

- SHORT, M. N., & SHANNON, E. V. (1930), Violarite and other rare nickel sulfides: *Am. Mineral.*, **15**, 1-17.
- TOLMAN, C. F., JR., & ROGERS, A. F. (1916), A study of the magmatic sulfide ores: *Leland Stanford Junior Univ. Pub.*, 76 p.

LLAMA BONES WITH LEAD-COPPER MINERALIZATION FROM BOLIVIA*

CHARLES MILTON, *U. S. Geological Survey, Washington 25, D. C.*

In assembling materials for a paper dealing with the preservation of fossils being prepared by a member of the U. S. Geological Survey, it was learned that there were some mineralized and supposedly fossil bones in the paleontological collections at Harvard College. The bones were reported to be replaced by copper or copper compounds. Through the kindness of Dr. Alfred S. Romer of the Museum of Comparative Zoology, the bones (Fig. 1) were borrowed for examination. They are labeled in German: "Vertebrae impregnated with copper—mineral collection of Friedrich Ahlfeld."

The bones are notably heavy and show perfectly preserved bone structure. They consist of calcium phosphate largely replaced by green and red oxides (massicot and litharge) and also probably by lead phosphate, with metallic lead, copper, and probably traces of silver. Figure 2 shows a polished section of the bone. Figure 3 is of another polished section showing replacement of bone by lead oxide.

The observed relations of the metallic lead and copper are in all respects those that would follow from the cooling of a melt consisting of lead with some copper, as may be seen from consideration of the equilibrium diagram for the Pb-Cu system (Fig. 4). It is possible that in a cupellation process bones were used for some reason, instead of the customary bone ash. Molten lead then would seep down, with its dissolved copper (and perhaps silver), to lodge eventually in the bone pores and there crystallize. At the same time oxide compounds of these metals would crystallize as illustrated.

To confirm or disprove this hypothesis of the mineralization of the bones, inquiry was made of Señor Ahlfeld, who, under date of May 4, 1954, stated that "the bones were those of the modern llama collected from the surface near an old copper smelter in the Corocoro district."

* Publication authorized by the Director, U. S. Geological Survey.

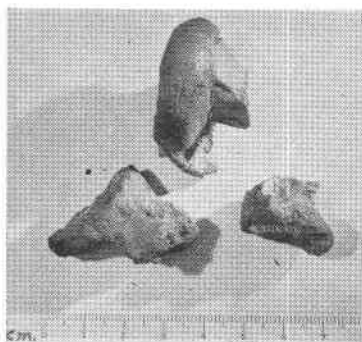


FIG. 1. Llama bones with copper-lead-silver(?) replacement.

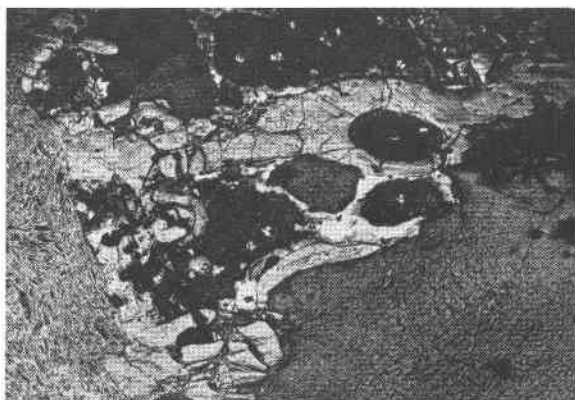


FIG. 2. Polished section ($\times 25$) showing bone structure with lead (gray in lower right and center) and copper crystals in the lead.



FIG. 3. Polished section ($\times 50$). The diagonal, large, gray, relatively smooth areas are essentially unmineralized bone. Crystallized lead oxide is in the bones pores across the middle of the section at upper left. The light-gray area in the lower right is celite, the embedding medium.

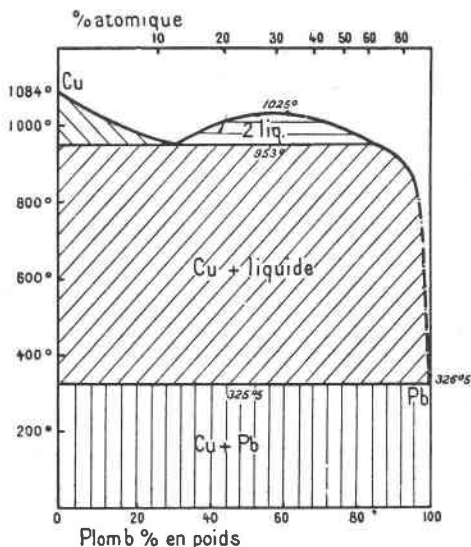


FIG. 4. Equilibrium diagram of copper-lead system (after Pascal, Paul, *Traite de Chimie Minerale*, 12, 429, 1934).

BIBLIOGRAPHY ON URANIUM IN ARKANSAS, IOWA, KANSAS, LOUISIANA, MINNESOTA,
NEBRASKA, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA AND TEXAS

The Geological Society of America published the following article in the March, 1955, issue of its *Bulletin*: "Bibliography and Index of Literature on Uranium and Thorium and Radioactive Occurrences in the United States. Part 4: Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota and Texas," by Margaret Cooper for the Division of Raw Materials, U. S. Atomic Energy Commission. Since this 70-page bibliography may prove helpful to both geologists and laymen interested in uranium prospecting, the Society has prepared reprints for public sale at 50 cents per copy. Remittance must accompany orders, which should be sent to:

The Geological Society of America,
419 West 117 Street,
New York 27, New York.

One Hundred Arizona Minerals is the title of a small Bulletin (No. 165) of the Arizona Bureau of Mines (Mineral Technology Series No. 49) recently issued by the University of Arizona, Tucson, Arizona. The author is Richard T. Moore. The price of this Bulletin is thirty cents, but may be obtained free if a resident of Arizona.

The fifth issue of the second series of the French Bibliographical Digest, devoted to all branches of crystallography and mineralogy, is now ready for distribution. It is published as a sequel to the volume dealing with geology which appeared in October 1954. The present bibliography lists publications for the years 1949-1954 and contains author's name, title of article, translation of the title into English, with volume, year and page references (with short abstracts). There are 582 entries of papers published by 433 authors. The preparation of the manuscript is largely the labor of Professor J. Wyart of the University of Paris.

The French Bibliographical Digest is intended primarily to make French scientific work better known in the United States. It is edited and published by the Cultural Division of the French Embassy, 972 Fifth Ave., New York 21, N. Y. Libraries, university departments and scientists will, upon request, be placed on the mailing list and receive the publications without charge.

Dr. Robert A. Hatch since 1947 associated with the Electro-Technical Laboratory of the U. S. Bureau of Mines at Norris, Tenn., where he directed research on synthetic mica, synthetic asbestos, industrial diamond substitutes and other synthetic mineral and ceramic materials has joined the ceramics section of the Electrical Products Laboratory of the Minnesota Mining & Manufacturing Co., St. Paul, Minnesota.
