and spongy layers as represented in Fig. 313, and the thin harder bands in this lamination or straticulation are persistent throughout the lithophysæ; as the figure shows they were sometimes arched in the making of the cavities, while often, on the other hand, they prevented the cavity from completing a circular form. The concentric partitions are fragile and consist mostly of minute crystals of quartz, feldspar, and tridymite; and sometimes topaz and garnets are in the cavities.

Richthofen regarded the lithophysæ as made by expanding steam, like vesicles in ordinary lava, and the concentric partitions as having been thrown off in the progress of the expansion, and hence the name. Mr. Iddings points out close relation between the lithophysæ and the associated radiate spherulites, and doubts the vesicular mode of origin. The following is a possible explanation. If the cavity made by vesiculation became at first filled with an aqueo-igneous or jelly-like solution of the rock, the concentric shells may be a *centripetal* result, due to progress in cooling and loss of moisture from the outside. The process would first produce a deposition of crystals over the confines or wall of the cavity, and thus deprive the inside solution, adjoining this wall, of part of its mineral material; then, the succession of shells might form inside in a manner analogous to that given for concentric rings on page 130. Johnston Lavis regards lithophysæ as concretions growing radiately outward, and refers the spaces between the concentric shells to the liberation of vapor from moisture contained in the glass, this liberation taking place as the glass becomes changed to feldspar in solidification. Whitman Cross, who adopts the vesiculation theory, found beautiful but minute crystals of topaz and garnets in lithophysæ of the rhyolyte, of Nathrop, Col. (1884, 1886). Iddings and S. L. Penfield have described (1885) yellow crystals of fayalite from those of the black obsidian at Yellowstone Park. Utah rhyolyte also has afforded topazes.

Veins made by the aid of deep-seated Igneous Ejections.

For the formation of veins through the heat of igneous ejections, the earth's crustal heat has been the agent, aided possibly by heat from local crushing and friction. The fissures at great depths may have had the heat required, without addition from mountain-making movements. The general steps of progress — that is, the methods of transfer and formation of mineral material by heated vapors — are the same that have been described.

Fissures descending to regions of fusion are necessarily deep fissures, and for this reason the veins that have been made in connection with them include the richest of ore-bearing veins. The deep fissures let out liquid rock. But they were the means of opening a way for whatever vapors or solutions the melted rock through its heat, supplemented by the earth's crustal heat, might gather from the rocks, or their crevices, along the way up, or from the depths below. The copper veins of the Lake Superior region are an example; and so are also the richest and the chief part of all the silver, lead, and copper veins of western America, from Fuegia on the south, along the western slope of the Andes to Central America, Mexico, Nevada, Arizona, Colorado, Utah, and Wyoming.

The results differ not only according to the kinds of rocks *below*, but also the kinds along *the upper part of the fissure:* whether they are (1) *of difficult corrosion*, or (2) *of easy corrosion like limestones.*