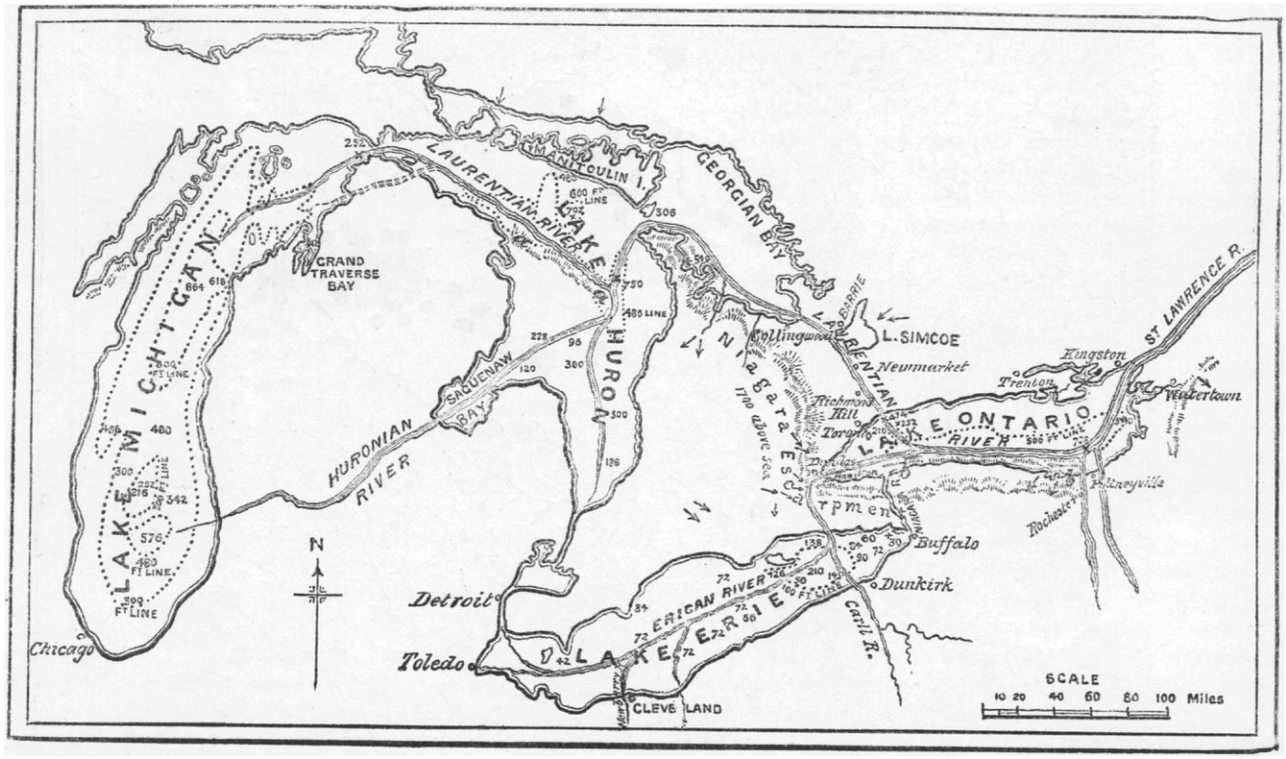
REVIEW OF THE ORIGIN OF THE BASINS OF THE GREAT LAKES.[1]

THE origin of such prominent features as the Great Lakes has a general interest to others as well as to geologists; but even phenomena so commonplace are not always readily explained. The delay in this case has been largely due to the want of information that could only be obtained by numerous borings, accurate levelling, and other data obtainable in regions where few active workers in surface geology have been carrying on their investigations. To these causes may be added a *quasi* satisfaction with favorite theories, to which facts are often moulded.

A score of years ago the mysterious agent which formed the lake basins assumed the guise of glaciers digging out new troughs or fashioning older ones. This plausible hypothesis received consideration, as it was championed by Dr. J. S. Newberry and other eminent men. At that time, and for years after, the extraordinary erosive power of glaciers, in scooping out basins, was an article of faith; but to-day few observers of existing glaciers, or of real extinct ones, have not modified this old creed, as observations do not support it. Apart from the question of the ability of ice to plough out great basins, the direction of the ice scratches about the Great Lakes is oblique, or often at right angles, to the escarpments or rock walls which bound the lakes, or are submerged in them These phenomena were first emphasized in America by Dr. J. W. Spencer, and were sufficient to disprove the hypothesis, even if no other had been available.

The amount of glacial erosion demanded was more than could be accepted by many glacialists. Accordingly Dr. T. C. Chamberlin accounted in part for the lake basins as due to depressions produced by glaciers accumulating to a greater thickness over preglacial valleys, but that with the retreat of the glacier the waters left in the basins still depressed the earth's crust. The demonstration of such a theory could scarcely be hoped for. It not only begged the question, but in doing so it did not consider that the previous removal of the hundreds of feet of rock, in forming the accepted valleys, ought to have permanently produced the opposite effects upon the earth's crust to that of the small quantity of water left in the basins, especially as the basins were sometimes shallow and sometimes channel-like.

These theoretical explanations showed the necessity for



further research, which has been made by Dr. Spencer with results announced from time to time for more than a decade, and may be summarized as follows: The lake basins are simply valleys of erosion, formed during periods of high continental elevation lasting long enough for the excavation of broad, deep valleys. This elevation amounted to 3,000 feet above the present altitude, as shown by the submerged channels upon the coast; and temporarily the continent appears to have reached even 6,000 feet. Some of the lakes now descend to nearly 500 feet below sea-level. The basins of the lakes were just such broad valleys as that of the modern St. Lawrence River north of the Adirondacks or farther seaward. During the later geological times, and reaching down to the modern days, the physical revolutions of the Ice Age converted the old valleys of the St. Lawrence (Lawrentian) River and its tributaries into basins, in which the modern lake waters are held. The phases of the physical revolutions which fashioned the basins were partial obstruction of the old waterways by drift accumulations, a general

[1] "High Continental Elevations Preceding the Pleistocene Period (in America)," with map. Read before Geol. Soc. Am., Aug., 1889. Bull. of Soc., vol. i. Geological Magazine (London), dec. iii., vol. vii., 1890.

"Origin of the Basins of the Great Lakes," with map of the Ancient St. Lawrence River and Tributaries. Quar. Jour. Geol. Soc. (London), vol. xlvi., 1890. Reprinted in American Geologist, vol. iv., 1891.

"Deformation of the Iroquois Beach and Birth of Lake Ontario," with map and illustrations. Am. Jour. Sci., vol. xl., 1890.

"Deformation of the Algonquin Beach and Birth of Lake Huron," with map and illustrations. Am. Jour. Sci., vol. xli., 1891.

"High-Level Shores in the Region of the Great Lakes, and their Deformation," with map. Am. Jour. Sci., vol. xli., 1891.

"Post-Pliocene Continental Subsidence," with map of deserted Short-Lines n the region of the Great Lakes. Read before Geol. Soc. Am., Dec., 1890. Bull. of Soc., vol. ii.

subsidence of the region, and a re-elevation of the land, rising most rapidly towards the north-east, whereby rock barriers, in fact, were formed across the old valleys.

The drainage by the ancient Laurentian River from Lake Michigan is shown by the remains of channels 600 feet deep, in the otherwise shallower north-eastern end of the lake. It crossed the Huron Basin at the foot of a high but now submerged escarpment. It passed into Georgian Bay by a submerged channel between the islands, also now partly buried by drift. The waterway through the shallow Georgian Bay is still left open to a depth of nearly 600 feet below the surface of the water along the edge of the Indian Peninsula. Thence to a point about twenty miles east of Toronto, where the deep river channel is seen near the shore in the shallower portions of Lake Ontario; this ancient valley is deeply buried by drift accumulations. The chain of borings reveal it to a depth of hundreds of feet beneath the rocky floor of the country through which it passes. Through Lake Ontario it is seen at the foot of a submerged escarpment, extending eastward to the point where the recent warpings, recorded in the shore lines, bring up the old channel to near the surface. This warping, recorded in the beaches north of the Adirondacks, is sufficient to account for the rocky barrier between Lake Ontario and the sea, the rise being five or six feet per mile towards the north-east. The warping east of Georgian Bay is 4 feet per mile; at the outlet of Lake Huron, 2 feet; at the eastern end of Lake Erie, 2 feet; and at the head of the lake it diminishes to zero. Across the Peninsula of Michigan an ancient tributary (Huronian River) flowed through a valley now buried by 500 feet of drift, or 350 feet beneath the lake, and through Saginaw Bay to join the Laurentian River. Through Lake Erie, and buried beneath the mud upon its floor, the ancient Erigan River drained the valley, and passed through the buried channel at the head of Lake Ontario. Such was the ancient drainage of the youthful lake basins, which date back only as far as the later Pleistocene period, since changed, owing to drift accumulations obstructing the valleys and to warpings of the earth's crust.

No phenomena of the Pleistocene period rests upon more substantial evidence, which very slowly appeared. The history of every great natural problem presents the same story. The literature of the older writers was not useless, but awakened an interest and gave suggestion, as the data had not been collected. Such, however, is the record of progress that much of every observer's work is only a means, which must be modified before reaching the end.

NOTES AND NEWS.

THE Italian Geographical Society has been authorized by the Municipality of Genoa to convoke a geographical congress to be held in that city, in commemoration of the fourth centenary of the discovery of America. No historical event is more deserving of celebration by geographers throughout the world. It was this idea that inspired the International Geographical Congress, held at Bern in 1891, when it decreed that to the commemoration in Genoa and in Spain, all geographical societies should be invited to send delegates. The congress will take place about the middle of next September. The precise date of its inauguration will he made known as early as possible.

— The Jury of Awards of the International Exposition at Paris, 1889, has awarded the Grand Prize to the United States Department of Agriculture for "Organization Methods and Material for Agricultural Instruction." In the award, Professors Atwater and Taylor are particularly distinguished, Professor Atwater, for his exhibit of maps and photographs on agricultural colleges, and Dr. Taylor, microscopist, for his collection of photographs and drawings of the microscopic analysis of food adulterations, especially butter. Each of these gentlemen is awarded a silver medal.

— Australians have had bitter experience of the mischief which rabbits are capable of doing, and now they seem likely to have trouble of a similar kind from the introduction of foxes. An Australian journal, quoted in the May number of the *Zoologist*, says that foxes have already spread over a wide area, and are most destructive both to lambs and poultry. They attain greater size and strength in Australia than in England, and the mild climate is highly favorable to the increase of their numbers. "It must be very disheartening," says the writer, "to all who have stock of any kind to lose, to find themselves confronted by some new enemy introduced by thoughtless or selfish persons. If some energetic steps are not soon taken, nothing can prevent the spread of foxes over the whole continent."

— The Civil Service Commission will hold examinations on the 28th of June, continuing through the 29th, to fill two vacancies in the position of computer in the Coast and Geodetic Survey at $1,000 a year, and one in the position of draftsman at $900. Arrangements may be made to hold the examinations in some of the large cities outside of Washington if there should be applicants. The subjects of the computer's examination will be orthography, penmanship, letter-writing, algebra, trigonometry, geometry, geodesy, practical astronomy, and differential and integral calculus. The subjects of the drafting examination will be letter-writing, geography, arithmetic, algebra, geometry, descriptive geometry, plane and spherical trigonometry, shades and shadows, and drawing. Application blanks may be had of the Civil Service Commission. Residents of the District of Columbia are ineligible. Applicants will be required to furnish the necessary implements for drawing.

— The new professor in physiological psychology at Yale is announced to be E. C. Scripture of Clark University. He has been chosen by the faculty, but his choice will not be confirmed until the meeting of the corporation. Mr. Scripture is one of the most brilliant disciples of the noted German philosopher, Professor Wundt. He is at present a valued assistant of President Hall of Clark University. Professor Scripture will enter upon his duties at Yale at the opening of the next college year. His selection involves the opening of an entirely new department at Yale, that of scientific physiological investigation in mental philosophy and psychology. This line of work is entirely new in American universities, the department at Yale being the third or fourth to be put into practical operation in this country. A new psychological laboratory will be built for the use of Professor Scripture and his assistants. It will contain all the latest appliances for scientific work. Work upon it will be commenced at once, and it will be ready for occupancy by the first of October.

— At the eighth annual meeting of the Kansas University Science Club held in Snow Hall, on Friday, May 27, 1892, the following papers representing original research were presented: Notes on Magnetic Declination, F. O. Marvin; Constants for the Fauth Alt-azimuth, No. 296, A. O. Ridgeway; Examination of Stramonium Seed, L. E. Sayre; On the influence of Parapeptones on Digestion, L. E. Sayre and H. Day; The Coffee Bean, L. E. Sayre and F. C. Combs; On Parachlormetanitrotoluene, E. C. Franklin; Analysis of a Mineral Water from Nemaha County, Kansas, E. H. S. Bailey and J. F. Noble; Analysis of the Alcaloid of Solanum rostratum, C. E. McClung; On the Affinities of the Phryganidæ and the Lepidoptera, V. L. Kellogg; On the Taxonomic Value of the Scales in Lepidoptera, V. L. Kellogg; A Graphic Method for Angle Blocks in the Howe Truss, A. S. Riffle, Portland, Oregon; Viaduct on the T. A. A. and N. M. R. R. at Ann Arbor, Mich., H. E. Riggs, Chief Engineer; A New Method for Extinguishing Fires in Dwellings, L. I. Blake; On MacCullagh's and Salmon's Methods of Generating Quadratic Surfaces, H. B. Newson; Maximum Moment in an Arch-rib, E. C. Murphy; Kansas Pterodactyls, Part I, S. W. Williston and E. C. Case; Kansas Mosasaurs, Part II, S. W. Williston; The Analysis of some Kansas Building Stones, E. C. Case; The Diseases of Grasses, W. C. Stevens; A Method of Trisecting an Angle, A. L. Candy; Brazilian Diptera, Part II, S. W. Williston.