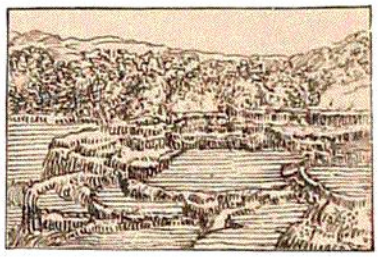
Thermal Waters, Geysers.

The subject of thermal waters constitutes an important part of Chemical Geology, and is here only briefly treated. Hot springs are (1) common in volcanic regions, and (2) occur also along the courses of non-volcanic eruptions. They are occasionally met with, away from all igneous eruptions, (3) on the lines of faults or the axes of flexures, and sometimes (4) where there are none of these conditions. The heat in the first two cases is generally of volcanic, or deep subterranean, origin; but in the others it may come from the oxidation of sulphides, or from other chemical action.

When the temperature is high, the waters may be either approximately pure, or strong mineral solutions. The waters often hold silica in solution, whose deposition, over the region around, makes irregular accumulations of a coarse opal, or rarely of quartz, and forms low cones or rims about basins. Occasionally, the waters are calcareous, instead of siliceous, and make calcareous basins or cones. The sources of such solutions, and some of the effects resulting from them, are explained on pages 131, 135, and beyond.

278.



Geyserite Terraces, from the "Pink Terrace" of New Zealand.

Geysers. — When a spring or basin of hot water is in nearly constant ebullition, or is alternately boiling and quiet, it is simply a hot spring or basin. But if the water is thrown up at nearly regular intervals, in jets, it is called a geyser. Iceland has long been noted for its geysers, and the theory of geyser action was there first investigated by Bunsen and Des Cloizeaux. It has one great geyser in the vicinity of Hecla, among many hot springs. The geyser sends up a great jet of 100 feet once in about 30 hours, and other smaller ones in the interval. The Icelandic word means a "gusher." New Zealand has its geyser region, about Lake Rotomahana, in the northern island, and had beautiful geyserite terraces until the volcanic eruption of Tarawera in 1886, when mud eruptions buried them.

Far exceeding either of these regions is the geyser area of Yellowstone Park, first described by Messrs. Cook and Folsom in 1870, and by the Hayden expedition in its volumes for 1871, 1872, and 1878, the last containing an extended account by A. C. Peale. The region has since been further studied and described by A. Hague, J. P. Iddings, W. H. Weed, and others. The geysers are situated mainly about the Fire-Hole Fork of the Madison, and near Shoshone Lake at the head of Lake Fork of the Snake. They are exceedingly numerous, and play at all heights up to 200 feet or more; and, besides, there are multitudes of hot springs of various temperatures, the most of them between 160° and 200° F., the boiling-point of the region being 198° to 199° F. There are also "mud-volcanoes" where steam issues through thick mud or muddy waters, producing, at times, ebullition, and occasionally geyser action. The principal locality at the park is four miles