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THE COPPER CONTENT OF CERTAIN OREGON MINE WATERS

by  
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The water that runs from or is pumped from most copper mines contains some dissolved copper mainly as copper sulfate. The amount of copper in water from a given mine is dependant on many factors, some of which are: magnitude of the ore body, nature of the ore body minerals, amount of moving ground water and the oxidizing quality of such ground water, the porosity of the ore body, and the volume of underground workings exposing the ore and trickling water to oxygen. Analysis for copper content of Oregon mine waters should give some clue to these factors regarding Oregon copper mineral deposits. Furthermore, profit is made by many copper mining companies by running copper containing mine water over scrap iron such as old detinned cans after the chemical equation:



The powdery copper deposit may be washed from the iron and is sold as a high copper concentrate sludge to smelters.

Samples of run out mine water were collected from one mine in northern California and from three mines of southern Oregon. The Blue Ledge mine is 40 miles southwest of Medford across the state line in California. The Silver Peak and Umpqua Consolidated mines (near Riddle, Oregon,) are 40 miles south of Roseburg. The Champion mine is in the Bohemia mining district 35 miles east of Cottage Grove. The volume of water running from the mines was evaluated by spouting the water into an open top five-gallon oil can and averaging the number of seconds required to fill it.

In a laboratory at Oregon State College, standard  $\text{CuSO}_4$ -containing solutions were made up. Rough runs on the  $\text{Cu}^{++}$  content of the mine waters were obtained by adding  $\text{NH}_4\text{OH}$  and colorimetrically evaluating the blue color of ammoniated Cu ion ( $\text{Cu}(\text{NH}_3)_4^{++}$ ). Blue coloration was obtained only from the Blue Ledge and Silver Peak mine samples.

More accurate colorimetric analyses were made using sodium diethyldithio carbamate,  $[(\text{C}_2\text{H}_5)_2\text{N} - \text{CS} - \text{SN}_2]$ . A brownish yellow color is attained as this chemical is added to very dilute solutions of copper.

The solutions prepared for the analysis of small amounts of copper in the mine water were as follows: A standard  $\text{Cu}^{++}$  solution was prepared by dissolving 39.3 mg. of selected blue crystals of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  in a liter of distilled water, which gives a solution containing 0.01 mg. of  $\text{Cu}^{++}$  per milliliter. The white sodium diethyldithio carbamate was dissolved in distilled water in amount one gram per liter. The ammonium hydroxide used was concentrated solution diluted one to five.

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For the blue ammoniated copper ion colorimetric estimation, Nessler tubes of 100 ml. capacity were used and color matching done in a Nesslerimeter. No coloration resulted as  $\text{NH}_4\text{OH}$  was added to the Umpqua Consolidated or Champion mine water samples. Considerable color developed on addition of  $\text{NH}_4\text{OH}$  to the higher copper content Blue Ledge and Silver Peak mine waters. Such waters were even diluted 20 ml. to 100 ml. in Nessler tubes in matching the blue color to a series of standard copper containing solutions ranging in concentration from 1.1 to 2.0 mg. per liter. Results on estimation of copper content of the mine waters by blue ammoniated copper ion colorimetry are given in table 1.

Table 1.

<u>Source of sample</u>	<u>Rate of flow from mine gal/min.</u>	<u><math>\text{Cu}^{++}</math> present</u>
Silver Peak mine	3	0.09 gm/l
Blue Ledge "	5	0.065 gm/l
Umpqua Consol. mine	2.25	none detected
Champion mine	100	none detected

Nessler tubes were also used in the sodium diethyldithio carbamate colorimetric copper determinations. The Nesslerimeter was found very useful in color matching. As ammonium hydroxide is added to some of the mine water samples, a visible precipitate of iron hydroxide was seen, resulting from soluble iron salts in the mine water. Filtration of the iron hydroxide with possible other occluded metal hydroxides was resorted to prior to colorimetric analysis on the  $\text{Cu}(\text{NH}_3)_4^{++}$  containing filtrate.

In a specific colorimetric run 50 ml. of mine water had added to it 5 ml. of about 8 percent ammonium hydroxide. Filtration followed. To the approximately 50 ml. filtrate containing copper ions was added 5 ml. of the prepared sodium diethyldithio carbamate solution and diluted to volume of 100 ml. in a Nessler tube. Comparison was made with standard copper containing solutions ranging from 0.005 mg. to 0.02 mg. of copper per liter, the standard copper solutions being likewise treated with ammonium hydroxide and sodium diethyldithio carbamate in Nessler tubes. Results on the estimation of the copper content of the mine waters by accurate sodium diethyldithio carbamate yellow coloration is given in table 2.

Table 2.

<u>Source of sample</u>	<u>Rate of flow from mine gal/min.</u>	<u><math>\text{Cu}^{++}</math> present</u>
Silver Peak mine	3	0.18 gm/l
Blue Ledge "	5	0.16 gm/l
Umpqua Consol. mine	2.25	0.006 gm/l
Champion mine	100	0.005 gm/l

Herewith is an estimate of how much copper flows to waste per year.

<u>Silver Peak mine:</u>	1 liter = 0.18 gm $\text{Cu}^{++}$ $0.18 \times 3.77 = 0.6786$ gms $\text{Cu}^{++}$ /gal. $0.6786 \times 3 = 2.0358$ gms $\text{Cu}^{++}$ /min. $2.0358 \times 60 \times 24 = 2931$ gms/day. $2931 \times 365 \div 100 = 453.6 \times 12.5\% = \$294.74$ per year.
<u>Blue Ledge mine:</u>	\$435.81
<u>Umpqua Consol. mine:</u>	\$ 6.79
<u>Champion mine:</u>	\$273.75

The mine waters were sampled in July of 1945. Check samples were procured from all but the Blue Ledge mine in April of 1946. The reruns on copper content checked quite closely with runs of the year before. Since there was still some snow in April 1946 above the Champion mine, the total water flow was up, but total copper content about the same.

A sample of the mine water from the Bonanza Mercury mine near Sutherlin, Oregon, was taken in the Spring of 1946. No copper could be colorimetrically discerned in the water. Furthermore, addition of hydrogen sulfide showed no trace of dissolved mercury in the water.

Since the authors have solutions made up for colorimetrically determining copper in mine water, they would welcome receipt of quart samples of mine water from other Oregon mines. Samples should be accompanied by information on rate of mine water flow and location of the mine.

- References:
1. Standard Methods for the Examination of Water and Sewage, Am. Public Health Assoc., 8th ed., 1936.
  2. Colorimetric Determination of Traces of Metals, E. B. Sandell, Interscience Publishing Co., N.Y.
  3. Colorimetric Analysis, F. D. Snell, D. Van Nostrand Co.

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#### MINING INSTITUTE

The 20th Annual Mining Institute of the College of Mines, University of Washington, will be held in Mines Laboratory on the campus in Seattle on Thursday, January 16. The morning and afternoon sessions will consist of addresses and motion pictures on current affairs in the mineral industry, also demonstrations of new pieces of equipment. In the evening the Institute will hold a joint dinner at the Faculty Club with the North Pacific Section of the American Institute of Mining and Metallurgical Engineers, to be followed by an evening program prepared by the section.

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#### PROSPECTOR'S COURSE

According to Dean Milnor Roberts of the College of Mines, University of Washington, the Prospector's Course authorized by the last session of the legislature will begin a new session on Monday, January 6, which will continue until March 20. These courses are open to men past high school age at very low cost. The instruction includes geology, chemistry, practice with prospecting, mining, and milling equipment, handling of ores and minerals in great variety, showings of motion pictures and views of current operations. Field trips are made on weekends.

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#### GEOCHEMICAL PROSPECTING

In recent years considerable research work has been done to investigate the possibility of prospecting for mineral deposits by analyzing soils, soil gases, plants, and ground water in places where the geology is thought to be favorable for buried deposits. Spectrographic, spectrochemical, and microchemical methods of analysis have been useful in this type of research. Techniques have been tried out in attempts to locate petroleum along these lines, and some success has been claimed.

The U.S. Geological Survey has announced that a geochemical unit has been set up to carry on such investigations, and that several field problems are under investigation at the present time. The announcement states that "One of the test areas selected for trying out methods of geochemical prospecting is in western New York, southwest of Clarendon, Orleans County. A number of peat bogs in this area, when drained for muck farming, developed a toxicity to plants. This toxicity was proved by analyses made by E. F. Staker of Cornell University to be due to high concentrations of zinc. Results of this work and a description of the area are given in Vol. 6 of the Proceedings of the Soil Science Society of America, pp. 207-214, 1941.

"A preliminary reconnaissance of the area has been undertaken by the Geological Survey, and samples of soil, water, and plants have been collected in an effort to determine the origin and mode of occurrence of the zinc. The area is underlain entirely by a thickness of Lockport dolomite which has been known for years to contain small amounts of sphalerite along its extensive outcrop. Certain toxic areas near the margin of the muck have proved to be directly associated with portions of the underlying Lockport dolomite which contain conspicuous crystals of sphalerite. Because of poor exposures, it is not possible to determine directly the quantitative abundance of zinc in the underlying dolomite, but it is hoped that an indirect interpretation of the distribution of the zinc can be made from the geochemical data. The leaching and transportation of the zinc by ground water evidently accounts for the concentration found in the peat."

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#### Eocene Age Assigned Shales at Toledo, Oregon

The Toledo formation has been assigned to the lower Oligocene by most students of Oregon Tertiary stratigraphy, but in many cases they have expressed the opinion that at least a portion of it may eventually turn out to be of Eocene age.

Microfossil studies now in progress substantiate this opinion. Shales from the Toledo formation exposed in a hillside cut behind Minnie's Sunset Cafe near the center of the south line of SE $\frac{1}{4}$  sec. 7, T. 11 S., R. 10 W., in Toledo, Lincoln County, Oregon, contain an excellent foraminiferal faunule which corresponds very closely with Beck's Cowlitz fauna from sec. 28, T. 11 N., R. 2 W., Lewis County, Washington, (Jour. Paleontology, vol. 17, no. 6, pp. 584-614, Nov. 1943), and with an upper Eocene assemblage from Helmick Hill, sec. 13, T. 9 S., R. 5 W., Polk County, Oregon. It appears, therefore, that the Toledo shales from this hillside exposure are upper Eocene in age.

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#### NEW MINING SCHOOL Stanford University

According to the San Francisco Call dated November 23, Dr. Donald B. Tresidder, president of Stanford University, has announced the establishment of a new school of mining sciences at Stanford.

Dr. Tresidder stated that the new school, which is a combination of the department of geology and the department of mining, will open January 1, with an enrollment which has been estimated to be 100 students.

The dean of the new school will be Professor A. Irving Levensen, now head of the geology department.

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