

SCIENCE LECTURES FOR THE PEOPLE.

NO. 3.—ELEVENTH SERIES.—1879-80.

PALESTINE IN ITS PHYSICAL ASPECTS.

*A Lecture, delivered in the Hulme Town Hall, Manchester,
on Wednesday, November 26th, 1879.*

BY

REV. CANON TRISTRAM, LL.D., F.R.S.

PRICE ONE PENNY.

JOHN HEYWOOD, EXCELSIOR BUILDINGS, RIDGEFIELD, MANCHESTER
AND 18, PATERNOSTER SQUARE, LONDON, E.C.

LECTURE SEASON 1879 & 1880.

The following Series of Lectures will be published by JOHN HEYWOOD, Manchester and London, immediately after the dates given in the Syllabus for their delivery, at the uniform price of ONE PENNY each, excepting the Manchester Statistical Society's Papers, which will be according to the number of pages each Paper contains.

MANCHESTER SCIENCE LECTURES FOR THE PEOPLE.

ELEVENTH SERIES. 1879-80. ONE PENNY EACH.

Islands, as Illustrating the Laws of the Geographical Distribution of Animals. ALFRED R. WALLACE, F.R.G.S., F.L.S. Illustrated. Ready.

The Age of Dragons. B. WATERHOUSE HAWKINS, F.G.S. Ready.

Palestine in its Physical Aspects. Rev. CANON TRISTRAM, LL.D., F.R.S.

Traps to Catch Sunbeams. Capt. W. DE W. ABNEY, F.R.S., R.E. Illustrated.

MANCHESTER HEALTH LECTURES FOR THE PEOPLE.

THIRD SERIES. SEASON 1879-80. ONE PENNY EACH.

(Published by the Authority of the Manchester and Salford Sanitary Associations.)

Alcohol, and its Hereditary Effects. H. HUMPHREYS, M.A., M.D., M.R.C.P. Ready.

Choice of Food. H. SIMPSON, M.D. Lond.

The Special Dangers to Health in Large Towns, especially in Salford. J. TATHAM, M.D.

Water: Its Work of Purification. A. RANSOME, M.A., M.D.

Ventilation of Houses, and Drainage. H. ASHBY, M.B. Lond.

Personal and Household Arrangements in Relation to Health. J. ANGELL, F.C.S.

Management and Recreation of Children. W. N. MACCALL, M.D.

Day Nurseries and their Bearing upon Public Health. J. M. SUTTON, M.D., M.R.C.P.

GLASGOW SCIENCE LECTURES FOR THE PEOPLE.

SEASON 1879-80. ONE PENNY EACH.

The Chemical Action of Light. Prof. ROSCOE, LL.D., F.R.S. Illustrated. Ready.

Liquid, Gas, and Steam. Prof. Sir WILLIAM THOMPSON, LL.D., D.C.L., F.R.S.

The Relation of Structure to Function in Animal Organisms. Prof. SCHÄFER, F.R.S.

Thunderstorms. Prof. TAIT, M.A. January 29th, 1880.

The Latest Researches into the Origin and Development of the Least and

Lowest Life Forms. Rev. W. H. DALLINGER, F.R.M.S. February 19th, 1880.

Mental Evolution. GEORGE J. ROMANES, M.A., F.R.S. March 4th, 1880.

MANCHESTER STATISTICAL SOCIETY'S PAPERS.

In the course of the Session the following Papers, among others, will, it is expected, be communicated to the Society:—

The Revival of Trade. Mr. ELIJAH HELM. Ready. Price Threepence

National Insurance considered Economically and Practically. Rev. W. L. BLACKLEY.

The Stationary Populations in the South and West of England. Mr. THOS. A. WELTON.

The Essential Conditions of Sound and Prosperous Trade. Mr. WM. HOYLE.

The Silver Controversy. Mr. ROBERT MONTGOMERY.

Silver in 1879. Mr. F. J. FARADAY.

The price of each Paper will be according to the number of pages.

ARTHUR MURSELL'S SUNDAY ADDRESSES TO WORKING MEN,

DELIVERED IN BIRMINGHAM. ONE PENNY EACH.

1. Will it Pay?

2. Edged-Tools.

3. Electro-Plate.


THESE ADDRESSES WILL BE RESUMED IN JANUARY, 1880.

Of the long series of popular addresses by this well-known lecturer, the "Spurgeon of the Midlands," these may be taken as fair examples—vigorous, eloquent, thoughtful, and thought-compelling.—*The Bookseller*, November 5, 1879.

PALESTINE IN ITS PHYSICAL ASPECTS.

*A LECTURE, delivered in the Hulme Town Hall, Manchester, on Wednesday,
November 26th, 1879.*

BY REV. CANON TRISTRAM, LL.D., F.R.S.

ROBABLY most of you have heard of the very interesting discoveries which have been made of late years by our antiquarians in some of the old monasteries in the East, where they have found, under some old monkish legend or later history, what is called a palimpsest—that is to say, the traces of some far older manuscript, which has been written on parchment, and that parchment has been triturated and rubbed smooth again, and in the scarcity of material for writing has been used for the record of some mediæval story. Now one of those palimpsests, which I have seen in a Greek monastery, affords you now and then, in the corner, just some peep by which even the untrained eye can detect the old uncial letter underneath the more recent writing.

I want you to look upon the face of any portion of the earth with much the same eyes that an antiquarian would look upon a palimpsest. I want you to conceive that this earth of ours has repeatedly been changed, and its surface rubbed down by the action of nature. It has been polished by the pumice-stone of time and change, and then upon that surface have been inscribed new features.

But however teeming the earth may be with life, however full it may be of objects of interest of every kind which are now living, we find everywhere the traces of the past. We find a line here and a line there so clearly marked out that the past is not left wholly to conjecture. Occasionally these processes of change are arrested, but this is not the case generally. I do not know any country

in the world which gives us so many glimpses of the past physical and natural history aspects of nature as does Palestine, or, as I prefer to call it, the Holy Land. And I think that this has not been without a reason in the arrangements of Providence, as I hope I shall be able to show you.

Whilst in the other countries and in the rest of Europe the glacial epoch, and still more the miocene epoch of comparative warmth which preceded it, has left no *living* traces, I think I shall be able to show you that that little corner to the east of the Mediterranean, Palestine, or Syria south of the Lebanon, has preserved the last living records of the period of miocene heat and of the period of glacial cold.

Now, there is a connection everywhere between the past and the present, the links of which it is the business of the naturalist and the geologist to find out. I think that in the living forms of Palestine we may trace many points of geologic history. What are those living forms, and wherein do they differ from those of the rest of the world?

Now, in the first place, I should like to point out to you that Palestine, though a very small country in a very obscure corner of the Mediterranean, possesses features unparalleled in the rest of the world. I do not know that there is any spot in the world where, within a space of 100 miles, you can find more startling contrasts in climate, and fauna, and flora, and natural phenomena generally. Let me give you some idea of the country. You know that from the great backbone ridge which stretches from the Pyrenees right across Europe and Asia to further China, there come down various lateral spurs northward and southward, like the Ural Mountains to the northward; and down from the Caucasus comes the chain of the Taurus, dividing Asia Minor from the western watershed of the Euphrates, and then coming down into Syria. Well, that mountain range culminates in the familiar names of the Lebanon and Hermon. Hermon is often called the Anti-Libanus, or the mountain opposite Lebanon. Lebanon and Hermon divide Syria into two natural parts—Northern Syria and Southern Syria, or Palestine. The Lebanon is 10,000 feet high, only 20 or 30 feet short of what would have been the line of perpetual snow. There is snow on Lebanon 50 weeks out of the 52, yet alpine travellers despise it. And Hermon only wants about 35 feet of the line of perpetual snow. I believe that Hermon usually has snow on it till about the end of August. I have seen snow on Hermon in September, and have

waded in its snow in July; so it is all but perpetual snow. Well, those two ridges are the culminating points of the range which comes down from the Taurid, and between the two there is a deep chasm called El Bukáa, the Cœle Syria of the ancients; and that chasm or hollow is the nursery which supplies the springs from which, lower down, the Jordan starts. The Lebanon runs down on the west, keeping close to the coast; it gradually subsides and expands southward until it is lost in the Sinaitic Desert, south of Beersheba, before you come to Suez.

It seems as though there was the same bulk through its whole extent, but flattened and expanded as you go southward. The Jordan divides the country by a deep chasm, of which I shall have something to say hereafter. On the east side, Mount Hermon descends first into the hills of Bashan, which are full of volcanic action, and then into those of Gilead, about 8,000 feet high, and finally descends to the mountains of Moab, which hardly reach 7,000 feet. It then runs down into the Akabah, and is lost on the east side of the Sinaitic peninsula. I have here tried to give you an outline of the country. You have two mountain ranges, each of them expanding as it goes southward, until lost in the Arabian Desert; but between them you have the extraordinary and unique phenomenon of the Jordan valley. I call the Jordan valley "unique" because there is no other instance known on the surface of this globe in which you have an open space 1,300 feet below the level of the Mediterranean or Red Sea. At the plain of Geneseret, which is about 60 miles from the Dead Sea as the crow flies, it is about 600 feet below the level of the sea. At the Waters of Merom it is just on the sea level. The Jordan, as it descends that narrow valley, performs a journey of almost 200 miles for every 60 in a direct line. It winds within such narrow limits that it never diverges seven miles from a straight line on either side during the whole of its course. The Jordan empties itself into the Dead Sea, which is about 16 miles wide by 45 long; and whilst its surface is 1,300 feet below the level of the sea, its deepest parts are the same depth, 1,340 feet. It is, in fact, the deepest inland fissure known to us on the surface of the globe. I have not yet spoken of the origin of this, but I wish to point out to you the peculiarity of climate which results from it.

You have on Lebanon and Hermon a climate like that of the Alps, or two-thirds of the way up Mont Blanc. You have on the tops of Lebanon and Hermon an almost arctic climate, and you have a fauna and a flora—animals and plants—corresponding

to that climate. You know that when you descend a coalpit 1,300 feet deep you get into a very warm temperature indeed. The consequence is you have around the Dead Sea a tropical climate, and you have tropical products. Now Hermon springs 10,000 feet high from its base at the Waters of Merom. Just up here, at the north of the Holy Land, you find yourself at the starting point of the Jordan, which springs not above 20 or 30 feet above the sea level. Mount Hermon rises abruptly from its base near Lake Huleh—ancient Merom. Although Hermon is only 10,000 feet high, I am not aware of any mountain which rises so suddenly or so directly from its base. Take, for instance, Chamounix. If you want to go to the top of Mont Blanc, you know that Chamounix is many hundred feet above the platform of the Mediterranean. It is true that Mont Blanc is many thousand feet higher than Mount Hermon, but from its immediate base it is not so high. When you get up to the Grand Mulets you are not so far from the summit of Mont Blanc as you are at Lake Huleh from the summit of Hermon; the consequence of this is that you have brought together in that spot a greater contrast of produce, animal and vegetable, than I have found anywhere else. You have the arctic climate of the north on the tops of the mountains, and a tropical climate in the Jordan valley, where, in the month of January, I have been glad to sleep in the open air, the thermometer never being below 80° at midnight. At the east and south you have the dry sandy desert, so that you have four distinct climates within view of each other. I can stand on any of the hills of Judæa and see the snow-capped tops of Hermon and Lebanon, and look over this vast desert eastward and down to the seething tropical valley of the Dead Sea.

Now, with all that, there is nothing in the physical character of that country which is striking or phenomenal, as people would call it. It is about the most commonplace and ordinary country in the world that I have ever seen. There are no startling features, but there is endless variety in it; and I cannot help thinking that there is something very providential in the extraordinary variety which is brought together within a district of the Holy Land, which is not so large as these six northern counties, because I remember that it was chosen as the country in which was written a Book which was to be for the teaching and guidance of all mankind in every country and in every age; and I know no spot in the world in which there could have been found brought together so many phenomena of nature, maritime and desert,

mountain and plain, hill and valley, tropical, temperate, and arctic, as are brought together there within the space of a few miles. And when I remember that that Book was to be for the teaching of all men, for all time, I feel that there is something providential in that ordering of circumstances which led to the selection of the only spot, as far as we know, in the whole world in which there is such a great variety of objects for the illustration, comparison, and elucidation of Holy Writ as in that country of the Holy Land. Often when I have been in that country, on one of its hills, and have noticed the variety of scenery brought into my view at one time, I have thought to myself, "What would the Bible have been if its pages had been written by men who had lived only in the monotonous valley of the Nile? What would they have been able to pen in the way of illustration which would have come home to the heart of the English peasant?" Again, if that Book was written by men who were only familiar with the phenomena of Arabian deserts, how could it have come home to those who dwell on the sea? Had it been written by inhabitants of tropical India, how would it have come home to those who are familiar with "snow and frost and vapour fulfilling His will"? In fact, there are illustrations taken from every kind of natural phenomena, and yet none of them are very marked or startling. I remember that on my first visit to the Holy Land, after I had been travelling in the Morea and Southern Greece, where the scenery was most exciting to the imagination, I found that in the Holy Land, though the scenery was not less varied, there was nothing that was not intensely commonplace. You may ask, "How do all these things come together?" Now I come to the direct point of my lecture, which is the physical history of the country, because I think that by natural causes we can account for all these singular varieties being brought together in this country; and I think I shall be able to show you, by the aid of a few specimens, how we may read the chapter of the past geologic history of that country.

In the first place, let me remind you that naturalists have of late years divided the world into six areas, if we may so call it, of creation. I do not mean to say that these things allow of a sharp line of division, for there are no sharp lines in nature. There is first, the Palæarctic, or Old World area, which includes Europe, Asia north of the Himalayas, and Africa north of the Sahara. There is the Indian, which includes Arabia, Persia, India, and all Asia south of the Himalayas. The third is the Ethiopian, Africa south of the Sahara but including Egypt. The fourth region is the

Nearctic, or North American down to the Rio Grande. The fifth is the South American region, including the West India Islands. The sixth is Australasia, which requires a great deal of subdivision. It so happens that three of the divisions I have mentioned—the Old World, India, and Africa—have their distinct plants and animals. Now observe the position of Palestine. It is almost an outlying part of the northern region; it is near Egypt, which belongs to the African region in the opinion of biologists; it is not far from Arabia, which belongs generally to the Indian regions; so that you see it is just on the fringe of three regions.

I have on the table before me specimens which show that it has drawn its forms of life from all those regions. There are in Palestine four distinct faunas and floras. I need not remind you again of the tropical temperature you get at a depth of 1,300 feet below the sea level. We have one flora and fauna on the coast and the highlands or hill country, which is what we call Germanic, the same as is found in the whole of Southern and Central Europe. Then we have in the outlying portion the desert fauna and flora. Then we have the alpine on the tops of Hermon and Lebanon, and then in the Jordan valley we have the tropical. I have not much to say about what we call the coast-line of the hill country, which is very much like the rest of Europe; but still there are certain remarkable differences, which show that the country has been for some time separated from continental Europe. Its general character is recent. There is hardly anything to be found in that part of Palestine—that is, taking the watershed which includes all the chief towns, Samaria, Bethel, Jerusalem, Bethlehem, and Hebron—which is not found in the neighbouring countries; but still there are some interesting varieties, which show how, when countries have been separated for some little time, differences become stereotyped, and in time become distinct varieties and species. Take, for instance, this jay—the jay of the Holy Land—which I hold in my hand. It is the common jay of the olive-yards, and is exactly like our jay, which I hold in my right hand, in all particulars excepting its headdress. You observe it has a black cap with a white front. Ours has a mottled cap altogether. This bird is only found in the Holy Land. If you showed me a jay like this I would stake my reputation it came from Syria. When I go to Asia Minor, to Mount Taurus, I find a jay that is black altogether. The Asia Minor jay is, as it were, the central one, and as it gets scattered it becomes more and more mottled. You see that the Holy Land jay has a white frill to its black cap;

the English one is black and white altogether. Now it is a curious thing that in Japan I find a bird exactly the same as the English one in dimensions, but there is this invariable difference, that whereas the English bird has a white line from the eye to the mouth the Japanese one is always black. It is not a question of more than one-eighth of an inch, but it is permanent and settled and never varies. Now what do we gather from that? I can build up from it a nice little theory, with which I have no doubt my friend Mr. Wallace would agree. I have a great collection of about 100 jays from all countries, from Ireland to Japan, and I can pick out any one, and tell you what country it came from; but the intense colour is always close to the centre, and the centre is somewhere—as it is for man—close to the Caspian and Black Seas. The jay gets more mottled as it is found at the extremities. In the Holy Land it has not lost the black cap, but it has got a white forehead; and that is one of the marks found only in the Holy Land, and it shows that the fauna has been isolated for a sufficient time to acquire distinctive marks. I also collected the insects of the Holy Land, and found them pretty much the same—that is, the winged things. The beetles are not very different; and some things which are lower than beetles, and which I won't name here, are decidedly distinct.

I found one or two very interesting traces of extinct mammals. I found a number of bone caverns in the lower slopes of the Lebanon, the contents of which I submitted to Professor Boyd Dawkins, a name very well known here, and he very kindly reported upon the teeth I collected. I found in those bone caverns, along with an immense number of rude flint implements, remains of the animal which in our Bible is translated unicorn, and which is simply the wild *aurochs*, which means the ox of yore. This animal was abundant in the time of Cæsar, and existed in the Hyrcanian forests, and in some parts of the Belgian forests, as late as the Norman conquest, but it has become utterly extinct in Europe. For 700 or 800 years there have been no traces of it. It was the largest and finest of the wild buffaloes. We also found numberless teeth of the bison. In a cave on the southern slope of Lebanon we came across a place which had been the resort of the primeval man of 3,000 years ago, a little before the time of Abraham, when the country was conquered by the Assyrians. These Troglodytes, of whom the Amalekites were specimens, and the Horites, which means "cave-men," evidently brought into this cave the animals they had captured in the chase,

*

and the teeth being the least perishable part remained in great abundance. We found also the teeth of the elk, and of the ibex, which is still found within 50 miles of the place. We found the teeth of the bison, and immense quantities of the teeth of the red deer and the roebuck, and still more curious, the teeth of the reindeer. That shows there has been a great change of climate since the reindeer was there contemporaneously with the others. Whether the reindeer was exterminated by man or by the change of climate, I cannot say; but there are the evidences of human weapons amidst the remains of these animals, most of which are extinct. These are the principal features of that part of the country.

The general conclusion I draw is, that everything there has come since there have been great géologic changes—it is, in fact, German; but when I get a little to the east, into the desert, the differences, which are considerable, mark its character as distinct from the peculiar features of the Sahara. I know a little of the Sahara fauna, and I was much struck by the difference between the desert south-east of Palestine and the Sahara, in this respect, that the country south-east of Palestine shows very strong African traces, whilst the Sahara shows nothing African. Everything in the Sahara seems to be related to the north; everything in the south-east of Palestine seems to be related to the south. The reason I lay stress upon that is this: for instance, here is the animal mentioned in the Bible as the cony. He is, indeed, a “feeble folk.” He has neither claws nor teeth worth speaking of, he has no canine teeth, and hardly any molars, and not a nail he can scratch with. Altogether, he is the most helpless creature in the world; and yet, though small and insignificant, he has noble relatives. His nearest relative is the hippopotamus—he is first cousin to the hippopotamus. In his anatomy he is absolutely unique. This creature is found only in the Jordan valley. But stop a moment. In Central Africa there are two other species—one near the Cape, and the other in Abyssinia—but they are distinct as species. He is a pachydermatous animal, perfectly harmless, a vegetable feeder. He is not found in the Sahara, but he is African in his relationship.

We found also there various curious antelopes, but I could not bring one here—in fact, we could not catch them. There are some fine antelopes there, very wild; also the ostrich, of which I possess a specimen; and it is rather interesting to know that the ostrich was formerly found in Asia, though not within historic

memory. Probably there is not another existing specimen of an ostrich found in Asia. My ostrich, killed by an Arab sheik between Bagdad and Medina, is a proof that the story of the Arabs is true, that there are a few ostriches left in Arabia—though very few. We also found the bustard, and many other desert mammals, like this beautiful jerboa and this desert squirrel. These little rodents of various species swarm in the desert, and are peculiar to it. The colour of everything is changed by the climate. For instance, the hare. I do not think an English game-keeper would condescend to prosecute a poacher for killing a hare like this; but this is the true hare of the desert east of the Holy Land. He is exactly the colour of sand. The creature is not so big as a British rabbit, yet his ears are twice the size of the ears of our hare. The Syrian hare is very much like our hare, or rather more like the Irish hare, but three times the size of the desert species. It is perfectly evident that the ears and colour of this hare were adapted to his mode and place of life. His ears are disproportionately long, because the little creature has to use far more energy in his preservation than would be necessary in an ordinary country. He lives upon the very sparse herbage of the desert, a tuft here and another tuft a hundred yards off, and nothing but sand between them, and no cover in which to hide himself; and therefore whilst reduced in size, and of a perfect sand colour, his ears have been lengthened, so that he may keep a good look-out for his enemies. On the other hand, his enemies have been developed also. Here is the wild cat of the desert. It is a rather formidable animal, and a poor hare would have little chance with it. I cannot say whether this is the original of our tame cat, but it is closely allied to it. It is a black-footed cat, very savage, and much larger than the ordinary wild cat. I was riding along one of the wildest parts of the desert of North Arabia when one of my servants shot this specimen. This cat preys upon the hares and conies. The climate, which has reduced their size and made them more alert, has made their enemy the cat more strong and vigorous, because there is more energy required in obtaining food than in an ordinary climate.

I may mention some curious *remanets* of former times. I have no doubt you have all read the charming and amusing accounts of his canoe travels written by my old friend, John MacGregor, "Rob Roy," and his interesting story of his having seen a crocodile on the Kishon. Rob Roy only "saw" a crocodile, but never caught it. Here it is. This is the head of a crocodile which

measured 20 feet long, and was caught in the marshes just at the foot of Mount Carmel, exactly at the place called by the ancients and by Ptolemy the Crocodile River. The Crusaders said the crocodiles were to be found there. I saw the footmarks of a crocodile there, and when I offered the Arabs a sufficient reward they brought me this crocodile. There can be no mistake about it, but it is the only specimen in Europe of the true crocodile found out of Africa. I show it here to prove the connection of the fauna of that part of Syria with the African or Ethiopian fauna. I do not look upon the desert fauna as a distinct fauna; it is an interesting modification. The country in which that hare was found must have been many centuries desert in order to reduce a respectable hare to those dimensions. The country in which that cat was found must have been of a nature to encourage great activity and great circumspection on the part of the feline race for many generations before they would develop to that size. Then we come to this conclusion—that the Arabian Desert is very much older as a desert than the Sahara Desert, because I find the Arabian birds and animals far more pronounced in colour than the African species. When I see the Arabian lark different from the typical lark, the conclusion I am entitled to form as a naturalist is that this lark has been separated from its kind, and been in a dry climate a much longer time than this intermediate species from the Sahara. I infer therefore that the Arabian or Holy Land Desert is older than the Sahara Desert, and I find that geology and palæontology corroborate this, so that one part of natural science works into another.

I must now touch very shortly on the third or mountain fauna, which I find extremely interesting from its remarkable similarity to the fauna of Lapland and Norway, the Alps and the Pyrenees. I remember being on the melting snows of Mount Hermon one morning at the end of May, when I saw a little creature rush, as I thought, under a stone amongst the broken ice. I ran forward, leaned upon the rock, and tried to catch it. My friend, who was behind, said, "Oh, you have crushed it." It was this rat, or rather not rat, this vole, which I had killed unintentionally. You know the difference between a vole and a rat. Voles have nothing to do with our rats, though they are rodents; but they are animals of a different class and more closely allied to squirrels. When I compared this with the animals in the British Museum I found it was identical with the little vole which is found on the Alps, the Pyrenees, and the Carpathian Mountains. Now it is curious how

a little animal like this, which does not travel, could possibly be found on the Alps, on the Carpathian Mountains in Hungary, as well as on Mount Hermon, but not in any intermediate country, excepting close to the snow-line. Afterwards we shall see the reason for this.

I now descend from Hermon into the Jordan valley, and I do not know a more marvellous day's journey that a naturalist can make. I have camped under the Scotch firs on the top of Mount Gilead, and then descending past Ramoth-Gilead I came to the Turkey oaks, and then down to the evergreen oaks, the prickly ilex, then the forests of wild olive, the sycamore, fig, and the splendid Syrian arbutus; then we came to the false balm of Gilead; and finally I camped at night under the date palms and the shittim, in a temperature of 88° , in the plains of the Jordan. That is one day's ride. In that day I passed through four different zones, from Scotch fir down to date palm in its native soil. I do not think you could do that in any other country in the world in so short a ride. What did we find when we got into the Jordan valley, 1,300 feet below the level of the sea? I will endeavour briefly to describe its peculiarities. I went round the Dead Sea. It ought not to be called the Dead Sea. That is a modern name, and gives rather a false impression, though there is no life in its waters. The Jews called it simply the Salt Sea, and they were right. We obtained a good pound and two ounces of salt out of three pounds of water by boiling, so you may fancy it is a saturated solution of salt. It is so buoyant you cannot drown in it, unless you will keep your head down and your feet up. The water is salt simply because the sea has no outlet. The Jordan and its tributary streams deposit their waters year after year, and the evaporation, which I think rather more than counterbalances the inflow, leaves all the earthy and mineral sediments, and as only pure water is evaporated, the sea is becoming more and more salt. I have waded twenty or thirty yards into the sea at the south end in shallow water, and have gathered from the bottom masses of salt crystals. There is an additional supply of salt at the south end. There lies on the top of the new red sandstone deposits close to the south of the lake a salt mountain, which is seven miles long, three miles wide, and about 300 feet high, by the side of which and underneath streams are continually percolating into the Dead Sea bringing in salt. No wonder, therefore, that there is no life in this sea. There could not be. But the land down to the water's edge is teeming with life, and the interest of that life is that it is so

different from what you find in the country higher up. I once spent a year in that country, chiefly in the neighbourhood of the Dead Sea. I was led to do so by a trifling incident. I had been asked to write some articles for Smith's "Dictionary of the Bible" about the Sea of Galilee, and amongst other things I was to touch upon the fishes found in that sea. I am ashamed to say that though I had often eaten the fish of the Sea of Galilee I had never examined them. I supposed they were the ordinary barbel, carp, and other fish. I never asked any questions about them, though I had helped to catch them; and nobody could tell me anything about them. There were no specimens of fish from the Sea of Galilee in London, Paris, Berlin, Washington, or in any other museum, so far as I could ascertain. Naturalists assumed that the fish must be the same as those in the waters of other neighbouring countries. But it would not do to take this for granted. Then I went to Sir Charles Lyell, and told him I had shot tropical birds in the Jordan valley, one of them a bird that had no business there, a new species, belonging to a family only found in tropical Africa, *Amydrus tristrami*. This led me to suspect that there might be peculiarities in the fishes as well as the birds. Sir Charles Lyell advised me in the kindest way, for he had a most genial manner of encouraging young men in their inquiries, and gratefully shall I ever cherish his memory. "If you want," said he, "to master the geology of that country, take a friend with you and your knapsack, and go to Auvergne, in central France, put up at Clermont-Ferrand for a fortnight, and walk about the country until you can read it like a book, and then you will be educated for the Jordan valley." I followed his advice to the letter, and I found I was educated for the Jordan valley, and could read it when I got there. But I did not expect to find, beyond the geologic solution, the palimpsest peering through the recent writing. I did not expect to find the birds of old India and the tropics living down there as we did. We found around the Jordan valley fifteen new species of birds, and seven or eight that are not found nearer that basin than Southern India, and as many more that are only found in the hotter parts of Abyssinia and the Zambesi. I found the sun-bird, *Nectarinia oseæ*, the only sun-bird found in the Mediterranean basin, its nearest cousins being in Southern India and Central Africa. I found this magnificent king-fisher, *Halcyon smyrnensis*, in abundance in the Jordan valley. To find it again you must go to Madras. I found this grackle. To find his cousin you must go to South Africa. I found this beautiful little partridge

of the wilderness in the very place where David was hunted "like a partridge in the wilderness," and where the Arabs still hunt it, breaking its legs by hurling sticks at it. It is a beautiful little bird. I show you here the ordinary partridge of the Holy Land, a noble species, very much like the red-legged partridge of Norfolk, but larger. But as regards this Jordan valley bird I must go to Southern India to find any species at all like it. Then, whereas in all the country round we found the old-fashioned peregrine falcon, here we found the lanner falcon, a less bold, and weaker bird, adapted, however, to that luxuriant climate. We found many other animals that were peculiar to that district, like this beautiful sun-bird and others, the nearest relations of which are to be found in tropical Africa, or tropical Asia. Amongst others we found the swift, the night-jar, doves, and warblers of various species.

It was the same with the plants. We found in that basin 82 plants that did not belong to the European family, and of those 9 were Indian and 43 African. We found butterflies and grasshoppers, locusts and beetles, nearly all of which were Indian or Abyssinian.

We proceed next to the fishes: they are the most interesting of all. There are no fishes in the Dead Sea; but there are fishes, chiefly *Cyprinidæ*, or of the perch tribe, in the little streams and rivers close to the Dead Sea. I have seen the date palm absolutely dipping its fronds into the Dead Sea as it hung over—for on the east side the date palm is very luxuriant. On the eastern shores there is as wonderful an exuberance of vegetable life as will be found anywhere on the face of the earth. The plants are like hothouse plants growing wild. In the warm waters entering to the sea there are small fishes of various species. We found 13 new kinds of fishes in the Jordan and its affluents. Dr. Günther, of the British Museum, kindly described them in a paper in the Proceedings of the Zoological Society of London, and certainly such a discovery amply repaid our search.

I wish now to point out the conclusions come to from these fishes, for they are really the climax of the physical geography of the Jordan valley. The fishes found in the Sea of Galilee not only belong for the most part to species different from those found in any stream flowing into the Mediterranean, but they belong frequently to different genera. Some years before, I brought home the type specimen of a fish, the only species I could find in some salt lakes of the Sahara, and Dr. Günther declared it to be not only a new species but a new genus. I remember Sir Charles

Lyell observing, "You have got there the last living representative of the Saharan ocean." We found in the Sea of Galilee three more species of the same genus, but each distinct. Speke brought back two species of the same family from the Nyanza, and Dr. Kirk has described several from the Zambesi and the neighbouring region.

Now we may see what that comes to. Why, we have got the same genus of fishes represented in an infinity of specific types from the Sea of Galilee and the Jordan that are found in the feeders of the Nile and in the central African lakes down to the Zambesi. The conclusion is natural that all these fishes come from a common origin, and that during the tertiary period there was a chain of fresh-water lakes extending to the lakes in Africa, similar to the chain of lakes in North America.

I have now stated the facts, and I will draw my conclusions very shortly. The inference I drew at the beginning was that the peculiarities of this country were providential. But we have also to explain their origin. I think there is one thing that solves at once these apparent varieties, and which is the dictionary by which we may translate them all, and that is the geological history of the glacial epoch, and the periods immediately preceding and following it. When we look at the Holy Land as it is at present, I think, in the lower hills, we can see traces of the close of the glacial epoch. We see the glacial epoch itself in its living relics in the fauna and flora of Lebanon and Hermon, and then we see what we see nowhere else, traces of the period before the glacial epoch in the fauna and the flora of the Dead Sea, and it is the only place in the world where we can see living traces of that epoch so far north.

You know that the geological theory is this: that the forms of life, vegetable and animal, which we find now, came upon the earth, or were developed, a little before the time when it was fitted for the reception of man; that immediately before the human period Europe and the countries around the Mediterranean were pretty much as they are now; that prior to that there had been a period of intense cold—a period during which, as we know by the researches of our own geological survey, these countries, especially the north of England and Scotland, were under water—the period to which we are indebted for the great glaciers which came down and carried the boulder clay from Norway, Greenland, and Iceland, leaving it on some of the best lands in England; but that before that period, as may be shown

by the chalk-cutting in Norfolk; there was a warm period, which is represented richly in Germany by the miocene deposits. Now that is history, and history which can be as clearly substantiated as any part of human history. But there is a further theory, and I do not say whether it is true or false—I merely state it as an hypothesis by no means improbable. It is that during the warm period which preceded the cold period there was a great southern continent extending from Madagascar across to India at the time when the Mediterranean and the Sahara were one vast ocean extending to the centre of Africa. Now, if this be true, see how marvellously the state of life in the Holy Land is explained by such a theory.

Supposing there were, as I suggest, at the time of the early existence of these fishes, a series of lakes extending from the foot of Hermon right down to the Zambesi and South Africa, we should naturally expect to find similar fishes in all these lakes, as is the case with the lakes in North America, and supposing there was this great continent extending from Southern India to Southern Africa—and the supposition is that the Indian Ocean at that time had not become depressed as it is now, but was part of the great continent—you would then have the same forms of life spreading all across that continent. Well, then, we can judge that the miocene was a warm period by the fossils found in it; and just as the coal fossils indicate that they must have grown in dampness and heat, so the miocene fossils must have lived in dry and moderate heat. Now, supposing that period to be suddenly changed—supposing an epoch of cold coming after that miocene period of heat—what should we find then? You would find that all the forms of life that were suited to a cold climate became more abundant and multiplied, and those that were adapted to a warmer climate retreated or perished. But remember that geologically the Dead Sea is far older than the miocene. If there is one thing certain, it is that that extraordinary phenomenon is older even than the eocene period; and that is an important point for our theory, because the geology of that country has nothing to do with recent volcanic eruptions. The country is full of recent volcanic eruptions and basaltic streams, but when we see, as we do there, the tremendous contortion in the dip of the old chalk beds, and the perfectly horizontal and undisturbed position of the later beds upon them, you see that the disturbance and the great convulsions of that country arose after the deposition of the lower strata, and before the upper were deposited. There has

been no great convulsion, but during the miocene period that must have been the hottest place in the world. It is hot enough now. What must it have been when the tops of the hills would have the climate of the tropics?

When the cold period came all the forms of life of the hotter period disappeared from these hills and plains. But remember that however much hotter than the rest of the country had formerly been the depression of the Jordan valley it still, during the glacial epoch, remained proportionately hotter than any other part; and therefore, whatever forms of life were not destroyed, if they could exist anywhere they could only exist in this refuge.

Now, then, we submit that this is a simple way of accounting for the phenomenon of the existence there of creatures that cannot fly or wander far. These creatures are the remains of those which during the comparatively cold period of the glacial epoch were able, in the warmer nooks of that deep valley, to sustain the struggle for existence, and who remained there. At the same time we may conjecture why we find, so strangely intermixed, South African and South Indian forms of life. Those forms we suppose to have been originally spread over the whole of that southern continent, but the South African and South Indian forms, sometimes by segregation and separation, have become differentiated into distinct types. They are very like others in India and Africa, and yet they are distinct from them. These mammals, insects, and birds, are all in the same category, for they remained in this country, which was relatively warmer, and during the struggle for existence in that long period only a few of the hardiest and more vigorous types remained. Then the climate gradually ameliorated, when this alpine chough, this curious little rat, and many others found on the tops of Hermon and Lebanon, which are the remains of races which once inhabited the whole of the country from the Pyrenees to the Himalayas, gradually retreated or were swept to the hill-tops, and while the Germanic flora and fauna crept on, these isolated colonies, these tropical outliers of this old miocene world of India and South Africa, have remained in the Jordan valley, shut up and insulated by the desert on one side and the mountains on the other, so that they have not had the chance of either rejoining their kind in Africa or India or of multiplying or extending their domain.

I do not wish to dogmatise. I merely suggest these explanations, as the only ones I can conceive of by which we can explain the interesting fact of a little spot in the world like this of the Jordan

valley having, if I may so say, a whole creation to itself, and yet the whole of these birds, animals, and plants, though isolated, having cousins in such strange and widely-separated parts of the earth. Though it does not amount to proof, yet still, I think, if we find that geologists, from their data the fossils, which are the medals of geologic history, have formed their theories of this glacial epoch, and of the warm period that preceded it, and then find that their theory, when applied, at once solves the problem of the present juxtaposition of various living forms, we may fairly submit it as worth consideration. We find, as I think we did find, in the Dead Sea valley the first living remains which illustrate and confirm the geological theory of the period of miocene heat which preceded the glacial epoch. Then I think we may fairly claim to have scraped a little piece of the palimpsest, and shown you a little living bit of an old world. The traces in the Lebanon of the glacial epoch are unquestioned. There are the flints, and caverns, and moraines, beside the isolated animal and vegetable forms of Hermon and Lebanon, but none of these have anything to do with the forms of the Dead Sea. Remember that however cold that country may have been, though there was the cold of Greenland when the reindeer roamed over that country—still the Jordan was 1,300 feet deeper than the sea level, and therefore proportionally so much warmer ; and only in this way can we understand how such tropical forms of life as these contrived to carry on a lingering existence.

These points which I have brought before you may seem small and trivial, yet I think they show us that even naturalists and ornithologists in their small way may contribute their little quota both to the illustration of geological history and, what I value even more, to the illustration of Scripture and its history.