

Hot Springs, Geysers.—The thermal waters of volcanic districts usually contain a marked percentage of dissolved mineral matter, notably silica, with sulphates, carbonates, chlorides, bromides, and other combinations. Perhaps the most detailed examination yet made of any such group of springs is the series of analyses performed by the Geological Survey of the United States on the waters of forty-three hot springs in the Yellowstone National Park. The temperatures of these waters ranged up to 93° C., and the total amount of dissolved mineral matter up to 2·8733 grammes in every kilogramme. The silica sometimes amounted to 0·6070 gramme, the sulphuric acid to 1·9330, the carbonic acid to 1·2490, the chlorine to 1·0442, the calcium to 0·3076, the magnesium to 0·0797, the potassium to 0·1603, the sodium to 0·4407, and there were minute quantities of numerous other constituents.⁹⁰

Oil Springs.—Petroleum is sometimes brought up in drops floating in spring-water (St. Catherine's, near Edinburgh). In many countries it comes up by itself or mingled with inflammable gases. Reference has already been made (pp. 254, 401) to the abundance of this product in North America. In western Pennsylvania, some oil-wells have yielded as much as 2000 to 3000 barrels of oil per day. That the oil, which is specially confined to particular layers of rock in the Carboniferous and Devonian systems, arises from the alteration of organic substances imbedded in the rocks of the crust, appears to be probable, but no satisfactory explanation has been given of the nature and distribution of the organisms which yielded the oil.⁹¹

Results of the Chemical Action of Underground Water.—Three remarkable results of the chemical operations of underground water are: 1st, The internal composition and minute structure of rocks are altered. 2d, Enormous quantities of mineral matter are carried up to the surface, where they are partly deposited in visible form, and partly conveyed by brooks and rivers to the sea. 3d, As a consequence of this transport, subterranean

⁹⁰ F. A. Gooch and J. E. Whitfield, Bull. U. S. Geol. Survey, No. 47, 1888.

⁹¹ See the authorities cited ante, p. 402.