

carbonic acid, vegetation must have attained a degree of vital activity, and derived the superabundance of nutrition necessary to furnish materials for the formation of the beds of lignite (coal), constituting the inexhaustible means on which are based the physical power and prosperity of nations. Such masses are distributed in basins over certain parts of Europe, occurring in large quantities in the British Islands, in Belgium, in France, in the provinces of the Lower Rhine, and in Upper Silesia. At the same primitive period of universal volcanic activity, those enormous quantities of carbon must also have escaped from the earth which are contained in limestone rocks, and which, if separated from oxygen and reduced to a solid form, would constitute about the eighth part of the absolute bulk of these mountain masses.\* That portion of the carbon which was not taken up by alkaline earths, but remained mixed with the atmosphere, as carbonic acid, was gradually consumed by the vegetation of the earlier stages of the world, so that the atmosphere, after being purified by the processes of vegetable life, only retained the small quantity which it now possesses, and which is not injurious to the present organization of animal life. Abundant eruptions of sulphurous vapor have occasioned the destruction of the species of mollusca and fish which inhabited the inland waters of the earlier world, and have given rise to the formation of the contorted beds of gypsum, which have doubtless been frequently affected by shocks of earthquakes.

Gaseous and liquid fluids, mud, and molten earths, ejected from the craters of volcanoes, which are themselves only a kind of "*intermittent springs*," rise from the earth under precisely analogous physical relations.† All these substances owe their temperature and their chemical character to the place of their origin. The *mean* temperature of aqueous springs is less than that of the air at the point whence they emerge, if the water flow from a height; but their heat increases with the depth of the strata with which they are in contact at their origin. We have already spoken of the numerical law regulating this increase. The blending of waters that have come from the height of a mountain with those that have sprung from the depths of the earth, render it difficult to determine the position of the *isogeothermal lines*‡ (lines of equal internal

\* Bischof, op. cit., s. 324, Anm. 2.

† Humboldt, *Asie Centrale*, t. i., p. 43.

‡ On the theory of isogeothermal (chthonisothermal) lines, consult the ingenious labors of Kupffer, in Pogg., *Annalen*, bd xv., s. 184, and bd.