

SCIENCE

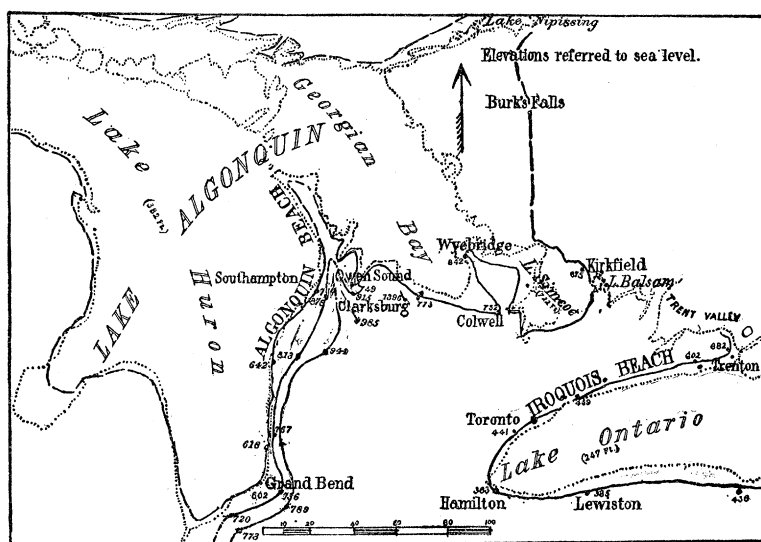
NEW YORK, DECEMBER 1, 1893.

REVIEW OF THE BIRTH OF THE GREAT LAKES AND THEIR DESERTED SHORES.¹

PAGE after page in the history of our Great Lakes has been deciphered by the researches of Dr. J. W. Spencer. This study has involved many of the most important questions in dynamical geology. First there was the long continued high continental elevation, during which the Laurentian valley was excavated by the erosion of the great river, its tributaries and the multitudinous branches. Afterwards, the old topography became disfigured, the hills were swept off and the valleys filled up, and all the other changes of the ice age followed, with the drowning of the lower lands by the encroachments of the sea upon the sinking continent. The lands had given place to the sea; now the sea receded from rising lands. In the olden days, the mountains had been worn down to mere trunks,

salt or fresh is not yet known. Its shores upon both sides of the Superior basin, about Lake Michigan and Lake Huron, on both sides of Erie, in Ontario and New York, are now more or less known, but not the northeastern limits. This is an enormous area for only three or four workers to cover: nearly the whole region by the author under review; New York and Ohio by Mr. G. K. Gilbert; north of Lake Superior by Dr. A. C. Lawson; about Lake Michigan, south of Superior and northeast of Lake Huron by Mr. F. B. Taylor,—this makes our list of workers.

From one strand to another, lower, lower, lower sank the Warren waters, and slowly rose the deserted shores of the great inland sea or lake. But this subsidence of the waters was caused by the rise of the land; not an equal uplift of the continent, but a greater elevation towards the north and east than towards the south and west. The lands about the shrinking lakes were gradually expanding, so as to eventually dismember the Warren water, when it was contracted within the sep-



MAP SHOWING THE EASTERN PART OF ALGONQUIN LAKE.

but with the pleistocene re-elevation which lifted the later shore-lines the old water-levels were deformed and broken. In our issue of June 3rd, 1892, we described the manner in which the lake basins had been formed—just ancient valleys closed by drift and by the warping of the earth's crust in proximity to some of their outlets. Then the history of these fresh-water lakes began. Fragments of their story have now been discovered, and their well preserved but deserted beaches mark the shrinkage of the waters.

About the close of the ice age, one great sheet of water covered most of the Great Lake region, occupying 200,000 square miles or more. This was Warren water, whether

arate basins. At first there were two of these. The greater was Algonquin Lake, covering most of the Superior basin, reaching to near the southern end of the Michigan, to near the southern end of the Huron, and expanding far beyond the eastern margin of Georgian Bay, and extending by a strait northeastward toward the Ontario basin by way of the Nipissing and Ottawa valleys.

The other branch of the dismembered Warren water was an unnamed union, embracing the waters in the Ontario basin and in the Erie basin, to the extent perhaps of a hundred miles from the Niagara River.

The waters at the level of the Algonquin and the lost pre-Erie beach tarried for a long period; but from these levels they gradually sunk, leaving fainter beaches and terraces until a level 300 feet below was reached—the Iroquois beach

Then Niagara River had its birth. At this level, the

¹"Deformation of the Iroquois Beach and Birth of Lake Ontario." Am. Jour. Sc., Vol. XL, 1890.

"Deformation of the Algonquin Beach and Birth of Lake Huron."

"High-Level Shores in the Region of the Great Lakes and their Deformation." Am. Jour. Sc., Vol. XL, 1891.

pause in the terrestrial movement was of long duration. The youthful Niagara drained only the Erie basin, and cascaded over the low Niagara escarpment in a sheet resembling the modern "American Falls."

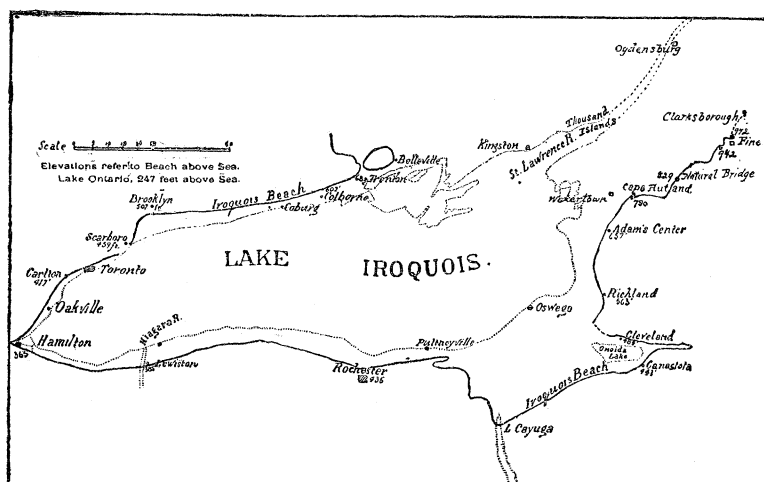
After a long rest, the continental undulations again became active, so that before long the waters in the Ontario basin sank eighty feet below its present level, and withdrew somewhat from the head of the lake, but they extended far down the Laurentian valley.

The Iroquois shore was formed at sea level. Before the Iroquois episode, the terrestrial warpings had set in, but the deformation was relatively slight. The deformation accompanying the epeirogenic movements following the Iroquois days was much more pronounced. About the head of Lake Erie, the beaches are now nearly level, but at the eastern end the deformation is two feet in the mile; east of Georgian Bay it amounts to four feet, and east of Lake Ontario it reaches five, six or even eight feet or more in each mile. In this Adirondack region, it is not unlikely that the old strands have been more or less dislocated by modern faultings such as occur from the Hudson River southward. Up to the present time we do

fragments at a thousand feet or more, the whole rising as a monument of the mutability of the most ancient hills of America.

The story of the lakes is still incomplete, and some of the most important questions are not yet settled. But a dozen years of research upon the old shore-lines, whether beaches, terraces or sea cliffs, has begun to throw some light upon the history of the most distinguished feature of the continent. We now know something of the origin of the basins, the birth, maturity and commencement of the old age of the great lakes. Something more of their age will be known when the history of Niagara Falls is written, but its history could not have been deciphered without the present history of the lakes being known.

—At the beginning of the present year a meeting was held in London to promote a memorial commemorative of the eminent services of the late Sir Richard Owen in the advancement of the sciences of Anatomy, Zoölogy and Palæontology. It was decided that the memorial should consist primarily of a marble statue, which should be offered to the Trustees of the British Museum, to be



MAP SHOWING THE WESTERN PART OF IROQUOIS LAKE.

not know what barriers, if any, closed these inland seas. The lower strands are known to be connected with old marine shore-lines. There may have been some land barriers now unrecognized on account of faulting. Some think that the waters were held in as glacial lakes. Of the eastern region there has been too little exploration for us to know anything about the lakes. But we do know that there were once greater bodies of water where the lakes now exist.

During the Niagara epoch, or throughout the Iroquois epoch, the Nipissing strait became lower, and the Algonquin waters slowly subsided so that they emptied by a river flowing through the Nipissing basin and the Ottawa valley to the Iroquois lake below. But with the rise of land accompanying the subsidence of the Iroquois waters, below their great beach, the Nipissing rim of the Huron basin was raised so high that the Algonquin lake flooded the head of the Michigan basin, and overflowed what is now the outlet (then the head) of the Huron basin, and drained by the Niagara River.

About this time the eastern rim of the Erie basin was raised up, so that the waters backed up to the present head of the lake, and the barrier at the outlet of Lake Ontario was uplifted so as to back water over the lands at the head of the basin to the extent of eighty feet.

To-day the Iroquois beach rises 363 feet above the sea (the lake is 247 feet). At the eastern end the same beach is 730 feet, and still farther, on the flanks of the Adirondack mountains, this old shore line may be seen in

placed in the Hall of the Natural History Museum. A large committee, including the names of many foreign and American men of science, was formed to carry out this project, the Prince of Wales being Chairman. The circular-letter sent out has been very liberally responded to, the subscription list amounting on Nov. 1 to £1,050. The number of contributors, however, is relatively small; and it is hoped that a much larger sum will yet be obtained: for Owen was so many-sided in his work that his memory has a claim upon naturalists of every grade all over the world. With a few notable exceptions, a very small number of American names have as yet appeared among the contributors. They have probably yet to be sent, and we would offer the present suggestion that subscriptions from intending donors should be sent with as little delay as possible to the Treasurer of the Fund, Sir William H. Flower, Natural History Museum, London, S. W.

—T. Y. Crowell & Co. have received word that Professor Ely's "Taxation in American States and Cities," published by them, will soon appear in Japanese, the work having been translated by Dr. Iyenaga, one of his former students, and Mr. Shiozawa. Messrs. Crowell & Co. hope to have Professor Ely's new book on "Socialism" on the market in the coming spring.

—James Pott & Co. announce that they have made arrangements with Prof. Henry Drummond to bring out his new work, "The Evolution of Man," being the Lowell lectures for 1893.