The Evolution of Indian Geography: Discussion

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continent has shrunk to a group of isolated islets, or proved the illusion of a mirage, and the decision of the true nature of those which the look out now sees may be left to time, which tries all things, and proves or rejects them. It has been enough for me to sketch briefly some of the discoveries that have been made in the past, and I would beg you to remember that, though the voice may be mine, the hands are the hands of my colleagues, past and present, and of that band of volunteer workers, alas! so small in number, by whom the facts have been collected, and on whose observations the conclusions I have spoken of are based.

Before the reading of the paper, the following remarks were made by the President:—

The paper this evening, on the "Evolution of the Geography of India," is by Mr. Oldham, who has been for fourteen years a member of the Geological Survey of India, and has traversed almost every part of that country from Beluchistan to Burma. Mr. Oldham is a son of the founder of the Geological Survey—of that accomplished and indefatigable public servant who for more than a quarter of a century worked in India in his department, and whose talents, energy, and accomplishments did so much to raise that survey to the position which it now holds. His son, Mr. Oldham, is admirably qualified to inform us on the subject which is announced for this evening, and I anticipate a most interesting communication as a result of his studies.

After the reading of the paper, the following discussion took place:—

Sir ARCHIBALD GEIKIE: I should first like to be allowed to express my own gratification at hearing this paper from the lips of the son of the distinguished geologist who for so many years was the life and spirit of the Geological Survey of India. Those who remember Dr. Oldham will be pleased to think that his son should have followed up his work so ably. The subject which has been brought before us is one of surpassing interest, for it illustrates well what geographers are too apt to forget—that, in order to understand the geography of any region as it now is, we must learn how it has been gradually built up. No country came into existence just as it is. If we would discover how its topography has originated, we must study the results of long-continued geological observation. It is only by such a thoughtful study that such a lecture as we have had to-night can be elaborated. Mr. Oldham has shown skill in marshalling the facts collected in India by his predecessors and colleagues as well as by himself. My own acquaintance with Indian geology is not large enough to entitle me to criticize the paper, but there are one or two points which must have struck you as of more special interest. Mr. Oldham showed, for instance, how in India, as in other regions, we can still in some degree trace out the ridges that have existed from early geological periods, and form the nucleus round which the outer framework of the country has gradually been built up. He also gave us illustrations of a singular fact which has been brought out exceedingly well in other parts of the globe—the slow growth of many mountain-chains. When we see among the Alps, as at the head of the Lake of the Four Cantons, the rocks of whole mountain-sides folded upon each other like so many crumpled layers of carpets, we are apt to imagine that so stupendous a result could only have been achieved by the sudden operation of some colossal force. But in certain cases there is distinct evidence that the process of mountain-making may be exceedingly slow—not faster, indeed, than the rate of erosion of a river, and we

know how comparatively slow that is. Deep gorges have been gradually cut out of ridges, because the rivers passed over the land before these ridges were upraised, the rate of elevation having been so slow that the rivers could saw their way down as fast as the ground rose. There are one or two features in the later evolution of Indian geography which have interest for us here. Mr. Oldham pointed out the enormous sheets of volcanic material in the Deccan. Something of the same kind may be seen in the great level basaltic plateaux of North-Western Europe and Iceland, which are fragments of the vast lava-fields poured out in tertiary time before the last upheavals of the Alps. The Deccan volcanic sheets may be more extensive than those of Europe, as the mountain ranges of that region are vaster than ours, but there appears to be a kind of relation between the sequence of events in both regions. A very interesting part of the paper was that in which the author described how the forces that have carved out the valleys are getting feebler and feebler, and how in certain places they are so feeble as no longer to act. Mountains there will eventually be buried under their own debris. I must congratulate Mr. Oldham on his paper, which may be taken as a good example of the manner in which the geographical evolution of a region should be worked out.

Dr. W. T. BLANFORD: As one of the older members of the Geological Survey, who retired from the service about the time that Mr. Oldham entered it, I can only express my gratification at hearing so able an account of what may fairly be described as the contributions made in the course of years by the Geological Survey of India to our knowledge of the physical geography of that country. The majority of the facts brought forward by Mr. Oldham have long since been published, and were noticed in the original 'Manual of the Geology of India,' of which he has lately completed a second edition; but, at the same time, he has added some novel observations and made some good suggestions. Amongst the most interesting of these are the data as to the geological age of the Aravalli range, and of the eastern and western coasts of the Indian Peninsula. The interest of the former is rather geological than geographical, but the history of the coast-lines comes certainly within geographical limits, and deals with a subject on which geology has much to say. On maps of India two ranges are often represented, called the Eastern and Western Gháts, approximately parallel to the two coasts. The name is bad, for a ghát is not a mountain. It may mean a pass, but as it also means a wharf or landing-place on a river—everybody has heard of bathing and burning gháts—it is clear that the term really implies a place of access. The Western Gháts were the places at which roads from the westward led up to the plateau which occupies so large a part of the Indian Peninsula, and which attains its greatest height near the Malabar and Bombay coast. Now, the northern part, known also by the far better and more distinctive name of Syhádri, is merely the scarp of a plateau composed of horizontal lava flows, and is not really a range at all; and the southern portion, consisting of ancient gneissic rocks, has no well-defined axis. The "Eastern Gháts" are a figment of the imagination, the name belonging to the roads that lead to the Mysore plateau having been loosely applied to sundry groups of hills that have no connection with the Mysore plateau, nor with each other. One of these groups, it has been suggested by Mr. Oldham, may be connected with the history of the eastern coast from Madras to Masulipatam. In this case, however, it will be seen, by looking at the geological map, that the parallelism is not very well marked, and there is no range at all having the same relation to the coast south of Madras. The age of the west coast may be rather later than eocene, the marine fossils found in Travancore, upon which the geological date depends, being miocene, not eocene. The curious gap in the "Western Gháts," through which the railway passes from Madras to Bypore, is very probably, as Mr. Oldham has suggested, due to an

ancient river, and this may have run from the eastward. But there is another possible explanation, and that is that the river ran from the westward, at a time when the Peninsula of India extended to beyond the Laccadive islands.

If the present paper does nothing more, it may be hoped that it will give the deathblow to one venerable tradition. Few persons can travel by railway from Calcutta to Lahore, and from Lahore to Karáchi, without being struck by the wonderful plain of Northern India, and all who have visited the base of the Himalayas must have noticed how the spurs of the mountains rise from the plain as land rises from the sea. It is almost a natural deduction that this great Indo-Gangetic plain is an ancient sea-bed filled up by alluvial deposits. When I first went to India I accepted this view, and never doubted its correctness until I had seen something of the Indus valley, and until considerable progress had been made in mapping the geology of the country on the borders of the great plain. Then it gradually dawned upon me that there must be some reason why marine tertiary beds occur everywhere, and marine cretaceous and jurassic rocks in many places, along the borders of the Indus plain, whilst not a trace of a marine bed has been found on the margin of the plains watered by the Ganges and Brahmaputra from Delhi to Assam. South of the hills that rise on the southern side of the Assam valley plain are marine beds of tertiary and cretaceous age that mark the prolongation of the old eastern coast of the Indian Peninsula, but, so far as it is possible to judge, the great plain of Northern India east of Delhi has never been sea. Nevertheless, the marine origin of this plain has been so generally admitted as to have been accepted by many geologists and by writers on the distribution of animals, like Dr. Wallace, as a well-known fact.

This is an example of the usefulness of a paper like the present in calling attention to scientific observations which are almost certain to be overlooked so long as they are only published amongst the detailed accounts of a geological survey.

Sir HENRY HOWORTH: Although I must obey the chairman's invitation, I feel some hesitation in intervening in a discussion in which my two friends have already taken a part. I congratulate the meeting very much, not only on the paper, which has been a model of lucidity in dealing with an intricate subject, but in that we have also had with us two veterans, each of them *facile princeps* in his own way, one of whom has almost founded the science of applying geology to physical geography. Many points that have arisen and have not arisen are singularly interesting to us all, and might tempt a long digression. I should like, among other things, to learn from Mr. Oldham about one of the greatest of all problems in the recent geology of India, namely, an explanation of the deposits of laterite, the great crux of Indian geology, and to ask him if he has a theory of any kind by which to explain them. The outlines of India are very old, as is confirmed by the fact that in the laterite beds human weapons were found, and were apparently contemporary with the extinct animals of the Nerbudda valley, and therefore, probably, the eastern boundary of India at that time was very much what it is at present. With regard to land extending across where the Laccadive and Maldive archipelagos now exist, we know that in the island of Perim the same species of tertiary mammals occur as in the Siwaliks of India, proving that there has been a collapse of land along the northern part of the Indian Ocean in recent geological time. I am glad Dr. Blanford has called attention to the great northern plain of Hindustan, and the problems arising out of it. This very old plain contains in its bosom very much of the secret history of our race. It is almost the oldest alluvial plain in tropical regions where we have reason to believe man existed in very early time, and in the lower strata of its alluvium we should find secrets explained which we have looked for in all kinds of places. When we go further north we enter into a

congeries of difficulties which have raised polemics of various kinds, namely, as to the age of the Himalayan range. It is impossible to enter into this problem now, but I was pleased to hear Mr. Oldham's view, that the elevation of this range is so recent, comparatively, as the pliocene and subsequent period. This confirms the opinion of the veteran Strachey, in his admirable article in the '*Encyclopædia Britannica*,' that 15,000 feet have been added to the height of that range in very recent geological times. It casts opprobrium on our race, that with all its energy and go, and with so many public servants at its command, we should be so absolutely ignorant of the deposits on the flanks of the higher ranges. We know little of them beyond what has been brought down in a fragmentary way through Tibet half a century ago, and, it seems to me, we ought to converge our efforts upon solving what is such an important scientific problem, namely, the actual age of the Himalayan range. This was a problem that the king of geographers, Alexander Humboldt, set before himself long ago, and which he was constrained to solve in a way that, in several recent memoirs, I have felt myself obliged to follow. He employed some cogent arguments to prove that the Himalayan range is very much younger than is supposed; that the mountains were raised to their present great elevation in exceedingly recent geological times. I must join with my friend, Sir Archibald Geikie, in congratulating Mr. Oldham (the son of the pioneer of Indian geology) on his paper, and in wishing him a long and successful career in India.

MR. OLDHAM: The only points in this discussion that appear to require any reply from me, are those raised by Dr. Blanford with regard to the east and west coasts. When I spoke of the age of the east coast, I did not mean to say that it has kept very closely its present position ever since the distant period at which the Aravalli hills were raised, but that its present position marks approximately the extreme limit beyond which the sea has not been able to extend; the land doubtless extended further to the east, and there have been great variations in the coast-line. As for the west coast, I take it that the miocene deposits of Travancore and thereabouts show that at the close of the eocene period the coast had been established; further back than that I have no desire to go. Sir Henry Howorth will, no doubt, excuse me from replying to the points he has raised, because they are so uncertain that they could not be adequately treated without introducing a great deal of matter still open to controversy, and consequently rather unsuitable at this period of the evening. They are of very great interest, and I should very much have liked to have been able to treat of them.

THE PRESIDENT: Mr. Oldham's most interesting paper, and the discussion which has followed it, more especially the remarks of Sir Archibald Geikie and Dr. Blanford, remind us how much we owe to geology. The meeting will remember that it was a President of this Society who compiled and produced the first geological map of India, and that this attempt—for I believe that Mr. Greenough never professed that it was anything more than an attempt—stimulated the study of geology in India many years before the foundation of the present Geological Survey. My predecessor felt strongly that these geological studies were the basis of physical geography, and that we must look to geologists to explain to us many of the grandest phenomena we see upon the surface of the earth now, because their origins must be looked for in a very remote geological period. Several explanations of these phenomena have been given us to-night in Mr. Oldham's paper, and they manifest the close connection between geology and physical geography. It was such considerations which led Sir Roderick Murchison to insist so strongly upon this connection in the two last anniversary addresses which he gave us. There is one other point I should like to refer to. Mr. Oldham has explained the crossing

of the axis of the Himalayan range by some of the great northern rivers, especially the Indus. It seems to me that in the courses taken by these rivers we see, in the most graphic way, the connection between our studies and those of the geologists. We must go to the geologists to explain the origin of those gaps in the mountains (elbows, as they are termed by General Cunningham). We must go to the geologists to learn how the Jumna once formed part of the basin of the Indus; and we could not venture as geographers—although geologists can venture—to assume that the waters of the Jumna once gave a share to the Indus and a share to the Ganges, just as the Casiquari, in South America, gives a share of its waters to the Orinoco and a share to the Amazon. Then the comparative geographer comes in. He can tell us that from the dawn of history the Jumna had been flowing into the Gangetic valley. He tells of the change in the position of the junction between the Chenab and the Indus, and how the bed of the Ravi has wandered away from the walls of Multan. Thus we find the study of the two sciences closely interlaced. There are many other very interesting and suggestive points in Mr. Oldham's paper, and I am quite sure that the meeting will authorize me to assure him that we have appreciated his communication, and that you will all unite with me in giving him a cordial vote of thanks.

A JOURNEY IN HADRAMAUT.

By LEO HIRSCH.

My intention to undertake an exploration of Hadramaut is an old one. I tried to execute it in the year 1888, when I went to Aden for this purpose. But want of information, and the uncertainty of success in consequence, made me give up the idea, and I went instead to the country of the Somals, making a stay of three months at Bulhar, where I applied myself to the study of the Somali language. After my return to Europe, I entered into a lively correspondence with an intelligent Arab at Aden, Abdul Kadir Mekki, whose acquaintance I had made during my stay there. From this intercourse I derived great advantage, and the valuable statements of my Arab friend encouraged me to take up my former design, and try it a second time. I arrived at Aden on December 2, 1892, receiving every assistance needed, especially letters of introduction to the chiefs of Makalla, Shehr, and Kishin from the British Resident, General Jopp, and the native Assistant-Resident, Mohammed Salih Ja'fer. In the middle of January, 1893, I left in a small steamer for Shehr, where I arrived after thirty-eight hours, the distance being 320 geographical miles. I was well received by the Jem'adar Husein bin Abdalla bin Omar bin Audh el Ka'aity, and a house was assigned to me, but nothing done to promote my aims. I therefore left, and went, February 4, by a sambuk to Seihut, a port on the Mahra coast, near the outlet of the great wadi, generally called Masila, which, after having taken its course through the whole of Hadramaut, enters the sea about two hours west of said place. My secret hope of pene-