

ART. XLVIII.—*On a new Thorium Mineral, Auerlite*; by  
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WHILE one of us was about completing a contract for twenty-six tons of zircons, to supply a recent large demand for that mineral, several crystals of the mineral forming the subject of this paper were noticed in the very last shipments from the mine. As the quantity then found was insufficient for a complete chemical and physical examination, the locality was revisited in July last and for five weeks a systematic and laborious search for the mineral *in situ* was carried on. We had already proved it to be a hydrous mineral rich in thoria, with silica and, strangely, a very appreciable quantity of phosphoric acid. Our interest was centered upon its apparent anomalous composition and a series of careful analyses was made by one of us as soon as the necessary material was procured. As the result of the search at the locality not quite 100 grams were found and it became necessary to mine over 200 kilos of zircons to get even this small amount.

It has thus far been found at only two places in Henderson County, North Carolina, namely, at the well-known Freeman mine, on Green River, and on the Price land, three miles southwesterly. At both places it occurs in disintegrated granitic and gneissic rocks intimately associated with crystals of zircons, and it is often seen implanted upon them—as a second or after-growth—in parallel position.

The color on a fractured surface ranges in different crystals from a pale lemon-yellow through various shades of orange to a deep brown-red. The form is distinctly tetragonal, only the unit pyramid and prism being observed, and excepting a tendency to a longer prismatic development, it is much like the common type of zircon found throughout the region. The faces being very rough and uneven, no constant angles could be obtained on any of the material, but they closely approximate to those of zircon.

Fragments of the mineral resemble some varieties of gumite and deweylite, but have a more waxy or rosin like appearance. It is sub-translucent to opaque, and has a dull yellowish white exterior. It is very brittle and easily crumbled. The hardness varies from 2.5 to 3, some crystals barely scratching cleavage surfaces of calcite. The specific gravity has a wide range, i. e. from 4.422 to 4.766, the dark-orange-red crystals having the highest density.\*

\* Some of the crystals were much lighter in color, softer and of specific gravity from 3.7 to 3.8. These we propose to examine and report upon later.

The largest mass found measured 1<sup>cm</sup> through the prism, and it was evidently only part of what had been a long crystal. The bulk of what we collected is in a very fragmentary condition, down to masses and broken crystals of 1<sup>mm</sup> diameter.

Our analyses have given the following results:

	1.	2.	3.	4.	5.
H <sub>2</sub> O } ----	10·7	----	11·21	----	9·88
CO <sub>2</sub> } ----		----		----	1·00
SiO <sub>2</sub> -----	----	9·25	7·64	8·25	
P <sub>2</sub> O <sub>5</sub> -----	----	----	7·46	7·59	
ThO <sub>2</sub> -----	----	69·23	70·13		
Fe <sub>2</sub> O <sub>3</sub> -----	----	1·42	1·38		
CaO -----	----	----	0·49		
MgO -----	----	----	0·29		
Al <sub>2</sub> O <sub>3</sub> , etc.*	----	----	1·10		
			99·70		

If the amount of CO<sub>2</sub> in analysis number 3 is assumed to be the same as it is in 5, and if we take the amount of H<sub>2</sub>O as the difference between the loss on ignition and the CO<sub>2</sub>, the ratio of hydrogen equivalents, of bases and acids (assuming the carbonates to be admixed impurity), is nearly 2:1:2. This gives the formula,



or a thorite in which part of the silica is replaced by its equivalent in phosphoric acid, when  $3\text{SiO}_2 = 1\text{P}_2\text{O}_5$ . The ratio of silica to phosphoric acid is variable and is approximately 1:1 in hydrogen equivalents; but the P<sub>2</sub>O<sub>5</sub> tends to be in excess.

We have considered it possible that this mineral is a mixture of a hydrated thorium phosphate with a hydrated thorium silicate, in some respects analogous to the occurrence of zirconium-silicate (zircon) in parallel position with yttrium-phosphate (xenotime),<sup>†</sup> although there is nothing in the appearance to suggest this—the mineral seeming to be perfectly homogeneous, except on the exposed surfaces. It is more probable, however, that we have here an example of a partial replacement of silica by phosphoric acid, which fact has not yet, to our knowledge, been noticed in the literature of Mineralogy; unless we should so regard the small proportion of P<sub>2</sub>O<sub>5</sub> (4·17) which Eakins<sup>‡</sup> observed in the xanthitane (altered titanite) from the same locality.

This occurrence of a thorium phosphate is the first instance of such a compound existing in nature and seems to have a

\* Including other oxides with traces of thoria.

† This Journal, Nov., 1888, p. 380.

‡ This Journal, vol. xxxv, p. 418, May, 1888.

direct bearing upon the presence of thorium in monazite, and we believe that the idea that thorium is included in monazite as thorite—mechanically intermixed—should be modified in so much that the thoria should be considered as partially present as a phosphate and the cerium earths partially present as silicates.

This mineral is readily soluble in hydrochloric acid, leaving a residue of gelatinous silica; after ignition it becomes insoluble. Thorium phosphate is generally regarded as a very insoluble compound, but the ready solubility of this mineral seems to disprove that opinion.

It is infusible and upon strong ignition becomes dull-brown and on cooling, orange again.

Thorite crystals having the form of zircon have been described by Zschau,\* and Nordenskiöld,† and later Brögger,‡ have expressed the opinion that the mineral known as thorite is a pseudomorph after an original thorium silicate analogous to zircon in composition. This view is confirmed by the fact that this new mineral occurs intimately associated with and implanted upon perfectly unaltered zircon.

As this mineral was found while mining the very large quantity of zircons necessary to supply the demand caused by the invention of the system of incandescent gas-lighting of Dr. Carl Auer von Welsbach, we propose to name it *Auerlite* in his honor.