if it takes place in a bed of calcite after its consolidation, would cause fractures, or make the rock porous and thus capable of holding much mineral oil (page 134), as in the Findlay oil region of Ohio.

Concretionary Consolidation.

The methods of consolidation that have been mentioned in the preceding pages are (1) by calcareous waters; (2) by ferruginous waters; (3) by siliceous solutions. Limestones, and rocks only partly calcareous, have been consolidated almost solely by the first of these methods. The second method is feeble in its results, and occurs in gravel deposits. Rocks that are colored by iron oxide, and *appear* to have a ferruginous cement, have usually been solidified by the third method.

Consolidation is often commenced or attended with concretionary consolidation, or accretion around centers throughout the mass, as illustrated on page 97. Isolated concretions often form in deposits of earth, clay, or other material, when they contain disseminated calcareous grains (derived from ground shells, or any other source). Percolating waters, aided by the carbonic or humus acids which such waters are likely to contain, dissolve the grains and deposit the material, in a drying time, around grains, or any small object, as a nucleus. In like manner, concretions of limonite and iron carbonate are made, if any ferruginous grains or any decomposable iron-bearing mineral is present. Occasionally other materials make disseminated concretions.

The form of the concretion is not owing to any central control of the molecular deposition, but to the regular progress of the superficial accretion, and to the rate of supply of the mineral solution in vertical and horizontal directions, together with the shapes of the nuclei.

The growth of the concentric forms above described is *peripheral*. There is also *centripetal* consolidation, or from the exterior inward. It commences outside, owing to outside evaporation and the consequent deposition of the concreting agent. The agent is commonly ferruginous. This process of outside drying is exemplified by the drying away of a spot of milk two inches or so in diameter on a slab of stone (as observed by the author): the evaporation goes on at the outer margin, and makes there the first ring, capillary attraction inside of this ring contributing material toward it; this outer ring completed, another ring begins and forms at the new outer margin of the milk-spot; and so ring after ring forms, until the spot of milk is reduced to a series of whitish rings. On the same principle, shell after shell may form in a sand-bed penetrated with a ferruginous solution, because drying is gradual from the outside; or there may be a single outer shell, with loose sand inside; or a central ball in the loose sand. The center of the concretion may originally have been a piece of the decomposing iron-bearing mineral which afforded the ferruginous solution.

The concentric rings of ferruginous coloration in Fig. 141 had probably