenching, and cooling, had a hard lustrous surface. This was undoubtedly due to case hardening from heating in contact with the coke in the forge, protected from oxidation by a coating of slag. Small pieces of slag attached to the metal submitted by the claimant scratched glass. The same results were obtained by a flux.

A case in which the claimant found a coating of "white metal" on the outside of an iron ladle used to flux his "ore" was investigated. The "white metal" was found to be slag. 9/ Other cases where the "white metal" was said to have "eaten" its way through an iron shovel and plated out on the edges of the hole were studied. 10/ The hole was caused by sulphides in the "ore" which reacted with the iron of the shovel and made it brittle,

4/ Investigator, C. C. Anthony, San Francisco, California.

5/ Investigator, F. S. Mulock, Chemical Engineer, San Francisco, California.

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8/ W. L. Piers, assayer and chemist, Denver, Colorado.

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10/ A. S. Eakle, mineralogist, Berkeley, California.

LETTER TO GRANTS PASS COURIER IN 1941

"White Metal" (Oregon White Metal)

Your article in Saturday, June 21st, Courier, copied from an article from the "Medford Mail Tribune", by Russell Mitchell-- whoever he may be--has got us "exponents" of the Oregon White Metal ("Mystery Metal) in quite an uproar. We can understand why some of the "uneducated" can stand back and "holler" "Wolf"! They did it when Fulton tried to get his Steamboat idea over--when Marconi tried so hard to get his wireless invention "on the air"-- simply wouldn't believe it could be done, 'cause it never had been done before, and they couldn't understand it!

That seems to be the trouble, these "dissenters" have never been able to run this white metal, and, so, it just can't be possible! On the contrary, we have seen it--have demonstrated its ability to withstand outlets from U. S. Springfield, 50-06, and from a Savage 22 "Hi-Power", at a distance of fifty feet. And this on a piece of metal about four inches square and less than $3/8$ ths of an inch thick! It has been truly said, "The proof of the pudding is the eating"!

This Oregon White Metal, so named by one of our local U. S. Licensed Chemists, has been known and attempts made to get it before the commercial world for the past ten years. Various reasons for the failure to get a recognition of its true merits have been blamed to many causes, the most plausible being that the "big shots" are not ready to open up any of the metals of Southern Oregon and are holding this back by ridicule and false statements until such time they can control the situation. The reason for this being that when and if this metal is ever put on the market it will supplant most of our tin, steel and nickel, due to its superior strength, ability to stand weather without rusting, corroding or deteriorating in any manner, and the further fact that it does successfully withstand all acid tests (no acid can touch it) and withstands any and all heat that has been applied to it. True it is hard to "run", no one has been able to get it by any of the "approved methods", but one of our local citizens, the chemist mentioned above, has been quite successful in recovering this metal from local "ore", and, even, from the dirt on his own claim on "Jump-Off-Joe".

Plates of this metal were submitted by us to representatives of the War Department in January of this year, and were approved and created quite a "stir". Action would have been taken at that time, if a certain ambitious citizen here had not undertaken to run some of this stuff for a certain Los Angeles concern, and, under supervision of a representative of that firm attempted to put pieces of cast iron into his "batch", and then to pass it off as "white metal".

This act has delayed any favorable action, as the firm soon broadcasted this "fraud" and accused the local men of being "A bunch of crooks"! Since this incident, parties who had been interested have cooled off and it threatens to be a "frost"!

However, as old man Barnum would say, "This is simply colossal, stupendous and almost unbelievable, if I didn't see it with my own eyes!" But we have seen it, tested it, and know what it can and will do.

A half inch thick (or less) of this metal used as a breast-plate for our soldier boys would save millions of lives! Helmets made from this metal, weighing less than half what our present helmet weighs, would save many of our boys from death. Our present helmet is so heavy it gives the boys bad cases of head-ache by merely wearing it. In actual use any bullet will shock a man into head-ache, and worse-- a direct hit will penetrate the helmet and whatever may be beneath it! A quarter inch of this white metal in a helmet would turn any bullet, machine gun bullets or shrapnel, without any appreciable bad result to the wearer. Half an inch of this over the light armor plates or our battleships would render her safer than 12-inches of additional armor plate would do. Not only that, but it would make her safe from torpedoes, and the increase in weight would be negligible!

What is keeping this metal off the market now, that all these facts have been disclosed, is merely a matter of capital to put the stuff on the market. One southern California Airplane factory has offered Mr. Otto, the local chemist mentioned above, a contract for ONE MILLION plates for airplane construction, but Mr. Otto has been unable to finance such an initial order.

True, Mr. Mitchell, this metal has about the same specific gravity as aluminum, but aluminum will not turn bullets. It is untrue that this metal "can be cut with a knife"! Then, it will wear out blade after blade of your best hack saws, without showing anything but a bright "scar". It is true that it will cut glass, as well, or better, than your best diamonds. Although it is an affinity of aluminum, a sample plate was sent to the United States Smelter Co. for analysis and the return stated "We find this to be 99% pure aluminum, with 1% of an unknown metal, which our laboratory has failed to classify, and this would not be in our line, so we suggest you refer this sample to the aluminum people". This was then sent to the Alcoa people, who reported, "This is a chromite alloy, and would not be of any interest to this company". So, Mr. Mitchell, is this a "Mystery Metal", or--? When two concerns like this cannot agree as to its true nature? Well!?

Germany has secured results similar to this by adding Berillium to her metal products, but we have no berillium in this country, so we are told, however, we do have Berillium Oxides" and we figure this item is what makes this metal bullet proof, also adds to its

light weight propensities. In fact, chips of this metal have been made so light that they float on water! Will aluminum do this? Try it!

True, if one hammers it, this metal gets harder and harder, until a piece has been driven into the side of an anvil. Will aluminum, or any of the derivatives of aluminum mentioned by Mr. Mitchell do this? Try it!

Ore, from which this White Metal can be run is deposited throughout the length and breadth of Josephine County, also some in Jackson County and in Northern California, but Josephine has the best and the largest deposits. No one man, or concern, could ever hope to "corner" this huge supply, and that's the real reason why the Guggenheims, and other interests have tried to hold us up. This supply is so huge that Josephine County alone could furnish enough for the world's needs for a hundred years. When it is finally developed, this metal will make iron and steel obsolete for defense materials, even for guns and artillery--making lighter, stronger, harder shooting guns that will practically never wear out! It would be used for lighter, stronger, farming tools and equipment--making plow shares that would be always sharp and never wear out. Making auto engines that would be lighter and never show wear or have burnt out pistons, as this metal is absolutely impervious to heat of all kinds. Its use would be unlimited, and the benefits to Josephine County would be enormous! The world will beat a path to our door and the discovery will surpass the flurry caused by the discovery of gold in California. The perfection of this discovery will make the name of Chemist, Clarence Otto, famous, and he will go down in history as one of our great men!

Proof of this metal will be available on request. A plate, showing the effects of high-power rifle will soon be available for exhibit at the office of the Courier in Grants Pass, where every "Doubting Thomas" who desires confirmation, may be able to see and examine it.

Financial aid for Mr. Otto is now being sought in Los Angeles to aid him in building and maintaining a plant in this county to develop and put this metal on the market, for defense airplane work. It is the duty of every red-blooded American to get behind this discovery and boost--for the sake of your Country, State and Nation!

This is not an appeal to sell stock, or otherwise seek public aid, as no stock Company will be exploited. It is merely to acquaint citizens in general with the truth and facts of what Mr. Mitchell has called "a figment of the imagination"!

Written and vouched for by
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For example, one claimant alleged that his "ore" when powdered and sprinkled on Norway iron and heated in a forge, would cause the surface of the metal to be coated with a lustrous, glass hard noncorrodible material, and the iron would change to steel. A treated specimen was submitted to the bureau station at Berkeley, Calif. ³ An analysis showed the ore to be obsidian. A small bar of Norway iron was packed in the powdered mineral and heated electrically above the fusion point of the mineral in the absence of carbon. The submerged part acquired a brilliant silver-like luster, but was not hardened or changed in any other way. The effect was apparently nothing more than a thorough cleansing of the surface, which no doubt would be less corroded than a surface more or less coated with iron oxide. The alleged "glass hardness" of the submitted specimen was shown to be due to small masses of the fused mineral adhering to rough spots on the surface of the metal.

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In another instance, the "ore" was basalt; the claimants were positive of the hardening effect, and attempted to demonstrate this by heating quarter-inch square bars of Norway iron to a bright red in a forge, dipping them in the powdered mineral, and repeating the process until the end of the bar was well coated with slag. On quenching in water the coated portion showed a lustrous surface, and on twisting the bar the treated part proved to be somewhat hardened. This, however, was found to be due to case hardening caused by particles of coke which were held in contact with the iron by the coating of fused mineral, this coating also excluded oxygen. Many other cases similar to these were all easily explained, and lead to the conclusion that the claimants were mistaken as to what could be accomplished by the "ores".

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One sample of pulverized "ore" (volcanic rock) was claimed to produce "white metal," by melting with flux in an electric arc with carbon electrodes, that would harden steel, iron and copper. A test ⁴ of this method, using a carbon ladle as container, showed the "white metal" to be iron.

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White metal said to be produced from a rock that was limestone was found to be zinc, which probably came from a galvanized can that the claimant has used. Various rocks claimed to have "white metal" virtues, said to be due to platinum, vanadium, uranium, or some other rare metal, did not contain these metals, or only slight traces, but were simply good fluxes and cleaned iron just as any good flux will, and had no power in themselves to alter the properties of the iron. Any hardening action was probably due to case hardening of the iron by the coal, coke, wood, or other fuel used, or by carbonaceous matter in the rock. In one instance it was found that when the pulverized "ore" (basalt) was heated as requested, in contact with iron in an electric arc, the iron became hard, because it had been partly converted to a crude alloy of iron and silicon. Also, a piece of iron on repeated dipping in a powdered "ore" as directed, quenching, and cooling, had a hard lustrous surface. This was undoubtedly due to case hardening from heating in contact with the coke in the forge, protected from oxidation by a coating of slag. Small pieces of slag attached to the metal submitted by the claimant scratched glass. The same results were obtained by a flux.

A case in which the claimant found a coating of "white metal" on the outside of an iron ladle used to flux his "ore" was investigated. The "white metal" was found to be slag. - Other cases where the "white metal" was said to have "eaten" its way through an iron shovel and plated out on the edges of the hole were studied. 10 The hole was caused by sulphides in the "ore" which reacted with the iron of the shovel and made it brittle, and by "burning" with the forge blast. The "plating" was the result of the cleansing action of the flux which left the iron bright and silver-like.

6 - Analyst, Fletcher Hamilton, State mineralogist, San Francisco

7 - Analyst, A. A. Hanks, chemist, assayer and metallurgist, San Francisco

8 - W. L. Piers, assayer and chemist, Denver, Colo.

9 - Investigator, H. W. Young, metallurgist, Palo Alto, Calif.

10 - A. S. Eakle, mineralogist, Berkeley, Calif.

In sum, it may be said that all authentic tests have given results that may be thoroughly explained by the usual properties of the materials used. One is forced to conclude, therefore, that the various unsubstantial claims that have been made were due to careless tests, to erroneous conclusions from these tests, or to an attempt to defraud.

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PRESS RELEASE NO. 56

MAY 12, 1943

NO BERYLLIUM FOUND BY STATE DEPARTMENT
IN THE JACKSON COUNTY DEPOSIT

No significant amount of beryllium was found by the State Department of Geology and Mineral Industries in representative samples obtained from the deposit reported recently as a new discovery of beryllium ore in Jackson County, Oregon. Spectrographic and chemical analyses of several samples of the rock gave results ranging from 0.001 to 0.002 % beryllium oxide - an amount too small to be classed other than as a trace.

The rock is classified as an altered volcanic tuff or breccia, made up of fragments thrown out by volcanic activity. Some samples contain secondary quartz and chalcedony. No beryllium minerals could be found microscopically.

Beryllium is highly important in forming alloys useful in certain war equipment, and after the discovery was announced over a week ago, the Department received many requests for information concerning the deposit.

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