

pink color with an occasional bright grain giving a vitreous or pearly reflection. The aggregate can be crushed to sand with the fingers. No information regarding the wall rocks is available. The optical measurements made by Dr. Larsen are as follows: Optically negative (—); extinction apparently highly inclined; axial angle, $2V$, medium; refractive indices $\alpha = 1.505$, $\beta = 1.515$, $\gamma = 1.517$.

The material was so different in appearance from ordinary laumontite that it was examined chemically in the laboratory of the National Museum. Before the blowpipe it fuses with intumescence to a white enamel. In the closed tube yields abundant water. It is soluble in hot hydrochloric acid with gelatinization.

Upon analysis the following results, agreeing with the recognized composition of laumontite, were obtained upon the air-dried material:

SiO₂ 50.90, Al₂O₃ 21.26, Fe₂O₃ 1.66, CaO 13.91, MgO trace, MnO trace, H₂O 12.64, sum 100.37%.

The mineral is of interest in its unusual form and mode of occurrence. The instance shows with what certainty a mineral may be identified by means of its optical properties alone.

THE MINERALS OF MADISON COUNTY, MISSOURI¹

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Madison County, Missouri, is noted especially for the linneite² found in the old Mine La Motte Mine. The occurrence of this rare mineral in abundance in this and nearby mines makes the area of interest, but many other minerals (one of which is known nowhere else in the United States) are found in this county.

Madison County is in the southeastern part of the state, about 145 kilometers (90 miles) south of St. Louis. It includes part of the St. Francois Mountains, which comprise an irregular series of rounded hills, some of which reach an elevation of 550 meters (1800 feet). In the eastern part of the county there are

¹[Our "Famous Mineral Localities" series, more or less interrupted during the past few months because of lack of space, recommences with this article, and will, it is hoped, be represented in every number during the current year. Ed.]

²[The simplest spelling of this name is preferred in this magazine. Ed.]

Cambrian sediments, with occasional patches of granite, granite-porphry, and rhyolite. The areas of igneous rocks increase in size to the westward to such an extent that in the western half of the county no other rocks are found.

The famous old Mine La Motte is in the northeastern part of the county and the younger mines are around Fredricktown, 8 kilometers (five miles) to the south. The Chicasaw Indians obtained lead in the district previous to 1720, and it was thru them that the lead deposits were first found, by a French mineralogist named La Motte, about 1720. These early explorers were looking for silver, but, failing to find it, they began mining the galenite.¹ Other discoveries of nearby lead deposits followed in the next decade. French people still live in one of these districts, called "Old Mines." Since 1720 mining has been carried on more or less actively on the Mine La Motte property. Much evidence of the early mining has been uncovered in the present workings.

The ores at Mine La Motte occur in sandstone and dolomite, but much residual galenite has been mined from the thick residual clays overlying these rocks, especially during the early periods of mining. The chief mineral of the ores in general is galenite. That found in the clay shows the effects of ground water, usually occurring in rounded masses, more or less pitted and almost invariably showing a thin coating of gray cerussite. Recent mining work shows that this residual clay contains considerable cerussite (occurring in small grains), frequently as high as 5 or 6 percent.

In the dolomite, especially near the surface, beautiful botryoidal forms of cerussite occur; but even more common are the radiating groups of cerussite crystals, which are often acicular. These groups attain a length of 3 to 5 centimeters. The crystals are transparent, tho occasionally stained yellow by limonite. They are found in cavities from the top of the ground to the bottom of the dolomite.

Linneite occurs mainly in the sandstone, just below the dolomite. It is found in veins, in cavities, and disseminated thru the rock. The best crystals (often one centimeter in diameter) occur in the disseminated form. The linneite in the veins

¹ [When the standard mineralogical termination *ite* can be added to a mineral name without seriously obscuring its derivation, or destroying its euphony, the uniform introduction of this ending seems desirable. Ed.]

is nearly solid and usually free from crystal faces. The crystals in cavities are fairly well developed. The usual crystal form of these is the octahedron, frequently in combination with the cube. Intergrowths are especially common. An unusual mode of occurrence was noted in cavities in the dolomite, the mineral having a radiating form similar to millerite. The fibers are coarser than those in the radiating forms of millerite and occasionally they show minute cubes along their sides. The linneite is a distinct reddish gray in color, making it easy to identify when intergrown with pyrite and marcasite, as it is at the Missouri Cobalt Company's mine, near Fredricktown. The Missouri linneite contains approximately 20% of nickel, thus making it the variety called siegenite (the isomorphous mixture of linneite and polydymite).

Two other cobalt-nickel minerals are found within the area. "Asbolite," or earthy cobalt ore, is found where the ores have been oxidized at the surface. It is compact-massive, jet black, and has a hardness of 4 to 5. The earthy variety is forming in the ores today, and is usually noticed as a black powder. Bieberite, a rare hydrous cobalt sulfate, forms as an efflorescence on the pillars in the old portions of the mine; this mineral has been found in America in but one other locality.¹ It will be described in a future paper.

Other minerals found at Mine La Motte are sphalerite (rare) chalcopyrite, massive and rarely in small poorly developed crystals intergrown with the linneite, and pyrite. Beautiful gray crystals of dolomite, and calcite in the form of very flat rhombohedrons, occur both in cavities and along fissures. Malachite is seen occasionally.

Pyrrhotite, annabergite, plumbogummite, and anglesite have been reported as occurring at Mine La Motte, but the writer has been unable to confirm these reports.

At the Missouri Cobalt Mine, about 1½ km. southeast of Fredricktown, the following minerals are found in abundance: galenite, in splendid crystals; pyrite, massive, in crystals, and as stalactites; marcasite, massive and in crystals; linneite, as crystals and massive; chalcopyrite, massive; and sphalerite, massive. Dolomite, calcite, and occasionally a little malachite

¹The Cornwall iron mines, Lebanon County, Pennsylvania. Genth, *Mineralogy of Pennsylvania, Second Geol. Survey Penna., Rept. B2, 149 1874.* [S. G. G.]

also occur. Many old shallow diggings show both malachite and azurite.

At Silver Mine, in the western part of the county, a quartz vein, discovered early in the nineteenth century, was worked for silver in the late seventies, but was a failure as a silver mine. In 1915 it was reopened and worked for the tungsten minerals it contained. The vein, which dips southeastward about 60 degrees and strikes a little south of west, is well exposed along the side of the St. Francois River.

Much of the galenite obtained during the early mining was silver-bearing, hence the name Silver Mine. A number of minerals, some very rare in the Mississippi Valley, and one, zinnwaldite, not reported elsewhere in the United States, are found here. Quartz is the most abundant mineral in the vein. It occurs massive and as crystals. Hübnerite occurs in fairly large masses, usually bladed, and often several kg. in weight. Purple fluorite is associated with the hübnerite and the quartz. Zinnwaldite is found as rosettes, singly or in chains. These rosettes may occur in bands a centimeter or more in width, and ten to twenty or more centimeters in length. The mineral has a dirty golden brown color. It shows the twinning characteristic of this mineral and also small lines, apparently due to wrinkling, perpendicular to the face and intersecting at the twinning plane. Galenite is the most common sulfide, but pyrite, sphalerite, chalcopyrite, and arsenopyrite are also found. Sericite is developed in the wall rock. Serpentine is abundant in the vein, and bands of zinnwaldite a centimeter wide ramify thru it in various directions. Topaz, tungstite, and stolzite have been reported, but the writer has never found them.

Many small quartz veins occur in the surrounding granite and rhyolite. These contain specularite, epidote, quartz, and garnet. Brown radiating crystals of epidote are of rather frequent occurrence in cavities in the granite.

Fine specimens of glauconite can be obtained from the Cambrian dolomite of the area, this mineral often constituting 20% of the rock. Great masses of drusy quartz are found in the dolomite; less often it occurs in, or associated with, the chert.