

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 campfires 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.