

heat may have at different times and in different degrees co-operated in the production of hypogene changes—the original internal heat of the globe, the heat arising from chemical changes within the crust or beneath it, and the heat due to the transformation of mechanical energy in the crumpling, fracturing, and crushing of the rocks of the crust.

Rise of temperature by depression.—As stated above (p. 500), the mere recession of rocks from the surface owing to superposition of newer deposits upon them will cause the isotherms, or lines of equal subterranean temperature, to rise—in other words, will raise the temperature of the masses so withdrawn. This can take place, however, to but a limited extent, unless combined with such depression of the crust as to admit of thick sedimentary formations. From the rate of increment of temperature downward it is obvious that, at no great depth, the rocks must be at the temperature of boiling water, and that further down, but still at a distance which, relatively to the earth's radius, is small, they may reach and exceed the temperatures at which they would fuse at the surface. Mere descent to a great depth, however, will not necessarily result in any marked lithological change, as has been shown in the cases of the Nova Scotian and South Welsh coal-fields, where sandstones, shales, clays, and coal-seams can be proved to have been once depressed 14,000 to 17,000 feet below the sea-level, under an overlying mass of rock, and yet to have sustained no more serious alteration than the partial conversion of the coal into anthracite. They have been kept for a long period exposed to a temperature of at least 212° Fahr. Such a temperature would have been sufficient to set some degree of internal change in progress,