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always characterized them. Let discussions which assume too disputatious a character be confined to the various periodicals open to such contributions, where the contending parties may find full space to advocate their respective views. Exciting as these topics are, and valuable as they often prove in leading to great discoveries, their real importance must be determined by the testimony of such patient observers as Livingstone and others now happily present in this room, whose well-defined observations are recorded in the volumes of our Society.

Lastly, let me congratulate you on our increasing prosperity, as testified by the cheering fact that, at the present meeting of the Session, no less than thirty-seven candidates desire to be enrolled among the Fellows of the Royal Geographical Society.

Captain R. F. Burton then read the following Paper—

1. *Lake Tanganyika, Ptolemy's Western Lake-Reservoir of the Nile.* By Captain R. F. Burton.

The author commenced by expressing his recognition of the many noble qualities of Captain Speke; his courage, energy, and perseverance. But he could not accept his "settlement" of the Nile. There were five objections to deriving the true Nile from the supposed Victoria Nyanza. 1, the difference in the levels of the upper and lower part of the lake; 2, the Mwerango River rising from hills in the middle of the lake; 3, the road through the lake; 4, the inundation of the southern part of the lake for 13 miles, whilst the low northern shore is never flooded; 5, the swelling of the lake during the dry periods of the Nile, and *vice versâ*. It might, however, be observed that, whilst refusing to accept the present settlement of the great problem, he in nowise proposed to settle the question: this must be left to time. Dr. Livingstone and Dr. Kirk, in their recent exploration of Lake Nyassa, threw remarkable light on the question, inasmuch as they had stated their convictions to be that no great river entered this lake from the north; the drainage of Lake Tanganyika, therefore, could not lie towards Lake Nyassa. Moreover, Dr. Kirk had informed the author that there was no community of species between the shells collected by Captain Burton in Tanganyika and those collected by Dr. Kirk in Nyassa; besides the "salt weed" (*Potamogeton pectinatus*, with *Valisneria spiralis*) found in Nyassa was unknown in Tanganyika. With regard to the effluence of the waters of Tanganyika in the opposite direction, namely, towards the Nile, Captain Burton confessed that what he learned when on the lake in 1858 militated against the supposition of a northern outflow. The information received about

the river connected with the southern end (River Marungu) was, however, quite positive to the effect that it entered the lake. Seeing now the difficulty of imagining a reservoir 250 miles long, situated at a considerable altitude in the zone of constant rains, without efflux, he was inclined to reconsider the question of an outflow to the north. The crescent-shaped "Mountains of the Moon," which appeared in a sketch-map published by Captain Speke ('Blackwood's Magazine,' August and September, 1859), surrounding the northern end of Tanganyika, Captain Burton showed to be a mere invention, and stated that in a later map of Speke's presented to the Society those mountains were no longer depicted. Many years ago Mr. Macqueen received from a native of Unyamwezi the statement, "It is well known by all the people there, that the river which goes through Egypt takes its source from Lake Tanganyika" ('Journal of the Royal Geographical Society,' vol. xv. pp. 371-4); and even Captain Speke, on his return from his first journey, recorded that a respectable Arab trader had informed him that he saw a large river which he was certain flowed out of the northern end of this lake, for "he went so near its outlet that he could see and feel the outward drift of the water" ('Blackwood,' September, 1859). Mr. W. S. W. Vaux has advanced the opinion that the drainage of Tanganyika is to the north, and Mr. John Hogg and Dr. Beke have also written to the same effect; Mr. Hogg pointing out that Tanganyika corresponded to the Zaire, or Zembre Lacus, or Western Lake-reservoir of Ptolemy. As to the level of Lake Tanganyika, given as only 1844 feet above the sea-level, this would be fatal to the supposition of its water falling into Lake Luta Nzigé and the Nile, if there were not great doubts of its correctness. The thermometer used in making the observations by the author and Captain Speke was a most imperfect one, and liable to an error which would make a difference of 1000 feet. The levels of Victoria Nyanza, Luta Nzigé, and the Nile at Gondokoro, as given by Captain Speke and Mr. Petherick, are also equally irreconcileable with the connexion of Victoria Nyanza with the Nile. The principal alterations which the author would introduce into Captain Speke's map were as follows:—1. Draining Lake Tanganyika into the Luta Nzigé. 2. Converting the Nyanza into two, three, or a larger number of lakes. Captain Speke saw only 50 out of the 450 miles' circumference of the lake; the rest was all hearsay, and, according to Speke himself, *Nyanza* meant equally a pond in the palace, a piece of water, whether pond or river, and the Nile itself. He travelled in the conviction that the lake was on his right; but he never verified that conviction. Irungu of Uganda expressed to Speke

('Journal,' &c., p. 187) his surprise that the traveller should have come all the way round to Uganda when he could have taken the short and well-known route *viâ* Masai-land and Usoga, which would be straight across the lake as depicted on Speke's maps. 3. Detaching the Bahari-Ngo from the Nyanza waters, which drains the mass of highlands between the equator and 3° s. lat., and sends forth the Asua River, which the author believed, together with Miani and Dr. Peney, to be the trunk-stream of the White Nile. He thought it probable that the white colour of the Upper Nile might be due to glacial water contributed by the Asua, which flowed from the snow-covered mountains to the south-east. The author concluded by expressing his conviction that the "great Nile problem," so far from being "settled," was thrown farther from solution than before. The exploratory labours of years, perhaps of a whole generation, must be lavished before even a rough survey of the southern Nilotic basin can treat the subject with approximate correctness of detail. "Mais les sources du Nil, sont elles decouvertes?" enquires Malte-Brun. "Nous ne le croyons pas." No geographer does, no geographer can, believe in the actual "settlement" of the Nile sources. That the Tanganyika is the Western "top-head," not source, of the Great Nile, and that the Bahari-Ngo, which supplies the Tubiri, is the Eastern, he had little doubt. But the Arcanum Magnum of Old World geography has not yet been solved. It still remains to this generation, as to its forefathers, "Caput quærere Nili"—to close the canon of geographical discovery.

The PRESIDENT, in returning the thanks of the Society to the author of the Paper, said he was sure Captain Burton would bring the subject forward in such a manner as to elicit a lively discussion, which he hoped would now take place. But Captain Burton knew as well as himself that the great question as to the ultimate sources of the most distant lake whence the Nile flowed could never be settled except by further explorations; and Captain Burton would accomplish much in the interests of geography if his paper proved to be the means of inciting other explorers to clear up the question. Geography is a progressive science, and its facts can be established only by actual exploration. He only hoped that Dr. Kirk, or some gentleman like him, might be induced to go to that portion of the globe, and clear up the doubts that still hang over the question of the sources of the Nile, as well as that of the real watershed of Southern Africa. Captain Burton had let fall an expression as to his wish to ascend to the sources of the Niger. It was only justice to that gentleman to state that during the interval between his quitting the Fernando Po Consulate and taking possession of his new appointment in the Brazils, he offered to determine the sources of the Niger by crossing from the west coast of Africa. He mentioned this to show what an energetic traveller Captain Burton was.

DR. LIVINGSTONE wished to say a few words in confirmation of what Captain Burton had said about the region north of Lake Nyassa. He would begin by saying that he was quite correct in his definition of the meaning of the name "Nyanza" or "Nyassa," both meant simply a piece of water. The most frequent name of Lake Nyassa was Nyanza, not Nyassi; but he would

continue to call it Nyassa, as it was the name by which it was generally known in Europe. When he went up the Lake Nyassa last year, he wished to go round to the north end of it, in order to ascertain whether a large river did not flow into that part of the lake. He was, however, prevented from doing so by a colony of Zulus, whom he believed to be very unfriendly, and who had desolated the whole of the country to the north and west of the lake. On that account he went away to the west from Kotakota Bay, hoping that when he had got about one hundred miles from the shores of the lake he would be able to get round to the north. Before he had got that distance, however, he saw so many rivers flowing into the lake in the driest portion of the year, and such abundant evidence of a very humid climate—the trees covered with lichens—that he came to the conclusion that the lake did not at all require a large river to flow into it from the north. From Kotakota he looked to the west, and saw, as it were, a range of high mountains, some ten or fifteen miles off; but when he reached the top he found it to be the edge of a plateau which, according to the boiling-point of water, was 3440 feet above the level of the sea. He then went straight west, nearly 100 miles from the lake, and found, first of all, that certain rivers flowed away back into the lake, and then a great number of shallow valleys exactly the same as he had found in Londa (or Lunda), in the middle of the country. Some of them had rivers flowing away to the south-west; and he was told by the people that they flowed into the Loangwa, which entered the Zambesi at Zumbo. Another river flowed to the N.N.W., called "Moitala," or "Moitawa," and which they said flowed into Lake Bemba, a lake ten days distant, which had not yet been discovered. He met a number of tribes called Babisa, who were great traders, and travelled far and near in search of ivory; these maintained that a river called "Loapola," or "Luapula" flowed out of Lake Bemba to the west. It flowed west, and then formed another lake called "Moéro," or "Moélo." Emerging from that it formed still a third called Mofué: and then passing near to the town of Cazembe, it turns away to the north, and falls into the Tanganyika. That was the statement of those men. He (Dr. Livingstone) wished very much that it had flowed according to his previous ideas, down towards the Zambesi; and he tried some of the men by saying: "It does go that way; it does go to the Zambesi?" The men spoke to each other laughingly and said, "He says the Loapola goes away to the Zambesi. Did you ever hear such nonsense?" He was forced to believe that the river actually did flow away to the north-west, and into Tanganyika. The next question he put was, "What became of the water that flowed into the Tanganyika?" But not one of them could answer it—not one could tell whether the Tanganyika had an outlet or not. That was all he knew about it. He might also say something about the Casai. When going away to Loanda, he crossed a river about the size of the Clyde, at Glasgow, flowing away to the north-east, which seemed to indicate a hollow in that direction; but when he got still further to the north, to the Portuguese at Cassange, he was assured that the river was the main branch of the Congo. He crossed another called the "Coango," or "Quango," which also indicated that the country to the east of it lay low; but whether the Tanganyika had an outlet in that direction, or an outlet away towards the Nile, he did not know, and he did not suppose anybody else did. That was a question to be decided. As he intended to leave England and go to Africa as soon as he had completed the book he had in hand, he might again visit those parts to which he had alluded; but he did not like to promise what he should do, for he always remembered a saying of his father who, he believed, quoted from a much wiser man:—"Let not him that putteth on his armour boast himself as he that putteth it off." He saw no difficulty, however, in the way of reaching that country. There was high land extending all along about 300 miles from the coast; and if they could get on to

A second Paper was the following:—

2. *On the progressing Desiccation of the Basin of the Orange River in Southern Africa.* By JAMES FOX WILSON, ESQ.

THE author, who had visited the country to which his Paper referred, enumerated a long list of cases which went to prove that the basin of the Orange River was gradually becoming deprived of its moisture; or, in other words, that the Kalahari Desert was gaining in extent. Springs of water, which, a few years ago, yielded a sufficient supply to irrigate garden and field, have diminished in their flow, causing the migration of the inhabitants to a more favourable dwelling-place. Pools and fountains have failed over a wide extent of territory in Bechuana Land. It was evident that, from some cause or other, a great change had taken place in the physical character of this region since it was first explored by Europeans. But the change must have commenced long before the entry of Europeans into the country, from the evidence afforded by the immense number of stumps and roots of acacia, where now not a single living tree is to be found, and from the many ancient beds of dried-up rivers. The author believed, contrary to Dr. Livingstone, that it was not to geological changes that this progressing aridity was due, as there were no signs of volcanic or earthquake agency; but maintained that it was owing to the reckless felling of timber and burning of pasture during many generations by the natives. Dr. Livingstone had imagined that the Barotse Valley and neighbouring lowlands were formerly occupied by a number of shallow lakes, and that the dreary Kalahari Desert, at that time, was fertile and well-watered. Accumulations of lacustrine tufa with imbedded fresh-water shells testified to the substantial justice of this theory; but Mr. Wilson believed that this process of draining-out must have taken place during the quarternary period of geology, and did not explain what has been going forward during the last few generations. The rain-clouds of the region come from the north-east, and, after fertilising Caffraria, are now dissipated over the interior and western plains by the radiation of heat from their bare surface, instead of depositing the remainder of their moisture, which they would do if the plains were wooded. Barren as are these central lands there are few spots, even in the Kalahari, which are wholly destitute of vegetation; and, as the average rainfall is but a few inches in the year, the diminution of even one or two inches is most severely felt. Where water is so priceless a treasure, no difficulty, which can by any possibility be surmounted, ought to stand in the way of a feasible plan of alleviating the aridity. The author believed that artesian wells might be bored, with great advantage, in the region around Kuruman, as there were many signs of the existence of perennial water underneath the surface-strata. But the chief hope of amelioration lay in the checking of the indiscriminate felling of timber by natives and colonists; and he concluded by insisting upon legislative action, on the part of the Cape Government, to prevent the continuance of the practice and also to promote new plantations.

The PRESIDENT said that to a great extent he thought Mr. Wilson's conclusions were correct. He regretted the absence from the Meeting of Mr. Cyril Graham, who could have thrown much light upon the present subject. In his description of the region of Hauran, to the east of Damascus, this distinguished traveller and scholar had showed how this country, which in Scriptural times was filled with towns and contained an immense population, had, without any geological change whatever intervening, become an uninhabitable desert from the same causes as those pointed out by Mr. Wilson. He knew, from his own observations in Russia, that the Volga had diminished in volume in consequence of the cutting down of the great forests on the Ural mountains. Even in our own country the same process was in operation from the removal of timber and the drainage of lands. The remedies which Mr. Wilson pointed out in reference to Southern Africa seemed to be reasonable. He would, however, call upon some of the African travellers present to state what they knew on the subject.

Dr. LIVINGSTONE could agree with the author of the paper in several points, and in others he must suspend his judgment. There could be no doubt as to the main fact of the drying up of the country to which reference had been made. The small stream on which he settled at Kolobeng was flowing very abundantly when he first laid out its waters in order to irrigate a garden; but in the course of two or three years it had entirely dried up. He ought to mention, however, that he had been informed since then, that the stream had begun to flow again. In other cases, in that same district, fountains had dried up at such a remote period, that no tradition existed of their ever having flowed, except in their names. No doubt these little streams did dry up and burst forth afresh; but the more general desiccation to which he referred left no doubt on his mind that the whole country had once enjoyed a much more humid climate than now. He had traced himself, in his earlier travels, for long distances, the dry beds of very large rivers which had a general course from north to south instead of east and west, the prevailing direction of existing rivers. In one instance he came upon the dry channel of a river two or three miles broad. It was remarkable that the natives still called these dried up water-courses by the name of rivers. In the dry bed of a large lake which he had discovered, as well as in the bed of the river just mentioned, he found large numbers of fresh-water shells, which were of the same species as those now living in the waters of the interior. The change in the state of the country, implied in the desiccation of these great streams and lakes, could not have been caused merely by the natives burning down trees and grass, though he admitted they did burn the grass extensively, so much so in certain months of the year that there was quite a haze over the whole country, which in Western Africa is called "the smokes." One thing that struck him as very remarkable was this, that there must have been very large fresh-water lakes in the interior of the country, and that a very considerable difference of level had taken place since these lakes contained standing water. The only way in which he could

account for their being drained off so completely is by the sudden opening of fissures by subterranean convulsion; and he believed these fissures were of a similar nature and origin to those which now form the Victoria Falls. The fissure into which this great cataract plunges was evidently not the result of wearing away by the action of water as in the case of Niagara. The edge over which the water falls shows no signs of wearing away, and the rock is quite perpendicular for 310 feet on all sides. The rock consists of hard basalt, and a little to the east it has all the appearance of volcanic tufa. The author of the paper did not seem to know that many of his suggestions had already been adopted at the Cape, where immense quantities of *Eucalypti* were grown in the Botanic Garden for distribution among those who wished to plant trees. In four years the tree grew to a height of twenty feet. The general desiccation of the country he attributed not so much to the cutting down of trees as to the elevation of the country, more especially on the west side of the continent. The ancient streams on the western side had ceased flowing to a greater extent than those on the east, and he found the west coast had been elevated about 200 feet. He believed it was in the process of elevation that the fissures which had let off the inland lakes.

Dr. KIRK said the writer of the paper presupposed a state of population different from that which is found in any part of Africa at the present day. In the tropical region that he visited, on the Zambesi, there was abundance of wood on the hill-sides, and the average amount of population; but he was sure the people alone could not complete the entire destruction of the forests. They used the wood for domestic purposes, but that did not in any way affect the average amount of vegetation in the country. Some other cause must be looked for to explain the progressing aridity of South Africa, but what that cause might be it was very difficult to point out. He was inclined to believe that the original aridity both of the Sahara in the north and the Kalahari in the south was due to atmospheric currents. Enormous volumes of air rushed towards the interior of Africa from both sides. This air must come down somewhere, after depositing its moisture in its ascent; and wherever it strikes the earth it will come down very dry. It was probable that in the north it came down on the Sahara desert, and in the south on the Kalahari.

Mr. GALTON said the author of the paper had omitted to explain why the destruction of timber had progressed more rapidly in recent times. It was probably to be accounted for by two separate causes. A few centuries ago the population of that part of South Africa of which he spoke consisted mainly of Hottentots, now it consisted chiefly of the Caffre race. There is a considerable difference between the habits of the two races. The Hottentots are eminently natty and saving, the Caffres eminently wasteful; and from that cause we might conclude that more timber would have been cut down in recent times than formerly. Another cause of greater importance was the free introduction of iron. Axes are now to be had everywhere throughout South Africa, where formerly iron was a rarity; and the consequence is, that the wood is cut down much more readily than heretofore, for making camp-fires and protection for the cattle.

Colonel G. BALFOUR stated that during the course of the investigation into the public works of India, on which he served twelve years ago, evidence was brought before the commission that the effect of cutting down trees was to diminish the moisture of the country. At the same time his brother, Dr. Balfour (Deputy Inspector-General of Hospitals, Madras Presidency), undertook an investigation into the effect of cutting down trees on the sources of springs, and the notes, which he drew up, on the influence exercised by trees in inducing rain and preserving moisture, satisfactorily proved that in many instances springs which had dried up had been found to open again on the trees growing up.

The Report was printed by the Government of Madras, and considered of such value that it was extensively circulated, with a view to further inquiries being made; but the results of these investigations have not yet been made public. He (Col. Balfour) had also observed the effect, on the rainfall, of the want of trees in different parts of Southern India. He might mention a tract of country, the Ceded Districts of the Madras Presidency, as large as Ireland, where there is scarcely a tree to be seen, and that area has a smaller proportion of rain than any other part of India. When he passed through Aden in 1862 he was informed by the officer in charge of political affairs there, that in consequence of the opening of tanks the trees had increased considerably, and the supply of water for the use of the troops and people had also much increased. He had been informed that morning, that in the West Indies the Government of Trinidad had passed a law prohibiting the cutting down of trees near the capital, in order to ensure a supply of rain.

Lord STRATFORD DE REDCLIFFE, on being invited by the President to relate a circumstance which had come under his knowledge, said, most people who were acquainted with Constantinople and its neighbourhood were aware that the capital was supplied by water contained in reservoirs attached to streams that pass through a district called the Forest of Belgrade. Some years ago permission was given to cut down the timber in this forest: speculators took advantage of the Sultan's permission, to cut it down largely. The consequence was soon felt: the reservoirs began to fail, and the Government was obliged to interfere and to restrict its permission, in order to prevent the drying up of the springs, which seemed so inevitable a consequence of depriving them of the shade of trees.

The meeting then adjourned.

ADDITIONAL NOTICES.

(Printed by order of Council.)

1. *Memoranda on the Summer Motions of some Glacier-streams in Southern Norway*, as observed by CHARLES M. DOUGHTY, Esq., in 1864.*

THE accompanying series of observations are merely intended to record the results of the first measurements which have been obtained of the seasonal-motions of Scandinavian ice-streams;† they are made on outflows of the great system of the Jostedal-bræ which lies between the parallels of 61° and 62°, and is the first great obstacle in that region which the moist ocean-winds encounter. The height of the average snow-line on the flanks of this mountain ridge is as yet only very approximately ascertained, and may perhaps be stated to be about 4600 feet. The measurements are given according to the Norwegian unit, which = 1·03 of that in our system.

* Months of July and August.

† The notes of the lengths of the several ice-streams as originally estimated by my guide are lost: those given overleaf are from memory.—C. M. D.