Review: The Nile

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articles of a sentimental nature, but the earthquake certainly did not destroy an island lying at a distance of 400 miles, larger than Jersey, and rising 3000 feet above the sea. Possibly the low-lying part of the settlement, not the island itself, was wiped out by the same sea-wave which visited the coasts of the Sandwich islands.

R. D. O.

REVIEWS.

AFRICA.

THE NILE.

Survey Department, Egypt. 'The Physiography of the Nile and its Basin.' By Captain H. G. Lyons, F.R.S. Cairo, 1906. Pp. viii. + 412. *Maps and Diagrams.*

YEAR after year light is being poured into the dark parts of the Sudan, and piece by piece the mysteries of the ancient river, the Nile, are being unfolded to an inquisitive generation. Junker, Schweinfurth, Marchand, Emin, Donaldson-Smith, and others have all taken their share in the work, and although there is still abundant field for the explorer and the sportsman up the courses of unknown Nile tributaries and along undiscovered watersheds, it may be said that the geography of the Nile basin, so far as the main features are concerned, is pretty well known.

In 1904 appeared the exhaustive report of Sir W. Garstin, closely followed by that of Sir W. Willcocks. Now we have the very interesting volume of Captain H. G. Lyons. Garstin and Willcocks wrote first as engineers concerned in the water-supply of Egypt. Captain Lyons writes as an engineer, a geographer, a meteorologist, and a geologist. His volume now before us consists of 387 pages of very solid matter, bristling with figures, and containing forty-eight plates and diagrams. There is not a page of padding or spinning out in the book. In fact, it is to be regretted that Captain Lyons did not develop some of his arguments more fully. They are so condensed as sometimes to be not very easily followed. It is, therefore, difficult to review such a book within reasonable length for an article for this journal.

There is little to be gained from disputing what is the source of the Nile. Garstin pronounces emphatically that the great reservoir of the Victoria Nyanza, covering an area of 24,000 square miles, is the true source of the river. But if it be measured by the volume which it contributes to the common stream north of the junction of the Victoria with the Albert Niles, then the latter river must be taken as the true Nile, having its source about lat. $1^{\circ} 30' S.$, where "the Great Rift" is finally blocked by the mountain masses of volcanoes rising to a level of above 12,000 feet, which form the watershed of the basins of the Nile and the Congo. Moore points out that this great obstruction across the long valley of the Albert Edward and Albert lakes is the result of a "comparatively recent volcanic outburst," before the occurrence of which the waters of Lake Kivu, which now discharge into Lake Tanganyika, probably flowed north into the Nile. It seems possible, then, that at one time the long course of the Nile was still longer, and its source was to be found south of Tanganyika.

The volume of water coming from the Victoria lake and flowing past Fowera to join the Albert branch is nearly constant, and amounts to about 20,000 cubic feet per second. The volume contributed by the Albert branch, on the other hand, is a very variable amount, ranging from a minimum of 17,000 to a maximum of 35,000 cubic feet per second. The reason assigned for this difference is the evaporation and the moderating influence of the vast water-surface in the Victoria lake and of the marshes of Lake Choga to the north. The rainfall, too, in the Great Rift, especially at the southern end under the Ruwenzori mountains, probably much exceeds

that of the basin of the Victoria lake. Observations are naturally very scanty, however, and we cannot quite be satisfied with the explanations given by Captain Lyons for this remarkable difference. We may be sure that the last word has not yet been said as to the variations in the discharge of the Nile and its many branches.

The water-surface of the Victoria lake stands at a level of about 3700 feet, and that of the Albert at about 2300 feet, above the sea. Down this slope of 1400 feet the Nile has to flow in a course of 250 miles. The Ripon falls are 16 feet high. Below this for 40 miles the river flows on a steep slope; then for 150 miles sluggishly through marsh and shallow lake. Willcocks estimates that the loss by evaporation in these great sheets of water must be as great as the gain by rainfall. On emerging from these swamps the river flows with a gentle velocity and a navigable stream for about 80 miles, when it again enters on a long series of cataracts and rapids, ending in a narrow cleft in the rock wall not 20 feet wide. Through this cleft the whole river rushes and thunders over the Murchison falls, a drop of 140 feet. A short distance below this the Victoria and Albert branches of the river unite.

Captain Lyons thus briefly sketches the geology of the southern part of the Nile: "A plateau lying some 1500 metres above sea-level, and composed of gneiss, quartzite, and schists. The central portion is occupied by Lake Victoria, while the deep fault valley in which Lakes Albert Edward and Albert lie forms the western portion. Much movement has taken place comparatively recently, and blocks of the plateau have been raised, lowered, or tilted, so that the drainage follows the depressions so formed. As yet the rivers have not had time to deposit or erode sufficiently to give a regular grade to their beds, so that marshes and water-logged depressions still alternate with reaches in which the fall is considerable, and the flow therefore rapid."

About 10 miles from the north end of the Albert lake the river flows in one channel about half a mile wide, between high and well-defined banks, and although there is no rock anywhere near the surface, Sir W. Garstin considers this the spot where a regulating weir ought to be thrown across the river, should it be determined to control the waters of the Albert lake, a measure which will certainly be undertaken some day. For about 140 miles from the end of the Albert lake the flow of the river is gentle, and navigation not difficult, though obstructed by papyrus marshes, and then begins a wild descent of 100 miles, in which the river falls 730 feet. In some of these cataracts the river is not 40 feet wide, and must be of great depth. The last of them is known as the Fola rapid. From this point, for a distance of 1150 miles the navigation would be uninterrupted, save for the very formidable obstructions known as *sadd*s, to be alluded to later on, masses of vegetation that rapidly block the whole course of the river. The river, which is here known as the Bahr el Gebel, has now deserted the plateau of the lakes, formed of gneiss and other rocks, and henceforth to the Mediterranean, a distance of nearly 3000 miles, it flows through an alluvial plain, unbroken save by the dykes of rock which create the six cataracts north of Khartum. Hitherto it has passed through mountain country. Now it is in the plains. Away 50 miles to the east is visible the great hill mass of Agoro, rising to a height of nearly 10,000 feet above the sea. On the west the hills rise steeply to a height of about 4000 feet, attaining to what is believed to be a high plateau, but it is largely unexplored.

In this part of the Sudan the temperature does not vary 5° between the hottest and the coldest month, the average of the year being about 79° Fahr. The rainfall is about 40 inches, of which 33 fall in the months from May to October.

Captain Lyons remarks that "it has been known for years past that the rainfall on the more elevated parts of its basin supplies the Nile, but the statement that

melting snows also play a considerable part still lingers, although, except for a few streams fed by the melting glaciers of the Ruwenzori, no snow-water reaches the Nile." We could have wished that Captain Lyons had told us where the melted glacier-water of the Ruwenzori all goes to, if a considerable proportion does not find its way into the Nile. Surely we have not sufficient data to go on to pronounce very positively on this question.

Captain Lyons objects to Willcocks' description of the Bahr Gebel, south of Lake No, as being deltaic, "since a delta is formed when a stream delivers its load of detritus into a body of still water, such as a sea or lake." But we think the term *deltaic* is capable of a wider signification. The course of a large river may generally be divided into three sections. At first it rises among mountains, or flows down very steep slopes, scouring its banks and bed, and carrying with it a quantity of detritus. During the next section the river flows through the foothills. The slope of the country and the consequent current is diminished, but is still sufficient not to continue scouring, but to float on the detritus brought from above. In the third section there is not force enough to carry on the detritus, which therefore deposits in the bed, and in the lake or sea into which the river discharges, and this we consider the deltaic stage. There is certainly no lake in this part of the Nile valley, but Captain Lyons calculates the slope of the Bahr Gebel as 1 in 24,000, a condition not very far removed from a lake. The explanation he gives, in page 144, of this part of the Nile's course is not very clear or convincing.

From Gondokoro to Lake No is a distance of about 414 miles, and for the northern 250 miles of this distance the river is liable to be blocked by *sadds*. These consist of tangled masses of three aquatic plants, the *papyrus*, the *Phragmites communis*, and the *Vossia procera* reed. On either side of this portion is a series of vast shallow swamps. These plants are bedded in the soil below the water. Their hold on the wet earth is lessened by the force of the wind, and if the water-surface rises the roots become detached from the soil, with earth adhering to them, and retaining them in a vertical position; the wind and current carry them into the sluggish stream of the river; a *snag* projecting in the stream checks their course; another floating island catches on to the first, and, as Sir W. Garstin says, "a strong gale may set hundreds of acres of these floating masses moving in one direction. When the surface of the water is blocked, the succeeding masses get sucked down, until at last the whole becomes wedged into one solid block, . . . not infrequently attaining a thickness of 5 metres." This blocking of the waterway naturally raises the upstream surface, flooding the marshes right and left till the river manages to find a side channel, or until the obstruction in the main channel at last bursts, and the river clears itself. There is record of a *sadd* of this description forming afresh seventy days after being cleared.

Notwithstanding that there is an annual rainfall of at least 39 inches over the catchment basin of the Bahr el Gebel, and that it receives from the lake plateau from 17,000 to 35,000 cubic feet per second, and although this vast swamp is the natural outfall of the Bahr el Ghazal and of many tributaries as far as the distant plains of Darfur—in spite of all this, and incredible as it appears, the volume of the river upstream of the junction of the Sobat does not exceed a constant supply of 16,600 cubic feet per second. Willcocks is positive "that the *sadd* region is unmistakably . . . an old lake which has silted up and become full of peat and sand deposits." Garstin is inclined to the same belief, but Captain Lyons pronounces this merely an hypothesis, and gives geological reasons for opposing it which seem sound.

For about 500 miles above Khartum, where it is joined by the Sobat, the Nile has no very considerable tributary. The Sobat is a very important factor in the hydrography of the Nile basin. For the first 125 miles its course is through the

Abyssinian mountains, whence it carries forward great deposits of silt to be dropped whenever it reaches a more moderate slope. For the remaining 340 miles of its course it meanders through almost level plains. The Sobat attains its maximum (at least 25,000 cubic feet per second) in September and October, but there is no room in the valley of the Nile at this season to allow the Sobat water to proceed northward in its course. A much greater river—the Blue Nile—is then in force, and this holds up the White Nile, the Sobat, the Bahr el Gebel, and all its tributaries.

From the junction of the Sobat to Khartum the slope of the White Nile is rarely more than 1 in 100,000. This extremely low slope renders the channel a vast reservoir, with (according to Captain Lyons) a storage capacity of about 53,000 million cubic feet.

So far, we have been considering the branch of the Nile that descends from the Lake plateau, and more or less serves to drain the great swamps that lie about 550 miles south of Khartum, while it receives the waters of the Bahr el Ghazal from the west. The basin of the White Nile and its tributaries vastly exceeds that of the Blue Nile and Atbara, but it is these last that create the wealth of Egypt.

The rainfall over this part of North-East Africa decreases from south to north, and so it happens that, while the Sobat is still in high flood up to December, the Blue Nile, which rises 6° further north, falls rapidly throughout October, and has a very modest discharge in January, by which date the Atbara has ceased to flow altogether and is merely a series of pools. Yet at its maximum in September the Blue Nile is discharging about 400,000 cubic feet and the Atbara 70,000 cubic feet per second. It is the water ponded up in the White Nile that keeps up the supply in Egypt until the end of December. For six months after that Egypt depends on the supply coming down from the lake plateau. The Blue Nile and the Atbara take their rise among the lofty mountains and elevated plateaus of Abyssinia, rising to a height of from 15,000 to 6000 feet. It is this high mountain region crossing the path of the monsoon current which causes the heavy rainfall which supplies the Sobat, the Blue Nile, and the Atbara. The slope to the west is gentle, and so most of the rivers flow in this direction in channels deeply eroded and devious in their courses. Of these the largest and most important is the Blue Nile, known in the upper part of its course as the Abai.

The geological formation here, as in general over the Eastern Sudan, consists of granite and gneiss, varied by tracts of lava and basalt. Embedded among these mountains, at an elevation of about 5800 feet above the sea, lies the beautiful Lake Tsana, covering an area of about 1200 square miles, from the south end of which flows the Abai or Blue Nile, the discharge of which Mr. Dupuis found to be, on January 31, 1903, about 1500 cubic feet per second. A marked feature of the Blue Nile and the other rivers of Abyssinia is the deeply eroded channel through which, by the most devious courses, they come out at last on to the plains of the Sudan. The gorge of the Titta, for instance, is 3400 feet high.

For some 500 miles of its course from Lake Tsana the Blue Nile flows through hilly country. From Roseires onward to Khartum, a distance of nearly 400 miles, it flows through wide-stretching plains covered with low scrub jungle until the approach to Wad Medani, the most important town on the Blue Nile, with a population of some 20,000, the capital of the Sennâr province. Here we get into abundant *dhurra* or millet cultivation. When the population has been replaced which was exterminated in the Mahdi war, and when a reasonable sum has been spent on irrigation works, the country between the two branches of the Nile should be one rich field of fertility, not inferior to the Nile valley of Egypt. From Khartum northwards the Nile valley is now so well known that it may be only briefly noticed here.

One fact is dwelt on by Captain Lyons. In the great tourist season of Cairo, the opinion is often expressed that the climate is changing, and whereas rain was formerly unknown in Egypt, it is now a yearly occurrence; and this is put down by some to the Suez canal, by some to the extension of irrigation since the English occupation. Reference to the Memoirs of the learned staff brought to Egypt by Napoleon at the end of the eighteenth century, shows that as the climate was then so it is now. "But at least," says the tourist, "no rain falls in Upper Egypt." And when he looks out from the hotel verandah at Aswan and sees the clouds pouring forth their supply, he is convinced that this must be a very exceptional year. Captain Lyons, talking of the Nile valley from Aswan to Cairo, remarks, "A few rainstorms occur every winter, but they are usually very local in their effect. On the eastern side the much larger area and the steeper slopes, together with the greater frequency of rain near the Red sea hills, make the winter rainfall a more important factor. In about every second year one or other of the larger *wadis* comes down in flood, sometimes so suddenly as to carry away camels and sheep which may be grazing in the valleys, and pours a large volume of water into the Nile. . . . These *seils* [or rain floods] are less rare than is usually supposed, and the dry arid appearance of the desert, together with the rareness of rain, cause the effect of such storms as do occur to be underestimated."

Captain Lyons may be congratulated on having brought out a very important addition to Nile literature. In a country until lately so very little known as the Sudan, it is quite wonderful how many valuable observations and statistics he has managed to collect together. This book must, in every way, rank very highly as a scientific geographical treatise. Everywhere he employs the metric and decimal system of notation, and in Appendix I. he gives, for the sake of the unlearned, conversion tables, so they cannot complain. But why does he not give us a table for converting square kilometres into square miles? and why will he not leave us our familiar Fahrenheit thermometer. Wherein is the Centigrade to be preferred?

The National Printing Department of Cairo deserves credit for turning out so good a work, probably the best they have ever done; but they might have given us a thicker cover than this wretched sheet of paper, and they should remember that the English synonym for a weir has not got the letter *n* in it (see p. 133).

C. C. S. M.

LIBERIA.

'Liberia.' By Sir Harry Johnston, G.C.M.G., etc. With an Appendix on the Flora of Liberia, by Dr. Otto Stapf. 2 vols. London: Hutchinson & Co. 1906. Price 42s. net.

Liberia, says Sir Harry Johnston, by reason of its fauna and flora, is a peculiar country almost rising to the dignity of a distinct sub-district of the West African sub-region. Nevertheless, Liberia is of interest chiefly by reason of the racial, social, and political problems there on trial. This fact the author recognizes by placing the history of the republic in the forefront of his narrative. The story of the endeavour to evolve a self-governing civilized negro state is clearly set forth. Into the controversy as to what lines of development the Liberians ought to pursue if they are to maintain a permanent place among the nations of the world we do not propose to enter, beyond stating our general agreement with Sir Harry Johnston that the ideal which they now cherish, namely, that of an Anglo-Saxon culture of the early nineteenth-century type, is not that suited for an African people. But the author, in his zeal and the plenitude of his knowledge, has done more than give the history of Liberia; he has devoted five or six chapters to the oft-told tale of Hanno's Periplus; to accounts of the voyages and traffickings of the Normans, Portuguese, English, and Dutch along the Grain Coast; and to a *résumé* of the slave trade and piracy