a fuller survey was made under the personal direction of Capt. Howard Stansbury, U. S. A., whose report, "Expedition to the Valley of the Great Salt Lake," issued at Washington in 1853.

The Great Salt Lake is by far the largest body of water existing in the "Great Basin." Its average length is seventy-five miles; and its width, forty miles. The altitude of the lake is near forty-two hundred feet above sea-level, and the region is declared by geologists to be still rising

Even a hasty examination of the Salt Lake Valley will convince the observer that the present lake is but the shrunken remnant of a vastly larger body of water which at one time stretched far beyond the limits of the valley. This former sea was a feature of quaternary times, and has been named Lake Bonneville. It extended beyond the Idaho line on the north, invaded Nevada on the west, and closely approached the Arizona boundary on the south. Of this great body, Utah Lake and Sevier Lake, now existing as distinct occurrences in the regions south, were but comparatively small bays. Numerous water-lines are visible along the mountains adjacent to the Salt Lake, the highest of which is about one thousand feet above the present water surface; and the evidence of wave-action along this ancient shore is abundant.

The history of Lake Bonneville, as recorded on the stony pages of its precipitous shores, and in the hardened sediments of its floor, is more complicated than a mere recital of the shrinking and falling of waters through evaporation and other wasting causes. For most of our knowledge upon this subject we are indebted to the detailed observation and study conducted by the United States government survey corps, and especially to the investigations carried on under the direction of Major J. W. Powell. Referring to the labors of Mr. C. K. Gilbert and his associates in the lake region, Director Powell thus briefly summarizes the history of Lake Bonneville:

"First, the waters were low, occupying, as great Salt Lake now does, only a limited portion of the bottom of the basin. Then they gradually rose and spread, forming an inland sea, nearly equal to Lake Huron in extent, with a maximum depth of one thousand feet. Then the waters fell, and the lake not merely dwindled in size, but absolutely disappeared, leaving a plain even more desolate than the Great Salt Lake Desert of today. Then they again rose, surpassing even their former height, and eventually overflowing the basin at its northern edge, sending a tributary stream to the Columbia River; and, last, there was a second recession, and the waters shrunk away, until now only Great Salt Lake and two smaller lakes remain."

As is clearly understood, the oscillations of the water in a lake possessing no outlet will be far more marked than in an opposite case. In a body of water with an outflow, a tolerable uniform level will be maintained; the irregularities in the supply being compensated for the most part by the varying volume of water flowing away; but the level of a lake completely enclosed will be due to the relation existing between the supply of water and the rate of evaporation. The topography of the ancient shore line of the Great Salt Lake shows, that since the time of the "second recession" of the waters, referred to by Major Powell in the quotation made above, the lake has been unable to find an outlet for its contents, and has consequently reached its present diminutive proportion through loss by evaporation alone. The composition of the water would necessarily vary with the concentration. The analysis most commonly accepted, and which forms, indeed, the basis for current quotations and references, is that made by Dr. Gale, and published in Stansbury's report. Gale found the water to possess a specific gravity of 1.170, and to contain 22.282 per cent by weight of solid matter, as follows: sodium chloride (Na Cl), 20.196 per cent; sodium sulphate ($Na_2 SO_4$), 1.834; magnesium chloride ($Mg Cl_2$), 0.252; calcium chloride ($Ca Cl_2$), a trace.

These figures are used as indicative of the present composition in several of the most recent cyclopædias, such as are used for general reference; and even the revised school text-books in geography quote as above. It should be remembered in accepting such results, however, that the investigation upon which they are based was made on water collected forty years ago; and it is scarcely to be expected that such would represent the composition of the water at the present time. For a number of years preceding 1883 the lake had been steadily rising. The rise was entirely independent of the annual oscillations to which the waters of the lake seem subject under all circumstances. In referring to this fact, Mr. Gilbert writes as follows (see "Lands of the Arid Regions," p. 66)—

"Thus it appears that in recent times the lake has overstepped a bound to which it had long been subject. Previous to the year 1865, and for a period of indefinite duration, it rose and fell with the limited oscillation and with the annual tide, but was never carried beyond a certain limiting line. In that year, or the one following, it passed the line and it has not yet returned. The annual tide and the limited oscillations are continued as before, but the lowest stage of the new *regime* is higher than the highest stage of the old. The mean stage of the new *regime* is seven or eight feet higher than the mean stage of the old. The mean area of the water surface is a sixth part greater under the new *regime* than under the old. The last statement is based on the United States surveys of Capt. Stansbury and Mr. King. The former gathered the material for his map in 1850, when the water was at its lowest stage, and the latter in the spring of 1869, when the water was near its highest stage. The one map shows an area of 1750 and the other of 2166 square miles. from these I estimate the old mean area at 1820 miles and the new at 2125 miles, and the increase at 305 miles, or 17 per cent."

The probable cause of this increased water-supply in the Great Basin would form a most interesting and instructive subject of inquiry, but such would be foreign to the purposes of the present paper; and here it must suffice to say, that two theories have been advanced as offering most probable explanations of the phenomenon; viz., the climatic theory, and the theory of human agencies. In the report already referred to ("Lands of the Arid Regions") the author says, "On the whole, it may be wise to hold the question an open one, whether the water-supply has been increased by a climatic change, or by human agency. So far as we now know, neither theory is inconsistent with the facts, and it is possible that the truth includes both."

During this recent epoch of increasing volume, the lake-water would be naturally expected to show a far lower percentage of solid contents. In "Contributions to the History of Lake Bonneville," published in the "Report of the United States Geological Survey, 1880-81," Gilbert places the total salinity of the water at fifteen per cent—a striking variation from the figures of