

ART. XIV.—*A Curious Occurrence of Vivianite*; by  
WM. L. DUDLEY.

WHILE making the preliminary survey of the Cumberland river from Nashville to its mouth for the purpose of locating the locks and dams which are to be constructed by the Government, Assistant Engineer C. A. Locke discovered some "blue roots" embedded in a stratum of clay which had been exposed in the bank made by the erosion of the waters in cutting out the channel of the river. The locality was about two miles above Eddyville, Ky. The stage of the river was about six feet above low water mark, and the stratum containing the roots was about two feet above the surface of the water or eight feet above low water. The stratum is exposed therefore only for a limited season each year.

Maj. Locke gives the general characters and thicknesses of the strata exposed in the cut, as follows: Soil, 2 feet; light yellow clay, 15 feet; light drab clay, 15 feet, at the bottom of which the blue roots were found; below this an unknown depth of gravel.

The "blue roots" were found in such position as to indicate that they were in the place of their growth. The clay is described as having a blue color when wet, and I regret that a specimen of it was not collected for examination.

Four of these "roots," more or less perfectly preserved, were handed to me. They were from one-half to two centimeters thick and six to twelve long. The blue mineral which has almost wholly replaced the woody fiber of the roots is of a deep blue color resembling cobalt-blue but somewhat darker, and of a duller hue. It is earthy and very friable. There is no evidence of structure, and the specimens seem to be casts of the original roots, formed gradually as decay proceeded.

Some of the remaining particles of the wood were given a microscopic examination by Professor Jas. M. Safford, who pronounced it coniferous.

For analysis some of the mineral was pulverized and suspended in water. The small particles of woody substance floating were removed. Heavy brownish mineral matter in small quantity rapidly settled to the bottom, and the water containing the blue substance in suspension was carefully poured off and allowed to settle during twelve hours. This operation was repeated and the mineral was in a very fair state of purity. It was then dried in the air at the temperature of the laboratory, and finally for twelve hours over sulphuric acid. Analysis gave the following result:

Water given off at 100°C.....	10.59	per cent.
“ “ “ 230° .....	7.24	“
Alumina .....	17.74	“
Ferric oxide.....	9.35	“
Ferrous oxide.....	24.58	“
Lime .....	0.59	“
Magnesia .....	0.43	“
Phosphoric anhydride (P <sub>2</sub> O <sub>5</sub> ) .....	27.71	“
Insoluble matter .....	1.84	“

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100.07

When the water was driven off at 100°, the residue had a dull green color resembling chromic oxide. After heating to 230° until all of the water was eliminated the color was light brown. In a desiccator, over sulphuric acid, the mineral gradually lost water and for several days became green. This occurred more rapidly of course if the air in the desiccator was exhausted.

If in the above analysis, the lime, magnesia and insoluble matter be eliminated and the percentages of the remainder be calculated to 100, it is found that the mineral may be very nearly represented by the formula  $2(3\text{FeO} + \text{P}_2\text{O}_5) + \text{Fe}_2\text{O}_3$ ,  $3\text{Al}_2\text{O}_3$ ,  $(\text{P}_2\text{O}_5)_2 + 17\text{H}_2\text{O}$ , or  $2\text{Fe}_3\text{P}_2\text{O}_8 + \text{Al}_6\text{Fe}_2\text{P}_4\text{O}_{22} + 17\text{H}_2\text{O}$ . This seems to indicate that the ferrous iron in the mineral is combined with the  $\text{P}_2\text{O}_5$  to form vivianite,  $\text{Fe}_3\text{P}_2\text{O}_8 + 8\text{H}_2\text{O}$ , and Professor F. W. Clarke arrived at the same conclusion upon examining some specimens which I sent to the National Museum.

If the double molecule of vivianite,  $2(\text{Fe}_3\text{P}_2\text{O}_8 + 8\text{H}_2\text{O})$ , be subtracted from the above formula, there remains  $\text{Al}_6\text{Fe}_2\text{P}_4\text{O}_{22} + \text{H}_2\text{O}$ , which resembles an almost dehydrated double molecule of turquois,  $\text{Al}_6\text{P}_4\text{O}_{22} + 10\text{H}_2\text{O}$ , in which one molecule of  $\text{Fe}_2\text{O}_3$  has replaced one of  $\text{Al}_2\text{O}_3$ . The mineral was so earthy and friable that sections could not be cut, and therefore microscopic evidence is impossible.

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