

§ 116. The conclusions of Dieulefait, as to the sedimentary character of the serpentines of Corsica, have already been mentioned (§ 71). He rejects the plutonic hypothesis of the origin of serpentines for the following reasons: The frequent alternation of very thin beds of serpentine with others of schists and of limestone equally thin; the changes in the constitution and composition of the serpentinic layers; these, being in one place pure serpentine, become gradually mingled with carbonate of lime, which at length constitutes a large proportion of the rock, and also forms lenticular masses in the midst of the calcareous serpentines. To all these, which are common to the serpentines of North America, we may add, as noted elsewhere, the frequent occurrence of grains, nodules, layers or lenticular masses of serpentine in beds of crystalline limestone. Dieulefait notes, moreover, the absence of any signs of igneous action at the contact between the serpentines and the underlying schists. He next adverts to the hydroplutonic hypothesis, and pertinently asks on what grounds we are authorized to suppose the ejection of muds of magnesian silicate from the earth's interior.

§ 116. His own conclusion is that while these serpentines are sedimentary rocks in the most complete acceptance of the term, the mud or sediment which gave rise to them was not ejected from below, but was formed in estuaries of the sea, by reactions between the silicious matters derived from the decay of pre-existing rocks and the magnesian salts of the sea-water; in which connection he insists upon the frequent metalliferous impregnations of the serpentines, as derived in like manner from the older rocks. This view of Dieulefait's, set forth in 1880,* is, as Lotti remarks, no other than "the hypothesis enunciated by Sterry Hunt," twenty years earlier. Lotti, for his part, while still reserving himself on the question of the supposed tertiary serpentines of Italy, adds, after his own studies of those of Corsica: "In any case, it is impossible, as Dieulefait has said, to regard the phenomena offered by these ancient serpentines as due to eruptions either of igneous or hydroplutonic magmas. The serpentine has either been deposited as such, as maintained by Sterry Hunt, and by Dieulefait, or is a sedimentary rock subsequently altered." † We shall notice later on the views of Stapf on this subject.

§ 117. The masses of rock known as serpentine are far from homogeneous in composition. Apart from the admixtures of carbonate of lime, dolomite and magnesian carbonate, which often enter into their composition, they occasionally include besides the hydrated silicate, serpentine, the anhydrous species, olivine and enstatite or bronzite, and more rarely the hydrous species, talc; silicates differing widely in density, in chemical stability, and in the oxygen-ratios between the silica and the fixed bases; that for olivine being 1:1, for enstatite 2:1, for talc approximately 3:1, and for serpentine 4:3. These differences, in the hypothesis of the aqueous origin of serpentine, may well depend upon variations in the composition of the generating soluble silicates, and upon the balance of affinities between silicic and carbonic acids in the watery menstruum, rather than upon the subsequent transformation of one magnesian silicate to another by addition or elimination of silica or magnesia. The association, in the same mass, of anhydrous olivine with serpentine is generally regarded as evidence of the change of olivine into serpentine; but, while admitting the conversion, under certain conditions, of both enstatite and olivine into

* Comptes Rendus de l'Acad. des Sciences, xci, 1000.

† Lotti, Appunti Geologici sulla Corsica; Boll. R. Comitato Geologico, anno 1883.