observations at this point served to strengthen my conviction that the ophiolite of Monteferrato is also but a small protruding mass of the same series.

I was enabled subsequently, as already noticed, (§ 54) to examine with Signor Quintino Sella a portion of the ophiolitic series of admited eozoic age, as seen in the Biellese, in the province of Novara, and to confirm the judgments of Gastaldi, Cossa, Bonney and others as to the apparent identity of these ancient ophiolites with those found in Eastern Liguria.

§ 107. We have already described, in a former part of this paper, the mass of eozoic serpentine which, in Staten Island, New York, rises from out of the horizontal or gently inclined cretaceous and triassic strata that have been deposited around its base. If now we conceive this region to be subjected to such movements as those which, along the eozoic belt a little further sonth, have compressed the Primal and Auroral strata against the northwest base of the South Monntain, and given them a southeast dip, we should have a phenomenon not unlike that presented by Monteferrato ; that is to say, a lenticular mass of ancient serpentine rising along the outcrop of southeastward-dipping mesozoic rocks, and differing only by the accidental circumstance that these, on the two sides, belong to different mesozoic horizons (22, 23.)

## VI .- THE GENESIS OF SERPENTINES.

§ 108. As regards the origin of the serpentine-rocks, we have already noticed briefly some of the hypotheses which have been proposed. Although those which suppose it to be derived by metasomatic changes from aluminous or calcareous rocks, either exotic or indigenous, such as gramites, diabases, gramulites or limestones, may be considered as now nearly obsolete, it may not be amiss to recall the fact that they represent two distinct and opposite schools, which agree only in admitting an unlimited alteration or change of substance in previously-formed rocks, through aqueous agencies.

The first view, which may be described as a general metasomatic hypothesis adapted to plutchism, is that which derives not only serpentine but limestone from ordinary types of feldspathic rocks, such as granites, granulites, gneisses, diabases, and diorites. The integral conversion of all of these into scrpentine by the complete elimination of the alumina, alkalies and lime, and the replacement of these bases by magnesia, has been maintained by many writers of repute belonging to the school in question. **\*** 

§ 109. Others still have supposed that the same rocks might be changed into limestone, by a complete removal of the silica, also, and the substitution of carbonate of lime. This extreme view has found its boldest and most consistent advocates in Messrs. King and Rowney, who not only assert this origin for the limestone-masses found in the gneisses of Sweden and the Hebrides, but imagine that the bedded crystalline limestones, many hu No ha gno ima vie dol to a of a so 1

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<sup>\*</sup> Bonney, who maintains the origin of serpentines by the hydration of emptye divine-rocks, has, in his paper already cited, given many reasons for rejecting the notion of the formation of serpentines by metasomatosis from the basic fedepathic rocks so often associated therewith. The observed relations of the two are, in his opinion, wholly opposed to this view, and he insists upon the difficulty of conceiving that such a process of change should be limited to certain parts of a great mass, while leaving adjacent portions unaltered. From their distinctness, he is even led to the conclusion that the serpentines and their accompanying emphotides and diorites belong to successive periods of eruption.