already demonstrated to us fundamental results by means as strikingly simple. To Loeb the problem of the universe is soluble in a finger-bowl; to Morgan in a milk-jar; and we must never forget that the importance of a result is often inversely proportional to the complication of the apparatus by which it was attained. With these examples before us, let us avoid the pitfall of bright glass and shining metal.

I have entitled this paper "Experimentalism in Zoology" and I have nowhere used the term experimental zoology. This has been intentional, for I do not believe in this term. The new movement does not mean a new province in zoology; it is a new method of attacking old problems. It will, of course, lead us to new fields, but it is method rather than matter. We are not exchanging old lamps for new but burning the old lamp in a new way. I therefore resist the term experimental zoology. We are all still zoologists and we have simply added to our equipment the experimental method. As each one, old or young, realizes the significance of this method and the great power that it puts in his hand, he will adopt it in proportion to his needs and abilities. In this way it is gradually pervading the whole fabric of biology from the realm of the systematist to that of the ultramodernist. Our times are full of such changes. To-day we men vote, to-morrow our women will vote. Let all such changes come as natural growths.

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THE PRODUCTION OF RADIUM, URANIUM AND VANADIUM ORES IN 1913

PROBABLY no other mineral is mined which has so large a hold on public attention and at the same time has so small a total monetary value as the uranium minerals. This interest is, of course, due not to the minerals as such, nor to the uranium they contain, but to the accompanying radium, which is found only with uranium. Hitherto the interest in radium, though lively, has been largely academic, on account of the marvelous qualities which it displays when compared with better-known elements. Toward the end of 1913, however, public interest became almost feverish, owing to the apparent cures of cancer wrought by the application of the gamma rays given off by radium.

Uranium minerals were produced in commercial quantity in the United States in 1913, as shown by preliminary statistics gathered by Frank L. Hess, of the United States Geological Survey, only in Colorado and Utah, and although during the year some pitchblende was mined in Colorado in the Belcher & Calhoun mines, only a few pounds were sold, though 50 dry tons of low-grade material carrying 1.49 per cent. uranium oxide (U_3O_8) was shipped to France from the Kirk mine. This had been mined a previous year. Carnotite, a yellow powdery or waxy mineral found in the sandstones of the high plateau between the Rocky Mountains of Colorado and the San Rafael Swell of Utah, south of the Book Cliffs, furnished the whole production.

Carnotite, as the word is ordinarily used, is a potash or lime uranium vanadate. Several vanadium minerals occur with the carnotite, so that in mining for uranium a great deal of vanadium is also obtained. At Newmire, San Miguel county, Colo., one of the vanadium minerals, roscoelite, occurs practically free from uranium and is worked for vanadium alone.

The total mine shipments of uranium and vanadium, as shown by preliminary figures, were equal to 2,140 tons of dry ore, carrying an equivalent of 38 tons of uranium oxide. The vanadium in carnotite ores shipped, together with that which is estimated to have been produced from the Newmire district, was equivalent to 914 tons of vanadium oxide. These quantities are equal to about 32.3 tons of metallic uranium and 412 tons of metallic vanadium.

The Bureau of Mines has determined that carnotite carries about 90 per cent. or even a little more of the theoretical quantity of radium in equilibrium with uranium, which, according to Rutherford ("Radioactive substances and their radiations," p. 16), is equal to about 1 gram in 3,000 kilograms of uranium. Assuming that 90 per cent. of the radium is recoverable, this would give 16.40 grams of hydrous radium bromide, worth, about $120 a milligram of metallic radium, about $1,055,000. The total value of the carnotite ores sold was about $142,000, which represents the uranium value only, as little was paid for the vanadium content and the figures for these receipts are not yet in hand.

The production of the year was the largest ever made, according to the Geological Survey figures, that for 1912 being equivalent to 26 short tons of uranium oxide (22 tons of the metal), and that for 1911 being equivalent to 25 tons of uranium oxide (21.2 tons of the metal)—an increase of nearly 50 per cent. for 1913.

Of the quantity produced, apparently 19.25 tons of uranium oxide, containing the equivalent of 8.3 grams of hydrous radium bromide, was shipped to Europe, and 18.75 tons, containing the equivalent of 8.1 grams of hydrous radium bromide, was retained in this country, although in tonnage the quantity retained in this country, 1,198 tons, was larger than that shipped to Europe, which was apparently 942 tons. One of the principal producers for foreign trade did little work for more than half a year, owing, it is reported, to the fact that its factory in Liverpool had not been completed. Had the factory come into operation sooner the exports would have been considerably larger.

A prominent feature of uranium and vanadium production during the year was the change in method of payment by American buyers, who no longer paid for the vanadium content in the ore but bought it on the basis of the uranium oxide content alone, though they received payment for the vanadium abroad. However, the miner received more or less compensation in a higher price for the uranium oxide he sold. Prices varied greatly and returns to the Survey show that the price per pound for contained uranium oxide ranged from $1 for ores carrying 0.6 per cent. uranium oxide to $4.60 for one lot carrying 3.15 per cent. uranium oxide and 4.82 per cent. vanadium oxide.

The demand for carnotite at increasing prices caused a large amount of prospecting, and the carnotite-bearing area was shown to extend from the Paradox country westward into the Dry Valley region of Utah, lying between Monticello and the La Sal Mountains. Farther west and south deposits of carnotite were found on Crescent and Trachyte creeks, in the Henry Mountains, and also southwest of the mountains.

During the fall a geologic reconnaissance of the uranium and vanadium deposits of Utah was made by Frank L. Hess and B. S. Butler, of the United States Geological Survey. They covered the territory lying between the Wyoming line and the south side of the Henry Mountains, and east of the San Rafael Swell. The deposits, as shown by the outcrops, are nearly all in small pockets, part of which are comparatively rich. All the newly found localities are far from railroad and the hope for commercial production from them lies in concentration on the ground by some cheap process, and many experiments are being carried on to develop such a process. Toward the end of the year steps were taken for the erection of a concentration plant in Dry Valley, 15 miles north of Monticello. A plant was put up on Mesa Creek, Colo., and another was said to be in course of erection in the Gateway district. A preliminary report on the uranium and vanadium deposits of Utah will probably be issued during the spring.

The Standard Chemical Company actively produced radium at its plant at Canonsburg, Pa., and the Radium Company of America established a plant and did preliminary work at Sellersville, Pa.