

referred to the Eocene period, and it follows that those vast movements which have raised fossiliferous rocks from the level of the sea to the height of more than 10,000 feet above its level have taken place since the commencement of the tertiary epoch. Here, therefore, if anywhere, we might expect to find hypogene formations of Eocene date breaking out in the central axis or most disturbed region of the loftiest chain in Europe. Accordingly, in the Swiss Alps, even the *flysch*, or upper portion of the nummulitic series, has been occasionally invaded by plutonic rocks, and converted into crystalline schists of the hypogene class. There can be little doubt that even the talcose granite or gneiss of Mont Blanc itself has been in a fused or pasty state since the *flysch* was deposited at the bottom of the sea; and the question as to its age is not so much whether it be a secondary or tertiary granite, or gneiss, as whether it should be assigned to the Eocene or Miocene epoch.

Great upheaving movements have been experienced in the region of the Andes, during the Post-Pliocene period. In some part, therefore, of this chain, we may expect to discover tertiary plutonic rocks laid open to view. What we already know of the structure of the Chilian Andes seems to realize this expectation. In a transverse section, examined by Mr. Darwin, between Valparaiso and Mendoza, the Cordillera was found to consist of two separate and parallel chains, formed of sedimentary rocks of different ages, the strata in both resting on plutonic rocks, by which they have been altered. In the western or oldest range, called the Peuquenes, are black calcareous clay-slates, rising to the height of nearly 14,000 feet above the sea, in which are shells of the genera *Gryphæa*, *Turritella*, *Terebratula*, and *Ammonite*. These rocks are supposed to be of the age of the central parts of the secondary series of Europe. They are penetrated and altered by dikes and mountain masses of a plutonic rock, which has the texture of ordinary granite, but rarely contains quartz, being a compound of albite and hornblende.

The second or eastern chain consists chiefly of sandstones and conglomerates, of vast thickness, the materials of which are derived from the ruins of the western chain. The pebbles of the conglomerates are, for the most part, rounded fragments of the fossiliferous slates before mentioned. The resemblance of the whole series to certain tertiary deposits on the shores of the Pacific, not only in mineral character, but in the imbedded lignite and silicified woods, leads to the conjecture that they also are tertiary. Yet these strata are not only associated with trap rocks and volcanic tuffs, but are also altered by a granite consisting of quartz, felspar, and talc. They are traversed, moreover, by dikes of the same granite, and by numerous veins of iron, copper, arsenic, silver, and gold; all of which can be traced to the underlying granite.\* We have, therefore, strong ground to presume that the plutonic rock, here exposed on a large scale in the Chilian Andes, is of later date than certain tertiary formations.

\* Darwin, pp. 390, 406; second edition, p. 319.