

bottom is the ferruginous sandstone of Shumard. The sandstone is regarded by C. R. Keyes as having been made while a final retreat of the shore line was in progress. He names it the "Aux Vases" sandstone.

The section of the Subcarboniferous at Burlington, Iowa, includes: (1) of the Kinderhook, 50'+ of clay shale; (2) 20'-30', soft shaly sandstone; (3) gray impure limestone, often oölitic below, 9'-13'; (4) fine sandstone, 6'; (5) gray oölyte, 4'; (6) buff limestone, 5', of the Lower Burlington; (7) brown and gray encrinal limestone, 27'; (8) buff calcareous and siliceous shales, with thin limestone layers and chert, 23', of the Upper Burlington; (9) gray encrinal limestone, somewhat cherty, 30'; (10) impure limestone with chert nodules and seams, 20' (Keyes). The Keokuk exposures include about 100' of Keokuk below and above Warsaw and St. Louis beds.

Keyes has further reported (Dec., 1892) the discovery, in northeastern Missouri, of a bed of the Kinderhook limestone, containing its typical fossils, and these chiefly Mollusks, intercalated in the overlying Burlington group, where typical in its fauna, and this chiefly crinoidal, and without a change in lithological characters or the purity of the limestone beds. It shows, as Keyes observes, that the Kinderhook and Burlington stages were not wholly successive as regards time; that after the Burlington group had made progress, the Kinderhook species still existed, for a while at least, outside of their former limits, but ready to return when the conditions favored. In Missouri, the whole thickness of the Subcarboniferous limestone is 1150'.

In Indiana, the "Knobstone," below the Keokuk, has a thickness in some places of 500', the Keokuk of 100', the St. Louis of 330', and the Chester of 75'; the latter consists of sandstones alternating with limestones. In Lawrence County, an irregular bed, or series of pockets, of porcelain clay, ranging to 6' in thickness, lies at the top of the Chester limestone, over a bed of iron ore. About a third is of pure white color. It has been called *indianaite*; with it occurs the mineral allophane.

In Michigan, the Subcarboniferous consists of four groups of strata, according to A. Winchell: (1) or lowest, 173' of grit and sandstone, called the *Marshall Group*; (2) 123' of shale and sandstone, the *Napoleon Group*; (3) 184' of shale and marlyte, with some limestone and gypsum, the *Michigan Salt-group*; (4) the Carboniferous limestone, 66' thick. This limestone is well exposed at Grand Rapids. The Marshall group is made the equivalent, in part, of the Kinderhook; and the limestone, at the top, the equivalent of the Chester and St. Louis groups.

In Ohio, the Subcarboniferous beds comprise the *Waverly* group.

In northwestern Pennsylvania, the Subcarboniferous is in the main equivalent to the Waverly. I. C. White has recognized three divisions: (1) the Oil-creek group, the equivalent, it is believed, of the Pocono; (2) Meadville group; and (3) Shenango group. In Warren County, the Panama conglomerate is more than 200' below the top of the Chemung, and may be recognized by abundant remains of *Ptychopteria*. The Waverly consists of shaly sandstones in its lower third, followed by a conglomerate (= Sub-Olean?) above which are thin-bedded buff sandstones.

In West Virginia, the Lower Subcarboniferous occurs along the middle portion of the main Alleghany Mountains, from the Potomac southward. In Greenbrier County, near the White Sulphur Springs, it includes a stratum of limestone 822' thick, with 1260' of shales and sandstone. The limestone to the north, in Monongalia County, was found by Meek, through its fossils, to be the probable equivalent of the Chester group.

In middle Tennessee, according to Safford, the *Siliceous group* consists, commencing below, of (1) the Protean beds, cherty and argillaceous, with some limestone, 250' to 300', and (2) the Lithostrotion or Coral beds, an impure cherty limestone, the equivalent of the St. Louis limestone, about 250' thick. The Upper member is limestone, 400' thick on the northern borders of the state, and 720' on the southern. These two divisions occur also in eastern Kentucky. The Upper member also extends into the northeast corner of Mississippi, where it is overlaid by Cretaceous beds (Hilgard). At Huntsville, Ala.,