

was thrown into the air, when the sea retired so far that a number of old anchors and brass guns became visible ; but it soon returned with great violence, carrying off all the houses of the convicts. A volcano also burst forth at the point where the sea was first agitated. The brig *Glanmalin* was in the latitude of Talcahuano, and about 100 miles to the westward of it, at the time of the earthquake, when the crew felt a shock as if the vessel had struck upon a rock.

Mr. Alison also mentions the existence near Valparaiso of the recent marine shells 1400 feet above the level of the sea, and of recent marine shells being dug near Conuco for the purpose of making lime. In the bay of Valparaiso, he says, a rock which in 1817 could be passed over in a boat, is now dry, except at spring tides.

“Geological notes made during a survey of the East and West Coasts of South America, in the years 1832, 1833, 1834, and 1835, with an account of a transverse section of the Cordilleras of the Andes between Valparaiso and Mendoza ;” by F. Darwin, Esq., of St. John’s College, Cambridge ; communicated by Prof. Sedgwick, were afterwards read.

Prof. Sedgwick began by observing that the notes were extracted from a series of letters (addressed to Professor Henslow), containing a very great mass of information connected with almost every branch of natural history ; and that he had selected for the occasion those remarks only which he thought more especially interesting to the Geological Society.

Mr. Darwin’s first letter contained some account of St. Jago (one of the Cape Verde Islands), which he visited early in 1832 ; and he considered that he had good evidence of its recent elevation, as he found on its surface beds of *recent shells and corals considerably above the actual level of the sea.*

In various portions of the notes he shortly described the vast extent of primary rocks along the shores of Patagonia, the existence of highly crystalline schists in the Falkland Islands, alternating with micaceous slaty sandstone, exhibiting the casts of bivalves (*Terebratulæ*), and encrinital stems, and a rock near Cape Famine containing some sort of Ammonites. On the line of the western coast of South America, from Chiloe to Tres Montes, he found a widely extended formation of mica-slate, traversed and burst through by a grand transverse chain of granite, and penetrated by innumerable dykes of great complexity of mineral structure.

From the position of the tertiary deposits, which exist on both sides of the Southern Andes, he concludes that the primary chain must have had a great elevation anterior to the tertiary period : and he thinks that a rough approximation may be made to the date of the commencement of the volcanic period, by observing the first association of streams of lava, with certain tertiary groups on the Patagonian side.

A considerable portion of the extracts was devoted to a description of the great tertiary groups on both sides of the chain of the Andes. Some of the details respecting the eastern side were derived from

observations made on the Rio Negro, and on the line of a transverse section from Rio Santa Cruz to the base of the Cordilleras. These exhibit the structure of what Mr. Darwin calls the great southern tertiary formations of Patagonia.

The lowest of these formations appears to be of great extent and thickness, and in one instance was found to contain a bed of ancient lava, which seemed to mark the commencement of the eruption from the craters of the great chain of the Andes. It is characterized by a great oyster, and by other shells and corals, some of which belong to species now living on the neighbouring coasts. Over it is a deposit which Mr. Darwin describes as chiefly composed of rolled porphyry pebbles, which he had himself traced for more than 700 miles. Overlying all the rest, and at a greater elevation above the level of the sea, were beds of recent shells, identical in species with the littoral shells of the neighbouring shores. Among these, he more especially notices a widely extended bed of Muscles, which still retain their blue colour, and emit an animal smell when thrown in the fire. From these facts, he thinks the tertiary deposits of Patagonia may be separated into distinct periods, somewhat similar to those derived by Mr. Lyell from a comparison of the newer deposits of Europe: and in making the transverse section, he thought that he saw traces in the valley of Santa Cruz of an ancient channel, which must have traversed a great portion of the south part of the continent before the elevation of the tertiary groups.

In noticing the groups on the western side of the Andes, he describes an old tertiary deposit (eocene or miocene?) south of Rio Mayo, and abundance of recent shells 1300 feet above the same level. He also describes the association of lava with beds containing recent shells in the island of Chiloe. Among other facts, he notices the appearance of pitchstone among the beds of lava, and the occurrence of a forest growing over a bed of recent oysters 350 feet above the actual level of the sea. All these *recent shells* are the *littoral shells* of the neighbouring shores; from which he concludes that the elevation must have been gradual, or by successive hitches, similar to those by which the coast of Chili and, more recently, the coast of Chiloe have been unquestionably elevated.

In addition to these very remarkable notices, Mr. Darwin mentions other *tertiary deposits* at Chiloe and Concepcion, composed of beds of sandstone and carbonaceous shale without shells, but containing many silicified trunks of dicotyledonous trees, and alternating with beds of lava.

During the progress of the four years' survey (in addition to the traverse above mentioned), Mr. Darwin crossed from Rio Negro to Buenos Ayres by Sierra de la Ventana, a chain almost unknown to geographers. He found two immense collections of large bones (of Mastodons) near Santa Fé, but in a condition not to admit of their being removed. He also found bones of a species of Mastodon at Fort St. Julian, S. lat. 50°, and more than 600 miles from the former localities. In one instance the bones appear to have been associated with marine shells. In the gravel of Patagonia he also found many

bones of the *Megatherium* and of five or six other species of quadrupeds, among which he has detected the bones of a species of *Agouti*. He also met with several examples of the polygonal plates of the *Megatherium*, which at first induced him to regard the animal as a gigantic Armadillo. A very large collection of these fossils has been sent to England, and are in the custody of Professor Henslow till Mr. Darwin's return.

Professor Sedgwick concluded by reading extracts from two letters describing a section transverse to the Andes, extending from Valparaiso to Mendoza. The Cordillera is here composed of two separate and parallel chains. The western chain is composed of sedimentary rocks, distinctly stratified, and resting on granite. The sedimentary rocks (composed of red sandstone, conglomerate, gypsum, &c.) are violently contorted, and dislocated along parallel north and south lines, and as they approach the granite, become so crystalline that they cannot be distinguished from the porphyritic dykes by which they are traversed.

Following the line of section, Mr. Darwin found, at the Pass of Puquenas, elevated 12,000 feet above the sea, that the red sandstone was replaced by a black rock, like clay slate and pale limestone, containing numerous impressions of shells; a *Gryphæa?* is the most abundant; but he also found *Ostrea*, *Turritella*, *Ammonites*, and a small bivalve (*Terebratula?*).

At the Portillo Pass is a conglomerate resting on micaceous sandstone, and traversed by great veins of granite. But at the Uspellata Pass (in the eastern chain), he found highly crystalline and felspathic rocks, regularly bedded, and resting on granite, the peaks of which reach the elevation of 14,000 feet. A wider examination of the overlying groups convinced him, not only that they were more recent than the western chain (being partly made up of its *debris*), but that they were of the same age with certain tertiary formations above noticed. For example, he discovered along the line of section, in the eastern chain, beds of sandstone, with silicified trunks of dicotyledonous trees, and beds of carbonaceous shale, resting on an ancient stream of lava, and surmounted by black augitic lava, 2000 feet thick; over all these were five grand alternations of black volcanic rocks and sedimentary deposits, amounting to several thousand feet in thickness. This series, in its structure and fossils, is considered as identical with certain tertiary deposits of Patagonia, Chiloe and Concepcion; for it loses its mineral character only where it approaches the granite; in which case it is shattered, contorted, and traversed by great veins rising out of the central mass; and its several beds, as well as the fossils they contain, become entirely crystalline. Mr. Darwin further states, that this singular overlying group contains very numerous veins of copper, silver, arsenic, and gold, which may be traced down to the granite; and as a general conclusion, he expresses his conviction that the granite (now rising into central peaks 14,000 feet in elevation), must have been in a fluid state since the tertiary group, above described, was deposited.