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The African Rift Valleys: Discussion

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Before the paper the PRESIDENT said: I have the pleasure of calling to-night on Prof. Gregory, professor of geology in the University of Glasgow, who for more than a quarter of a century has taken a special interest in the rift valleys extending right down the heart of Africa, and travelled there for the purpose of studying them. Just recently he has returned from India, where he had been with the Universities Commission, and on his way back again visited East Africa and was afforded special facilities by the Governor to carry out further investigations. He will give us this evening the results of his long study of the great question of the rift valleys of Central Africa.

Prof. Gregory then read the paper printed above, and a discussion followed.

The PRESIDENT (after the paper): We have here this evening General Sir Edward Northey, who commanded the British force which proceeded from Rhodesia into German East Africa, and which he led with such distinguished gallantry, skill, and success. He is now Governor of East Africa. He is home on business, and also, I am sorry to say, because of a serious accident he had out there, and he will, I hope, be good enough to give us a few observations on the remarkably interesting lecture we have just listened to.

Major-General Sir EDWARD NORTHEY: I am afraid that I am not an expert in geology, and I have not prepared a speech, but it may interest you to know that at the beginning of 1916 I was asked to take over the Rhodesian and Nyasaland troops, then on the defensive on the borders of German East, with which four months later I invaded and took the south-western provinces of German East. I then saw a great deal of the country, from the south side, to which Prof. Gregory has so ably referred to-night. Subsequently, a year ago, I was asked to go out to British East Africa as Governor. I have, therefore, seen also the rift valley from the north down to Lake Magadi. You will like to know from quite a casual observer that the rift formation strikes one in a most extraordinary manner, and one almost gets a habit of seeing the difference between what are obviously escarpments formed from subsidence and the ordinary sides of the hills that have been worn away by years of corrosion. There is one interesting point that I think Prof. Gregory may like to hear from me, and that is this. After coming up to the north end of Nyasa when I first went out in 1916, I walked from there to Lake Tanganyika and back, inspecting the troops, and seeing what I could do with them: it then struck me particularly how that rift formation seemed to echelon away from Nyasa to Tanganyika; and, subsequently, when I made my advance and eventually joined hands with General Smuts' troops near a place called Iringa, 200 miles north-east of Lake Nyasa, near the upper waters of the Ruaha river, I made other observations. After we had got over the first 50 miles of mountainous country north of Lake Nyasa, (and there the formation is due to recent volcanic eruptions), we went across a big plain at about 3000 feet, and I have a most distinct recollection that, for about 100 miles, on our left was a great buttress of this cut-away formation which showed that there had been subsidence there. You do not always get the rift where it has sunk on both sides: sometimes you see a distinct break on one side, and you cannot see it on the other side. I am inclined to think that Prof. Gregory, in examining this question as to whether the rift valley goes down to join Lake Nyasa, has been led astray by the fact that for 50 miles north of Lake Nyasa the rift is broken by volcanic formation, and this is more interesting now for the following reason. The first large town, if you can call it so, which we came to was the southern capital of German East Africa, a place called Neu Langenburg, 40 miles north of Nyasa; just north of it, standing about 10,000

feet above the sea, was a large extinct crater called Rungwe, which must not be mixed up with Lake Rukwa to the north-west : I took a lot of trouble to find out what was known of this volcano, and there were old natives who said that their parents had remembered smoke coming out. Since I was there that volcano has broken out again, and the whole town has been levelled to the ground. What I wish to point out is that I think the rift formation does go north-west from Nyasa, but is lost sight of because of the break in it caused by volcanic eruption. It was the very greatest pleasure to me to welcome and assist Prof. Gregory in his work in Africa. He used to make little trips and come and tell me about them ; and everything he tells one is of most extraordinary interest, and he has a pithy way of explaining and putting his points. Having seen these formations, I can assure you that the slides put on to-night give you a very true idea of how they appear.

Mr. C. W. HOBLEY : I have been greatly interested in the paper Prof. Gregory has given us this evening, and for two reasons : first of all because I have been associated with East Africa for many years and have taken a small part in the exploration of that country, and, further, during my service there have taken a great interest in its geology, and endeavoured to obtain a general insight into the structure of the country ; secondly, because of my long friendship with Prof. Gregory. I first met him about 1892, and the occasion was this : he returned to Mombasa very disheartened from the break-up of an expedition with which he had great hopes of doing good work ; a projected expedition up the Tana which broke up for reasons I need not enumerate. Prof. Gregory returned to Mombasa with his adventurous spirit undaunted, and he decided to endeavour to make an expedition to Kenya and the highland region at his own cost. He appealed to the officials of the Imperial British East Africa Company for assistance, and I had the honour to help him in fitting out a caravan. I gave him the best headman I could procure, about thirty porters, and my blessing, and then awaited with anxiety for his return. For many months he disappeared and we almost gave him up. On several occasions we heard rumours that the Masai had cut him up, but could not send to inquire. The interior at that time was not nearly so safe as it is to-day, and the marvel is that he attained as much as he did on this trip. However, one day he turned up, quite cheerful but looking ill and worn. He had come through after many adventures, and the results of that trip are known to most of you from the account of them published in a book now historical : 'The Great Rift Valley.' The title of that book gave the name to the valley. Twenty-five years later I had the pleasure of being associated with an expedition which Prof. Gregory made in East Africa, the one to which His Excellency Sir Edward Northey has referred, and on this occasion I had the good fortune to accompany him. He has not given us any particulars of his journey, and I am sure if he had done so it is unlikely that he would have told you of the very narrow escape he had from a bad-tempered rhino. Prof. Gregory's latest visit to East Africa was arranged in order that he might give the Government of British East Africa some advice on certain projected borings for water. This tour has however enabled him to check the theories he had built up with regard to the structure of the country as long ago as 1893. The full and detailed exposition of these views will be of great value to the scientific world, and particularly to the projected geological survey of the country, because they will form a firm basis on which that survey can build. Local workers in Africa up to now have been to a great extent rather like the man who could not see the wood for the trees—they become engrossed in the local aspect of the problems, but when a man with world-

wide experience like Prof. Gregory comes along he reduces the whole problem to proper perspective. I hope that Prof. Gregory will a little later on be able to revisit East Africa and spend several months there, and eventually publish a *magnum opus* which will be a standard work on the tectonic structure of the country. With regard to the technical matter of the lecture, I must say that the age of these great phonolite beds which spread over such a large area in East Africa is a problem which has afforded many of us great thought. Personally I never believed that they were of such great age until I had the pleasure of travelling with Prof. Gregory and hearing his arguments in detail. There is on the eastern side of the Athi river a very big ridge called the Yatta plateau. This is very narrow, but stretches for a distance of about 200 miles parallel with the river. Prof. Gregory's theory is, I believe, that this is the relic of an extension of the great lava-sheet, but preserved because it lay in the valley of an old river. I regret that he had not time to visit it, for this is one of the geological problems which needs further consideration, and I hope that on his next visit he will be able to give it more detailed attention. The geological problems of British East Africa are various and vast, but they have got to the stage when they can only be solved by detailed survey and the help of a big-scale accurate map. The day when the geographer walked through the country and made compass sketches is past. We are now getting down to accurate surveys of small areas, and detailed geological surveys, whether for economic or theoretical purposes, depend on surveys with accurate and large-scale maps. With regard to the title of the paper, I think this is one of the few instances in which a scientific man has given a name to any part of the world which has obtained popular vogue. The Great Rift Valley's name was Prof. Gregory's invention, and every week one sees in the local papers notices of Rift Valley Hotels and sales of Rift Valley farms, and such like.

Mr. W. MCGREGOR ROSS: I am not a geologist, but a civil engineer, and I should like to speak for a moment upon the application of these problems, which Prof. Gregory has done so much to solve, to the industrial conditions prevailing to-day. One of the effects of having a region seamed by these deep vertical cracks or faults is that surface water-supplies, which would otherwise be available, go below and are lost underground, and one of the main reasons why the Government of East Africa invited Prof. Gregory to visit the country on this occasion was that he might advise as to the possibility, or likelihood, of our being able to recover some of the underground supplies of water which are probably there, due to the passing of surface supplies downwards. The result of his advice may, we hope, be that steps will be taken to recover something of those supplies in specified districts, and the economic effect of that upon the East Africa Protectorate, and not only there but upon human conditions elsewhere, may be very considerable indeed. The portion of the Rift Valley which Prof. Gregory visited on this occasion is occupied in parts by farms under white ownership, and in other parts by native tribes, who are ranchers on a tribal scale. The principal tribe there is the wealthiest nation on the face of the Earth at the present time—not excluding some profiteers we know of. They are about 25,000 in number, and they are said to be worth £300 sterling a head,—man, woman and child. Their stock of cattle runs to upwards of a million head, and sheep and goats several millions, and if water were obtainable in considerable stretches of the territory which Prof. Gregory has alluded to, a very large increase in the stockage of that country would be possible, which is at present impossible owing to the dry weather which we have annually. The effect, then, of turning the insight of geologists

into technical advice on obtaining underground water, will be a very large increase in the stockbearing value of an enormous piece of British territory, and secondly, in a really almost overwhelming invitation to cold-storage concerns to start operations in the Protectorate, and invest capital in their operations among the rancher community. This, we may hope, would lead to the necessity of converting the Uganda Railway from a single to double line, at least for a portion of its length, and this again would employ further British engineers and set rolling mills here at work, with other industrial developments too numerous to follow up. Therefore these really intricate problems of geology on which Prof. Gregory has touched to-night have this extremely practical side, that the advice which he is in a unique position to give upon the structure of this particular territory may be of extreme value to the local Government in expediting and advancing the development of the country.

The Very Rev. Sir GEORGE ADAM SMITH: I am here only by chance and did not expect to speak, but having been called upon I cannot fail to pay my tribute to the lecture we have heard to-night. Prof. Gregory has quoted me with regard to the beginning of this great rift in the world's surface, and as having said that there is nothing like it on Earth but that there may be something like it upon another planet. It seemed to me, as I heard him to-night, as if he were taking me into that other planet, from the little region of Palestine into the great continent of Africa, and the practical conclusion that has been forced upon me is that we want him to come to Palestine and do some work there, as he has done in the continent of Africa, on the continuation of the great Rift Valley. In the first place, we have never had studies of the geology of the whole land which have thoroughly exhausted the subject, in spite of all that Hull and his English successors, and the German Blanckenhorn and the French Lartet and Diener have done in that little bit of the world. We need another geological survey of the whole land, and no one could do it better than Prof. Gregory. The last speaker's remarks lead me further to say this, that in addition to a scientific geological survey of the whole land, we need the practical application of its results in the recovery of the fertility of that country to the extent which it reached both in Old Testament times and, as I believe and indeed as we all know, in the early Arabic Moslem period. It is just this matter of discovering underground water for irrigation which is going not only to restore Palestine to its former productiveness but to one beyond anything it knew even in the most flourishing former period of its history. I know the deserts which separate the main part of the United States of America from California, and how they have been transformed on the Californian side into some of the most productive parts of the Earth's surface. I believe the same can be done with the southern part of Palestine where the ruins of Byzantine cities are still strewn across the sands—proofs of the former fertility of that region; and it is just such an expert as Prof. Gregory that is needed out there to start the same restoration of Palestine as of the desert surrounding California. The only other remark I have to make is a very obvious one, and it is that we are more and more coming to see that prior to any intelligent study or mastery of the subject of history lies a knowledge of the physical basis on which all history rests and is moved. Until you understand the lie and the lift of the Earth's surface you cannot understand either the political, or the military, or the economic movements of history.

The PRESIDENT: If there is no one else who would like to take part in the discussion it falls to me now to propose a very hearty vote of thanks to Prof. Gregory. He has given us a wonderfully interesting and very lucid description

of the origin of this unique feature in the Earth's surface. To us travellers who have been about the world it is extraordinarily fascinating to hear a geologist, a great master of his subject, telling us in clear and simple language, how the features of the Earth's surface, amongst which we travel, have originated. I have had the great pleasure of listening to the Director of the Geological Survey in India describing how the Himalayas have arisen, but I have never listened before to any one describing a great depression such as these great rift valleys of Africa. During the first part of the lecture I was listening anxiously to hear the actual cause of this great subsidence. "Faults" are talked about by geologists, but one does not realize quite clearly what has been the cause of a fault—how it is that a certain part of the Earth's surface has sunk away leaving other parts of the arch still standing. That was very clearly explained to us by Prof. Gregory. And we listened with the greatest interest to his description of the origin of those wonderful depressions on the Earth's surface which run down from the Dead Sea to the southern part of Africa. We would also like to hear something about the age, but here geologists are extremely cautious. They talk about the age of London Clay, about the Miocene period or Pliocene period, but they never come down to actual figures. They talk about recent times. I remember Mr. Hayden of the Indian Geological Survey telling me that the Himalayas were a quite recent formation, but by "recent" he meant near about three million years old. I gather the rift valleys are also what the geologists call "recent." What we liked in Prof. Gregory's lecture was the feeling that he was dealing with a subject from a big point of view. He was taking the Earth in his hands, as it were, and looking at it all round underneath and inside, as well as on the top. I have not before realized the relation there was between one side and the antipodes, but one understands now how the depression, the foundering of the Pacific Ocean, has had something to do with the features of the land in the centre of Africa. One of the speakers has referred to the difficulty of seeing the wood for the trees, and remarked how men engaged on the spot merely see their little problems and how these engage their attention, yet what a pleasure it is when some one, taking a general view, comes and points out the relation of what they see close at hand to the great general problem! I have often felt that when I have been in out-of-the-way parts and had with me these men who take a general view. I am sure we have experienced that great pleasure also to-night. I will ask you, therefore, to give to Prof. Gregory a most hearty vote of thanks for his exceedingly interesting and very lucid lecture.

Major L. F. I. Athill sends the following note as an addition to the discussion :

On the south-eastern shores of Lake Rudolf lives a small fish-eating tribe called the Elmolo, now reduced to the verge of extinction by raids. Its old men relate that many years ago the Elmolo were a large tribe, rich in flocks, and ranging over the area, then dry land, which is now covered by the southern waters of the lake. One day, when the ancestors of the existing remnant were herding their goats near the foot of Mount Kulah, there was a terrible earthquake, and the ground where their fellow-tribesmen were pasturing gave way, the waters of the lake rushing in from the north and filling the depression.

An island, now known as Elmolo or South Island, escaped submergence, and from it the smoke of fires continued to rise for some thirty years, after which period it was no longer seen. The Elmolo conjecture that during that time some survivors of the catastrophe were keeping themselves alive on the

island by catching the fish which abound in the lake and which form their own staple diet. The manner in which the tale is told suggests that the events took place only a few generations back, but the Elmolo are incapable of estimating time beyond the limit of their own experience. To this day Elmolo Island remains unexplored, and when it is at last visited it will be of great interest to learn whether any traces of former human habitation exist.

Count Teleki reported that the volcano at the south end of the lake was emitting clouds of yellowish smoke in 1888. This volcano seems to have been extinct for the last eight years at least, but another story told by the Elmolo bears witness to its recent activity. They say that the crater is the home of a witch-doctor, and that within very recent years they have seen the clouds of dust raised by his cattle, and have heard them lowing as he drives them to his kraal at sunset.

The Elmolo are markedly more intelligent than their meat-eating neighbours. Is this an argument in support of the brain-making properties of a fish diet?

A BRIEF REVIEW OF THE EVIDENCE UPON WHICH THE THEORY OF ISOSTASY HAS BEEN BASED

Colonel Sir Sidney Burrard, K.C.S.I.

Read at the Afternoon Meeting of the Society, 12 April 1920.

IN putting forward the theory of Isostasy geodesists take upon themselves a considerable responsibility. Geodetic methods are technical, and they are described in technical language, which has not been studied by laymen. Geodesists have therefore to weigh their words well before they commit themselves to the statement that the evidence in favour of Isostasy is incontrovertible. The Royal Geographical Society has invited me this afternoon to summarize briefly the evidence in favour of Isostasy.

The theory of Isostasy ascribes to the Earth's crust a peculiar structure; it states that all mountains and heights standing above sea-level are compensated by deficiencies of matter underlying them below sea-level, and that all oceans and surface hollows dipping below sea-level are compensated by excesses of matter underlying them in the crust.

The theory that deserves our confidence is the theory that best fits the observed facts. The force of gravity has been observed in different parts of the Earth, and the crucial question is this: Does the theory of Isostasy accord with the observed facts?

I will illustrate my meaning by borrowing an example from the tides. There are two methods of predicting the height of tidal high water. For the tides in the Red Sea the first method of prediction gave heights differing from the actual observed heights of the tide by amounts varying from 9 to 16 inches, whereas the second method predicted heights that agreed with the observed heights within 2 to 4 inches. Which of these two