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The Volcanoes of Guatemala: Discussion

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of Finca Helvetia, as well as other planters too numerous to mention, for their kind assistance and hospitality. Their local knowledge in a country like this was simply invaluable.

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Before the paper, the Chairman, Colonel CHURCH: It is with much regret that I have to announce that our President is unable to be present this evening owing to a slight illness. Our lecturer this evening is already known to you, and about four years ago he entertained us with his experiences, his studies, and his wonderful photographic plates of the volcanic eruptions in Martinique and Mont Pelée. I may mention that not only did he greatly distinguish himself by his analysis of those eruptions, but that he is also familiar with many parts of the world where he has done good work in the same direction, work always characterized by a thoroughness which is worthy of admiration. He has taken care to possess himself of everything in the shape of mechanical appliances known to photography, and consequently what he does is perfectly reliable. He was accompanied in his examination of Mont Pelée and Martinique by Dr. Flett, of the Geological Survey. The country from which he now returns with so much valuable information is one of the great volcanic centres of the world. I will now call upon Dr. Tempest Anderson to read his paper.

After the paper, Dr. FLETT: Listening to Dr. Anderson's descriptions to-night, and seeing on the screen the beautiful series of photographs of Guatemalan scenery and volcanoes, I could not help being struck very greatly with the similarity which exists between the volcanic phenomena in Guatemala and those with which Dr. Anderson and I became acquainted in the year 1902, when we had the opportunity of visiting together the volcanoes of the West Indies. There is some connection between the volcanoes of St. Vincent, Martinique, and those of Guatemala, because in May, 1902, when Montagne Pelée in Martinique and the Soufrière in St. Vincent burst into eruption, there were earthquakes in Guatemala; and six months later, while the volcanic activity was still going on in the West Indies, this great eruption took place of which Dr. Anderson has shown photographs to-night. One feature of the outbursts in both these districts was that the products were principally ashes, sand, and dust, so that the scenery of the Guatemalan volcano is very like that of the volcanoes in Martinique, where the whole surface of the ground was covered over with thick layers of ashes and sand.

Equally striking to us, perhaps, who are accustomed to temperate climates is the extraordinary rapidity with which these great masses of ashes are swept away from the bare surface of the ground in tropical climates. The photographs, for example, shown us to-night, when compared with the photographs taken in 1902 and 1903 by Prof. Karl Sapper, show that, vast as was the quantity of material ejected, the greater part of it has been swept away from the higher ground by the rivers, and transported to the sea. In the same way, in the West Indies, the larger part of the material which wrought devastation there was very soon removed, and with it part of the underlying soil, which had been, of course, left bare and unprotected by the destruction of the vegetation. I think you will agree with me that the year 1902 is one which will be marked with a red letter in the history of volcanic activity. In that year we had three volcanic outbursts of great magnitude: these were, the eruptions at Montagne Pelée, at the Soufrière in St. Vincent, and at Santa Maria in Guatemala. It is a curious fact that the greatest of these three in physical magnitude, namely, the Guatemalan eruption, is one which has been least known hitherto to English and American geologists, whereas the one which was least in point of mere magnitude has, on account of its fatal action on the town of

St. Pierre and the loss of nearly thirty thousand lives, and the extraordinary nature of the volcanic phenomena which it presented, become so famous as to be almost a household word to geologists. The service which Dr. Anderson has rendered in visiting Guatemala and bringing before us so careful an account of the volcanic phenomena in that quarter, is one which I am sure the scientific public in England will highly appreciate.

Mr. MAUDSLAY: I can add very little to what Dr. Anderson has told us. I certainly do know these volcanoes very well, having ascended the Volcan de Fuego once and Agua three times. I quite agree with what Dr. Anderson has said about the destruction of the first city of Guatemala. It must have been a cloudburst, and not a volcanic eruption, that destroyed it. We must remember that Guatemala—the city of Guatemala, as it was called even in those times—was a very, very small affair indeed. The wife of the conqueror Pedro de Alvarado lost her life in that cloudburst, and no doubt it made a great impression upon the people in the country, but I have gone carefully through the accounts of it, and it is quite clear that it had rained very hard for three or four days, and that it was a wave of mud from the slope of the mountain that overwhelmed that small town. The few inhabitants took refuge in the chapels, where they were most of them smothered. You have seen from some of these photographs the very beautiful outlines of the volcanoes in that country, and I do not think one really could exaggerate the beauty of Agua and Fuego and the lake of Atitlan. The view at sunset or at sunrise from the top of Agua or Fuego, with the sun tinting that long line of peaks, is exquisite. And the cloud effects are unrivalled. It is extremely interesting to me to see these photographs of Santa Maria, because the last time I saw it it was a perfect cone, and Quezaltenango was then a flourishing city. I can do no more than congratulate Dr. Anderson upon the work he has done, and thank him for the photographs he has shown us.

Mr. ASCOLI remarked that he had been in the country at the time of the eruption and of the previous earthquake, but that the details were too numerous to go into that evening. A feature of the eruption not mentioned by Dr. Anderson, and which might tend to elucidate the mystery of the destruction of Ciudad Vieja, was the following: During great activity of the crater, at night-time, about a week after the first outburst, the village of Santa Maria, situated on the south-eastern flank of the volcano, was awakened by a terrific roar, which continued during several hours. On investigation the following morning, it was seen that a tremendous torrent of water had swept down the mountain-side from near the summit, and had cut a channel about 17 feet deep and 33 yards wide from the road about a quarter of a mile below the village, carrying everything before it. Up to the present no satisfactory explanation has been given as to the origin of this torrent, for on no part of the mountain-side is there room for any quantity of water to have collected. It is surmised that the occurrence was due to the rapid condensation of steam emitted from the crater; but this seems hardly compatible with the immense quantity of water which descended the mountain-side.

Mr. A. H. GEHRKE: The pleasure we have all had to-night in hearing Dr. Tempest Anderson, and viewing the magnificent photographs that he has shown us, is in my own case greatly enhanced in finding some notice taken at last of one of the greatest volcanic eruptions of modern times, which, in respect of its intensity and scope, considerably overshadows those other and much more celebrated eruptions which took place in the same year at Martinique and St. Vincent. True, the loss of life was, fortunately, not so great as at Martinique, though we probably lost more than two thousand in Guatemala, but the exact number will never be known. It was a remarkable fact, to us of the British colony, that the

Press in England barely noticed the eruption, some only mentioning it as a rumour from Washington. The contemporaneous German papers were, however, better informed of an event of such magnitude, and, indeed, in Germany volumes have been published by Dr. Karl Sapper, of Tübingen University, who had arrived in Guatemala the very night before the eruption broke out.

In order to give you some idea of the magnitude of the eruption, I must mention that Captain Saunders, the commander of the Pacific Mail s.s. *Newport*, which was off the coast of Guatemala at the time, says that he measured the height of the column of matter ejected, by his instruments, from the bridge of his steamer, and it was between 17 and 18 miles high, as near as he could reckon. The stuff was ejected in a north-westerly direction, and the fall of the so-called ashes extended as far as Acapulco, in Mexico, fully 600 miles away. On the other hand, the sound of the explosions travelled in exactly a contrary direction, to the south-east, and at Punta Arenas, in Costa Rica, also 600 miles away, it was so loud that people there thought that a warship was firing her guns all day long, "round the point." The deposit of the so-called ash—in reality pumice-stone, granite pieces, and their smaller particles forming a kind of sand—was, of course, deeper nearer the crater, where it still lies over 200 feet in depth, but it rapidly diminished with distance, till, at the frontier with Mexico, about 60 miles away, it only measured 13 or 14 inches, and from there on it tapered away gradually for 500 miles, until at Acapulco it was a slight layer of white dust. A rough calculation of what fell on Guatemalan territory alone—and it was only on that south-west corner that any stuff descended—shows the quantity to weigh well over 20,000 million tons, all ejected in those seventy-two terrible hours of complete darkness; and that is without taking into account the vast area in Mexico, thousands of square miles of deposit, inches deep. On our estate, "Helvetia," of which Dr. Anderson has shown you some interesting photos, and which has an area of about 5000 acres, the scoria lay from 7 to 12 feet deep, as it is situated only about 6 miles from the crater, and the total quantity we had on our land, we reckon, is not less than 50 million tons. The coffee-trees, which I can liken in size and shape to a good-sized lilac bush, say from 12 to 15 feet high, were just about buried in the ash, only a few twigs, leafless, of course, showing themselves above the surface. The houses and machinery had all been crushed flat; practically all the big forest trees still standing about on the estate were charred stumps, killed by lightning during the eruption; and the scene of devastation of what was once one of the finest coffee plantations of Central America, or indeed of anywhere in the world, was terrible to see. At the time of the outbreak there were nearly a thousand people working on the property, and that more were not killed is entirely due to the courage and devotion of the manager, Mr. Moesly, who stuck to his post, and imperilled his own life fearlessly in order to bring his labourers into as safe a place as possible; which was not very safe, however, as we lost some fifty lives as it is, amongst them that of the assistant-manager, Mr. Hartmann, who, with seventeen others, was crushed to death by a falling roof.

Some months afterwards, on revisiting the place with Mr. Moesly, we found some signs of promise. For one thing, there was more of the coffee-trees visible above ground. The heavy rains, most remarkable in their intensity, and due to the condensation of the immense quantities of steam continually issuing from the crater, had beaten down the sand to a more compact mass, and washed away a great deal besides, so that to-day, after five years, we have only a deposit of from 3 to 5 feet on the place, which we are anxious not to lose, as we find it useful in keeping down the growth of weeds, besides other advantages. When we looked at the place five years ago, and four months after the eruption, and saw a few leaves

appearing, we realized that the trees we thought dead were still alive, and we determined to do our best to save at least some of the estate. We had a bitter struggle, and had to spend an immense sum of money, but we have succeeded in bringing the plantation to a state of perfection that it never had before, and the crops are, as a rule, much heavier and of better quality than previously. One of our greatest troubles was that of sickness, owing to the balance of Nature having been upset by the eruption, which, having killed all the birds for some hundreds of miles, enabled the flies, mosquitoes, and rats to multiply to such an extent that life to man became nearly unbearable. The immediate consequence was an epidemic of malaria, which cost more lives than the eruption itself—many times more. It has passed, happily; the birds having come again, the breeding of these pests is checked, and the district again enjoys the excellent reputation for health that it deservedly had before.

I wish to point out that when we commenced work on the plantation after the eruption, we did not know very well how to set about it; conditions were all changed, former experience was useless. There was no information available, and though there was advice in plenty, it was contradictory and not practical at all. We and all the planters on the coast were left to invent our own devices and methods, and whilst many may have been successful, others have not. Even to-day, now that it is all over, and the individual planters have either sunk or swum, it is not clear what was exactly the best way, and what was the real cause of failure or success. Now, I think that here there is scope for a proper scientific investigator, with a taste for seismology, to put on record the eruption itself and its after history and effects, especially with regard to agriculture. He would find a field of absorbing interest; he might confer great benefit on future victims of these occurrences in other parts by telling of our experiments and their results as compared with those of other planters on that coast, and he would find a hearty welcome at Helvetia, where we should be glad to extend him the usual hospitality and good cheer, and tell him as much as we know. I give the invitation from no selfish motive, as our results are attained, and we are out of the wood, and it is inconceivable that we should have another eruption of this nature in this neighbourhood, seeing that the open vent now acts mildly as a safety-valve. In fact, our volcano will now probably rest content with its little fling for a few centuries. The common experience of volcanoes, in Central America at least, points to the fact that heavy eruptions are never followed by others in that particular district. It is generally another volcano that has a turn; so we consider our situation as particularly safe and sound, and pity other poor people who have eruptions still to come.

Colonel CHURCH: Guatemala is not a little country by any means. Its area is about 47,000 square miles, and it is the most densely populated of any of the Central American states. I desire to call attention to the treaty which has been made very recently in Washington between the five Central American nations. In this, their representatives have agreed to abandon all their differences, to respect each other's territorial possessions, and to end revolutions. Should this lead to a federacy of those states, it is of extreme importance to the commercial and political world, and to the general peace of the American continent.

In the admirable paper to which we have listened, one item has struck my special attention, and that is the enormous distance to which volcanic dust is carried. Dr. Anderson said it was 600 or 700 miles. That reminds me that, about six years ago, I was visiting a cousin of mine in the United States, on Narragansett bay, near the famous watering-place of Newport. He has a country seat there, and he told me that soon after the eruption of Mont Pelée, perhaps about

ten days afterwards, he had a barn painted, and before the paint dried there came a fall of volcanic dust, which evidently had travelled all the way from Mont Pelée, about 1200 geographical miles. But, worse than that, a lady, who happened to be calling at the house during the dust shower, had not only her gown but her best new hat spoiled. All that remains for me now is to echo your wishes, and convey your heartiest thanks, not only to the lecturer, but to the gentlemen who have kindly favoured us by taking part in the discussion.

Dr. TEMPEST ANDERSON: I thank you for the very kind manner in which you have received my name. I assure you it has been a great pleasure to come here to-night to speak to you.

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## THE STORY OF LONDON MAPS.\*

By LAURENCE GOMME.

IN order to consider properly the story of London from the maps, we must give some attention to London before the maps. London was a Celtic stronghold, as its name attests: it was appropriated as a Roman military camp, and grew into the proudest of Roman cities, *Lundinium Augusta*; it was utilized by the greatest of the Anglo-Saxon kings as a military defence against the encroaching Danes and men of the North; it was brought under the Norman dominion, and transformed into a city-institution of the English state by the great Plantagenet sovereigns. But of all these periods we have no maps; perhaps it would be safe to say no maps existed. But the question may well be asked whether any remains of these far-off periods cannot be restored to the maps? and a further and more significant question is presented to the student of London maps, Do not the maps themselves, coming to us in successive stages from the sixteenth century, contain remains of the earlier periods before the maps, some ancient landmarks, some unobliterated features which the cartographers recorded but did not create?

This last question is obviously an important element in the story of the London maps, for when we come to examine these precious relics of the past, it is borne in upon us that they contain much more ancient history than that belonging to Tudor times—topography that has never been obliterated. I shall be able to point out to you presently what I exactly mean by this. At the moment, I am anxious only to impress upon you the importance of knowing something of London before the maps in order to understand the London of the maps.

I will ask your attention, in the first place, to the stratification of modern London. It is not often possible to illustrate this, for those who have penetrated to underground London have not always been those who have understood or cared for the history of London to be

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\* Royal Geographical Society, February 10, 1908. Map, p. 588.  
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