The History of the Niagara Falls

The Falls of Niagara, Their Evolution and Varying Relations to the Great Lakes;
Characteristics of the Power and the Effects of Its Diversion by J. W. W. Spencer
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de Martino found its effective control limited to a few garrisoned ports and the rest of the country defiant. At Cyrene itself he was treated with suspicion, and strongly advised to make himself scarce; but he came to no harm, his companions being favourably known to the tribes. He saw great possibilities in the country, but an actual state of deplorable neglect and disafforestation. Of places where the Ottoman rule prevails he gives a bad account. But he deprecates Italian political interference, and recommends a policy of peaceful penetration. By the way, he states some curious facts about Egyptian action in this region: the frontier seems singularly indefinite. On a possible future for the port of Tebruk he rightly insists.

The part of his book devoted to Tripoli and Tunisia is of less interest, and very superficial. He uses the little he saw of this latter country chiefly as an ensample to his countrymen. If France can do what she has done in the old territory of Carthage, why not Italy in that of Cyrene? But this is hardly consistent with peaceful penetration!

D. G. H.

AMERICA.

THE HISTORY OF THE NIAGARA FALLS.

J. W. W. Spencer. "The Falls of Niagara, Their Evolution and Varying Relations to the Great Lakes; Characteristics of the Power and the Effects of its Diversion." Geological Survey of Canada. Ottawa, 1907, xxxi. + 490 pp. *Plates and Maps.*

The written history of Niagara dates from the visit of Hennepin in 1678. The position of the falls at that date can be inferred from his description, and the rate at which the falls have been cut backward during the past 230 years can therefore be determined. Niagara, accordingly, is an instructive example of the rate of river erosion, and, as the falls must have come into being at the end of the glacial period, they supply a means of estimating the length in years of post-glacial time, for the locality of Niagara. The first important estimate was that by Lyell, in 1835, who assigned Niagara a part-life of 35,000 years. The date has since been re-calculated several times, by geologists with much fuller data than were available to Lyell. The problem does not admit of simple solution, owing to the complexity of the physical geography of the country and its river system. Lyell explained the whirlpool below the Niagara rapids as due to a former river channel, now filled by soft drifts, which are more easily worn away than the harder rocks of the old river banks. The presence of such an ancient gorge along the present course of the river would have so greatly facilitated the formation of the existing canyon that Lyell's estimate of the time necessary may be greatly reduced.

Modern studies of the geology of the area have continually added to the complexity of the problem, and the Geological Survey of Canada is to be congratulated on the important monograph by Dr. Spencer, in which he summarizes the available evidence, and makes several important additions to the known facts. The new information in this work includes the results of a series of borings, as originally suggested by Prof. H. S. Williams, to determine the cause of the buried river channel exposed at the whirlpool. The second important contribution is the survey of the Niagara river below the falls, by a course of difficult and dangerous soundings. This work has shown the existence, immediately below the falls, of a basin 192 feet deep. Further down-stream, at the cantilever bridge, the channel shallows to only 86 feet, owing to the accumulation of limestone boulders that have fallen into the river from the sides of the gorge. When the falls were at that position the depth of the river channel below them was as deep as it now is further up-stream.

The rate of recession of the falls is now well established. The retreat has been

proved by careful surveys between 1842 and 1905, and the mean retreat during those 63 years has been 4.2 feet per annum, while $7\frac{3}{4}$ acres of the river channel above the falls has been worn away during that period.

Lyell's estimate has been reduced until Dr. G. K. Gilbert allows the falls a past life of only 7000 years, and a future of some 3500 or 5000 years. This prediction is based on the assumed tilting of the area of the great lakes, which would, if continued, divert the drainage from the St. Lawrence into the Mississippi. Dr. Spencer rejects both Gilbert's conclusions. He even exceeds Lyell's estimate, as he assigns the falls a past of 39,000 years, and promises them a long future unless all their water be diverted for the sake of electric power. The factors that add to the antiquity of Niagara include the great increase in the height of the falls and in the volume of the water. At first the Niagara river plunged directly into Lake Ontario, as that lake was then standing at the level of its highest beaches; the falls were only 35 feet high. Moreover, the volume of the river was only 15 per cent. of the present amount, for at that time the drainage of the great lakes was discharged from Lake Huron into the valley of the Ottawa river. Earth-movements closed this outlet, and for a while the great lakes overflowed from Lake Michigan across the divide near Chicago into the Mississippi, and at another time their outlet was from the southern end of Lake Huron into Lake Ontario. Finally, during these complicated changes in the river systems, Lake Huron flooded the valley which is now occupied by Lake St. Clair and the Detroit river, and reversing the direction of the rivers there, overflowed into Lake Erie. The Niagara river thus received all the waters discharged by the great lakes, except Lake Ontario.

The history of the Niagara river is, therefore, unusually complex, but Dr. Spencer has the most engaging faith in the certainty of his estimates. He calculates that the falls were opposite the whirlpool 3000 years ago, and the overflow from Lake Michigan into the Mississippi happened from 2000 to 2500 years since.

Another important geographical problem connected with the Niagara question is the still-continued tilting of the area around the great lakes, which, according to Dr. G. K. Gilbert, is still in progress, and will drain Niagara some 3000 years hence. Dr. Spencer, however, maintains that the area in question is quite stable, and that it has not moved in recent times. The earth-movements in this region were confined to the north-east of Lake Ontario, and the supposed recent changes in the shores of Lake Michigan he attributes to local meteorological causes. Dr. Spencer discusses whether the admitted tilting to the north-east of the great lakes be an isostatic effect due to the retreat of the ice; he, however, rejects this view, and prefers the explanation of the Rev. O. Fisher that the movement was caused by a flow of material in the fluid sub-stratum of the Earth.

The Geological Survey of Canada is to be congratulated on this valuable contribution to an important geographical question, but we regret that such a work should have been made the medium for a series of accusations against one of the most distinguished of American geographers.

GENERAL.

ETHNOGRAPHY.

'The World's Peoples: A popular account of their bodily and mental characters, beliefs, traditions, political and social institutions.' By A. H. Keane, LL.D., F.R.A.I. London: Hutchinson. 1908. 8 x 5, pp. 429. Price 6s.

Dr. Keane's work as an anthropologist is well known and justly valued, and he has done good service to the science in writing this popular account of the peoples of the world, the price of which should put it well within the reach of every one,