

primary slate, and red sandstone. Partial layers of lignite and pieces of wood are found in these beds.

At some localities on the margin of the basin quartzose grits are found; and, where these rest on granite, they are sometimes formed of separate crystals of quartz, mica, and felspar, derived from the disintegrated granite, the crystals having been subsequently bound together by a siliceous cement. In these cases the granite seems regenerated in a new and more solid form; and so gradual a passage takes place between the rock of crystalline and that of mechanical origin, that we can scarcely distinguish where one ends and the other begins.

In the hills called the Puy de Jussat and La Roche, we have the advantage of seeing a section continuously exposed for about 700 feet in thickness. At the bottom are foliated marls, white and green, about 400 feet thick; and above, resting on the marls, are the quartzose grits, cemented by calcareous matter, which is sometimes so abundant as to form imbedded nodules. These sometimes constitute spheroidal concretions 6 feet in diameter, and pass into beds of solid limestone, resembling the Italian travertins, or the deposits of mineral springs.

1. *b. Red marl and sandstone.*—But the most remarkable of the arenaceous groups is one of red sandstone and red marl, which are identical in all their mineral characters with the secondary *New Red sandstone* and marl of England. In these secondary rocks the red ground is sometimes variegated with light greenish spots, and the same may be seen in the tertiary formation of freshwater origin at Coudes, on the Allier. The marls are sometimes of a purplish-red color, as at Champheix, and are accompanied by a reddish limestone, like the well-known “cornstone,” which is associated with the Old Red sandstone of English geologists. The red sandstone and marl of Auvergne have evidently been derived from the degradation of gneiss and mica-schist, which are seen *in situ* on the adjoining hills, decomposing into a soil very similar to the tertiary red sand and marl. We also find pebbles of gneiss, mica-schist, and quartz in the coarser sandstones of this group, clearly pointing to the parent rocks from which the sand and marl are derived. The red beds, although destitute themselves of organic remains, pass upwards into strata containing tertiary fossils, and are certainly an integral part of the lacustrine formation. From this example the student will learn how small is the value of mineral character alone, as a test of the relative age of rocks.

2. *Green and white foliated marls.*—The same primary rocks of Auvergne, which, by the partial degradation of their harder parts, gave rise to the quartzose grits and conglomerates before mentioned, would, by the reduction of the same materials into powder, and by the decomposition of their felspar, mica, and hornblende, produce aluminous clay, and, if a sufficient quantity of carbonate of lime was present, calcareous marl. This fine sediment would naturally be carried out to a greater distance from the shore, as are the various finer marls now deposited in Lake Superior. And as, in the American lake, shingle and sand are annually