

DETERMINATION OF COPPER.			
Copper taken. Mg.	Copper found. Mg.	Error. Mg.	Error. Per cent.
20.00	20.01	+0.01	+0.05
20.00	19.99	-0.01	-0.05
20.00	20.00	0.00	0.00
30.00	29.99	-0.01	-0.03
30.00	30.00	0.00	0.00
40.00	39.98	-0.02	-0.05
40.00	39.96	-0.04	-0.10
60.00	60.01	+0.01	+0.02
60.00	60.01	+0.01	+0.02
80.00	80.12	+0.12	+0.15
80.00	80.03	+0.03	+0.04
80.00	79.98	-0.02	-0.02
80.00	79.98	-0.02	-0.02
100.00	100.00	0.00	0.00
100.00	99.99	-0.01	-0.01
120.00	119.95	-0.05	-0.04
140.00	140.00	0.00	0.00
160.00	160.00	0.00	0.00
160.00	160.00	0.00	0.00
180.00	180.00	0.00	0.00
180.00	180.00	0.00	0.00
200.00	200.00	0.00	0.00
200.00	199.9	-0.1	-0.05
203.2	203.2	0.00	0.00
220.2	220.1	-0.1	-0.05
240.0	240.0	0.00	0.00
240.0	240.2	+0.2	+0.08
261.6	261.6	0.00	0.00
280.0	280.0	0.00	0.00
280.0	280.3	+0.3	+0.10
300.0	300.1	+0.1	+0.03
320.0	319.9	-0.1	-0.03
320.0	319.9	-0.1	-0.03
340.0	340.0	0.00	0.00

NOTE.—The sum of the + and — errors very nearly equals zero.

For the opportunity of carrying out this work I wish to thank Dr. N. B. Foster and for assistance with the analytical work Mr. A. W. Thomas.

[CONTRIBUTION FROM THE CHEMICAL LABORATORY, UTAH EXPERIMENT STATION.]
**THE OCCURRENCE OF POTASSIUM NITRATE IN WESTERN
 AMERICA.**

BY ROBERT STEWART.

Received October 18, 1911.

About one year ago a sample of material was received at this laboratory for chemical analysis. The material was almost completely soluble in water and the analysis showed that it contained 12.79 per cent. of nitric

nitrogen and 35.06 per cent. of potassium. The discoverer stated that it was found in large quantities in Southern Idaho, about 35 miles northeast of Soda Springs. This deposit was examined by the writer and others in June of this year. The nitrate was found in a cave occurring in red sandstone. The cave, which is located in a mountainous country at an elevation of 7,000 feet, is very small and contained probably 25 pounds of the nitrate. The sandstone roof of the cave contained crevices through which the nitrate had been carried by percolating water, the nitrate being deposited on the roof of the cave on the evaporation of the water. The position of the deposit and the nature of the surrounding country indicated that the nitrate could have been carried only through the sandstone by percolating water. The position of the deposit, high up in a mountainous country, far above any irrigating systems, precludes the possibility of its recent formation by bacterial action under the influence of irrigation water. Within a few miles of this deposit, there occur large deposits of sodium chloride which is at present being mined for domestic use.

Two samples of this material were collected for analysis. A sample of the sandstone, which appeared to have been stained with the nitrate, was broken off the face of the cliff about 100 yards above the cave. This was also analyzed. The results of the analysis are recorded in Table I.

TABLE I.—COMPOSITION OF CRUDE NITRATE AND SANDSTONE.

	No. 1. Nitrate.	No. 2. Nitrate.	No. 3. Sandstone.
Residue insoluble in water.....	4.22	2.73	98.21
Nitric nitrogen.....	11.12	11.48	0.127
Ammoniacal nitrogen.....	None	None	None
Calcium.....	2.91	2.12	..
Magnesium.....	0.11	0.17	..
Potassium.....	30.89	31.55	0.18
Sulfur.....	1.54	1.58	..
Chlorine.....	Trace	Trace	..

These results indicate that this material is crude potassium nitrate with some calcium sulfate. Deposits of nitrates have been reported elsewhere in Western America.¹ Samples have been received here from the southwestern part of this State near the Utah-Nevada line and from the central part of the State in Wayne County. A sample received from Pocatello, Idaho, contained 0.22 per cent. ammoniacal nitrogen, 2.59 per cent. nitric nitrogen, and 7.89 per cent. potassium.

Although the nitrate has not been found in quantities of commercial importance, the fact that it does occur in sandstone deposits is of interest just now for two reasons. It may indicate that water-soluble potassium occurs in quantities of commercial importance in the arid West. This

¹ Dunn, *Exp. Sta. Record*, 18, 430.

is a question worthy of investigation by our national Geological Survey. It may have some bearing on the recent discovery¹ that nitrates are the predominating constituents in some of the western soils impregnated with alkali. The occurrence of these nitrates has been attributed to their formation by bacterial action at the present time. The existence of deposits of nitrates in the country rock in widely distributed areas in the arid West may have some connection with the occurrence of excessive quantities of nitrates in these agricultural soils.

LOGAN, UTAH.

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF MINNESOTA.]

A CHEMICAL STUDY OF LIGNITE. PART II. THE VOLATIL CONSTITUENTS.²

BY G. B. FRANKFORTER AND ANDREW P. PETERSON.

Received March 8, 1911.

In the proximate analysis of lignite, the determination of the volatil constituents is unquestionably of great importance, and like the determination of moisture is deserving of special attention. A considerable portion of the volatil combustible matter in lignite, as determined in the proximate analysis of coal, seems to consist of small particles of carbon carried off by the liberated gases and by the moisture. This is evident from the fact that in addition to the flame produced by the burning of the gaseous constituents themselves, particles of solid combustible matter are carried upward by the gases and appear for an instant as glowing sparks before being completely oxidized. These solid particles are especially noticeable if the lignite contains a large amount of moisture or if the determination is made without first thoroughly drying the sample. Even though the crucible lid fits perfectly, these particles are thrown off when the heat is applied as indicated in the ordinary analysis of bituminous coal. The volatil constituents may be varied from 5 to 12 per cent. by slowly or rapidly raising the temperature to a red heat. The variation is more noticeable, however, in the undried lignite. It was found that not only the quantity of volatil matter but also the composition of the gas varied, depending upon the heating and whether or not the lignite contained its hygroscopic water.

The first experiments were made with the idea of determining the quantity of volatil matter, both by weight and by volume as compared with good bituminous coal. Accordingly, determinations were made by the ordinary method and by heating in an atmosphere of hydrogen.

The samples examined came from the extreme limits of the Dakota, the Canada and the Alaska coal belts. Samples from these different

¹ Bulletins Nos. 155 and 178, Colorado Agricultural Experiment Station.

² For the first paper see THIS JOURNAL, 29, 1488 (1907).