

THE GEOLOGY OF PALESTINE.

(*The following summary of geological work hitherto accomplished in Palestine is abridged from Professor Huddleston's Address to the Geologists' Association, Vol. VIII, No. I.*)

As a direct result of the great Napoleonic wars, the commencement of the present century was not favourable to the investigation of distant countries, and the records of travel are consequently but few. It is, however, a fact that about this period certain parties in England formed a kind of association for the exploration of Palestine, and there is a tradition that agents were sent out, who failed, in the then disturbed state of affairs, to reach the Holy Land.

Shortly after the conclusion of the general peace which resulted from the crowning victory of Waterloo, great efforts were made by most European States to extend geographical knowledge. In the direction of Arabia and Palestine our fellow-countrymen, Irby and Mangles, were not long in availing themselves of the recently acquired opportunity, and about the same date Burkhardt commenced his classical researches. Soon afterwards there was a renewal in England of the attempts to form an association for the exploration of Palestine, but somehow the attempt fell through, although a certain amount of money was collected for the purpose. The balance of this fund, amounting to upwards of £130, was handed over to the Royal Geographical Society in 1834.¹

The decade from 1830 to 1840 may be said to have witnessed the first serious attempts to describe the *geology* of Palestine and the neighbouring countries. The oldest of these really geological works is that by Botta, entitled "Observations on Lebanon and anti-Lebanon," published in the *Memoirs of the Geological Society of France*,² 1833.

The year 1837 was rendered memorable for the important discoveries then made. Dr. Roth, a Bavarian, brought from Judæa a series of fossils, many of which have since been described by Dr. Fraas. But the great discovery of all was the recognition of the depression of the Dead Sea basin, a circumstance which had escaped the notice of Burkhardt and all the earlier travellers. It is difficult to believe, at this time of day, that not only were the writers of antiquity ignorant of this most important feature, but that even modern men of science, five-and-forty years ago, were equally in the dark on the subject. Several names are mentioned in connection with this discovery, and amongst others the names of two Englishmen, Messrs. Moore and Beck, who published an account in the "*Journal of the Royal Geogra-*

¹ It appears that the "Palestine Association" held a meeting on the 24th April, 1805; but that, in the interval from 1809 to 1834, no steps were taken by the Association. On the 28th January, 1834, a meeting was held, Mr. Bartle Frere being in the chair, when the sum of £135 9s. 8d., being the balance of the funds, was disposed of as stated in our text.

² 1st ser., vol. i, p. 135.

phical Society" for 1837. There was some difference in the earlier estimates of the amount of depression; but, to anticipate, I may say that the figure fixed upon by the surveyors of the Palestine Exploration Fund is 1,292 feet below the level of the Mediterranean.

The Biblical Researches of Dr. Robinson, an American clergyman of great learning, published about this period, contain much valuable physical information, which was materially supplemented by a posthumous work, entitled "Physical Geography of the Holy Land." Russegger, an Austrian mining engineer in the employment of Mehemet Ali, travelled in Egypt and Nubia, and subsequently in Sinai, Palestine, and the Lebanon, though his principal work was not published till some time afterwards.

1840-1850. Stimulated by the remarkable discoveries which had been recently made, and encouraged, perhaps, by the success of their learned fellow-countryman, Dr. Robinson, the Americans seemed to have taken up the subject of the geology and physical geography of Palestine with much zeal. In 1843 appeared an important paper by Hitchcock,¹ who, although personally unacquainted with the country, put together the notes and examined the specimens forwarded by certain American missionaries with such sagacity that, as M. Lartet cynically remarks, he was able to give a better account of its structure than the majority of Eastern travellers, whether before or since that time.

Undoubtedly the most remarkable effort of this decade was the celebrated United States Exploring Expedition under Lieutenant Lynch.² In April, 1848, the party descended the Jordan in boats from the Lake of Tiberias to the Dead Sea, and to them we owe the first thoroughly reliable information respecting these two sheets of water and the river which connects them. So tortuous is the bed of the Jordan that, within the space of 65 miles, the river was found to traverse a distance of at least 200 miles. Considerable difficulties were experienced from shallows and rapids, but these were finally surmounted, and the two metal boats which contained the party entered the Dead Sea on the 18th April. This was probably the first time that the Jordan had been navigated the entire distance between the two lakes.³ Under the superintendence of Dr. Anderson a large collection of fossils was made during this expedition, chiefly from the Lebanon, and from certain localities in Western Palestine. Many of these were subsequently described and figured by Conrad in the official report.

With this expedition all doubts as to the true physical structure of the great *fissure*, known as the Ghor, extending from the hollow of Syria to the Red Sea, were terminated. The weird and unwholesome nature of the place, and the strange traditions with which it was associated, had

¹ "Assoc. of American Geologists," p. 369, Boston, 1843.

² The official report was published at Baltimore in 1852.

³ The banks of the river at the termination of its course were found to consist of red clay and mud; soundings gave a depth of 7 feet, with muddy bottom; width of river 80 yards; current three knots per hour. At the actual embouchure the river was found to be 180 yards wide and 3 feet deep.

long enveloped the *Lacus asphaltitis* in a haze of mystery akin to the fogs which a copious evaporation sometimes causes to hang over its waters. Opinions might be divided, as they still are, on the causes which have produced this remarkable fissure, but the leading facts of its physical structure had at length been obtained, and thus the way was paved for the study of its geology.

The decade extending from 1850 to 1860 does not appear to have been marked by any great expedition having reference to those subjects, but the succeeding ten years were very fruitful in discovery, and the investigations of that period may be said to have formed the staple of our information up to the present day. The most important works are "Aus dem Orient," by Dr. Fraas, of Stuttgart, published in 1867, and M. Louis Lartet's essay on "The Geology of Palestine," published in 1869.¹ It is from these two works, but more especially from the latter, that this communication has, in the main, been compiled.

M. Lartet accompanied the Duc de Luynes in his expedition to Palestine during the spring and early summer of 1864. Lieutenant Vignes assisted in the navigation on the Dead Sea, and published a narrative of the journey conformably to the instructions of the Duke himself. The party having made a short excursion into the Lebanon, passed by way of Galilee and Samaria to Jerusalem, whence they proceeded to embark on the Dead Sea in the iron vessel "Ségor." A thorough examination of the Dead Sea and its shores was the result, thus supplementing the observations made by Lynch's party sixteen years previously. Precautions were especially taken for obtaining specimens of the water for analysis from various depths by means of an apparatus which is described and figured in Lartet's work. These results were of great value. After spending a month on the Dead Sea, the party ascended the right bank of the Jordan, about half-way to the Lake of Tiberias, and thence returned by the left bank; thence to the mountains of Ammon and Moab, which they were the first to examine scientifically.

A second visit from Jerusalem was made to the Dead Sea by way of the mountains of Judæa, and thence along the Arabah to the watershed, the altitude of which was determined barometrically by M. Vignes. The hollow south of this watershed, or ledge, usually known as the Wâdy Akabah, was found to be little else than a desert of sand, sometimes in motion, sometimes cemented by saline incrustations. The rocks of the Mount Seir range presented opportunities for studying the granites, &c., so extensively developed in Sinai and Egypt, but which are wanting in Palestine. Having reached the Gulf of Akabah, they returned north by way of Mount Hor and Petra, and then, crossing the Arabah obliquely, passed over the calcareous plateaux which form the continuation of the desert of the Tih to the south of the mountains of Judæa. A second

¹ As M. Lartet's voyage was made in 1864, there are numerous notices by this author previous to 1869. See "Bull. Soc. Géol. de France," 2nd ser., vol. xxii, p. 420 (1865); *id.*, p. 537; *id.*, p. 719; *op. cit.*, vol. xxiv, p. 12 (1866).

expedition was made into the trans-Jordan district, attended with much success in the discovery of cretaceous fossils. Finally, having traversed the basaltic flows of the Jaulan (*Gaulanitis*), the sources of the Jordan itself were inspected, and especially the Hasbâny, its longest, if not its most copious, branch.

I have been thus particular in describing the route of M. Lartet from February to June, because his journey has been more productive of geological information than any other as yet undertaken. Nevertheless, our own fellow-countrymen were not idle at that period, as the notices of Messrs. Duncan, Carter, and Holland, in the "Quarterly Journal of the Geological Society," and in other publications, will show. In 1868 Mr. Bauerman also contributed a valuable paper entitled "A Geological Reconnaissance from Suez to Wâdy Feiran,"¹ and about six years afterwards Mr. Milne, another student of the School of Mines, published some important "Notes on the Sinaitic Peninsula and North-West Arabia."²

In the *Quarterly Statement* of the Palestine Exploration Fund for 1869 it is observed with regard to geology—"Of this we are in ignorance in almost every detail. The valley of the Jordan and basin of the Dead Sea is one of the most remarkable on the earth's surface." As observed by Murchison, "It is the key to the geology of the whole district." Hitherto no great amount of geological matter has been published in the pages of the *Quarterly Statement*, although the other subjects have, for the most part, received ample illustration. Yet some of the papers by Captain Conder show that the subject of geology, and especially the question of the age and nature of the deposits of the Jordan valley, have possessed considerable attraction for him. Captain Conder's "Physical Description of the Holy Land,"³ and his chapter on the "Jordan Valley,"⁴ should be read diligently by every one who desires to become acquainted with the geology of Palestine. The 1-inch Map of Western Palestine was published by the Committee of the Exploration Fund in 1880, and they have also issued a very useful reduction, together with sections drawn to scale.

The peninsula of Sinai was surveyed by a party of Royal Engineers, under Captains Wilson and Palmer, assisted by Mr. Holland, about the year 1869, and the model of Mount Sinai now at the Indian Museum was executed about the same time.

Though scarcely geological, the admirable volume of the late Dean Stanley, and the adventurous narratives of Canon Tristram, contain much geognostic information, and as they are well illustrated and ably and pleasantly written, these works have always been in great favour with the English public.

Finally, the two greatest authorities on the geology of Palestine have within the last few years published the results of their latest information.

¹ "Quar. Journ. Geol. Soc.," vol. xxv, p. 17, *et seq.*

² *Ibid.*, vol. xxxi, p. 1, *et seq.*

³ "Handbook to the Bible," p. 205, *et seq.* (Longmans, 1880.)

⁴ "Tent-Work in Palestine," p. 214. (Bentley, 1880.)

In 1877 M. Lartet summarised his knowledge in a magnificent quarto volume, well illustrated with maps, sections, and plates of fossils, entitled "La Mer Morte," and in the following year Dr. Fraas brought out the second part of "Aus dem Orient" in the shape of a "Geological Treatise on the Lebanon."

Many valuable notices, in addition to those already mentioned, are scattered up and down in the Proceedings of Societies throughout Europe and America.

HEBREW INSCRIPTIONS.

CONSIDERING how scanty the ancient Hebrew and Aramaic texts whence we may draw definite ideas of the growth of the Hebrew alphabet still are, it will perhaps be interesting to note the result of the exploration of Palestine in this respect. In 1864, Madden could only compare the Hebrew of the coins with the coffin of Eshmunazar (which dates 500–400 B.C.), the Assyrian lion-weights (750 B.C.), and the Carpentras stone and Ptolemaic papyri (300–200 B.C.); all his other alphabets are later than the Christian era—including the Palmyrene texts (second century A.D.), the Samaritan text (527 A.D.), the Bowls found at Babylon (fifth and seventh centuries A.D.), and the Stones from Aden (717 A.D. and 916 A.D.).

In addition to these texts, and to the Phœnician inscriptions of Marseilles, Malta, Cyprus, and Athens, together with the Jewish coins of the Hasmonean age, we now have the Moabite Stone (876 B.C.), and the Siloam inscription (perhaps 732 B.C.), all of which are in the ancient character called "broken" in the Talmud (Tal. Jer Megilla, i, 11), and said by Rashi to be called *Libonai*, because it was used by the inhabitants of Lebanon—that is to say, by the Phœnicians. The object of the present note is to gather together the instances which show the early existence of the square character in Palestine itself; for of the texts given by Madden, the earliest approach to the square character is found on papyri, and on a monument of Egyptian origin. The square characters are derived from the Aramaic or Syrian branch of the Phœnician alphabet, and not from that which gave birth to the Moabite, Siloam, and Hasmonean types.

Carrying our researches backwards, we must first recall the inscription at the Synagogue of Kefr Bir'im ("Memoirs," Vol. I, p. 233). It is in square Hebrew, and the character of the building agrees with Jewish tradition in attributing the erection of the doorway to about the year 130 A.D. The position of the text forbids us to suppose that it was executed later than the time of the erection of this synagogue. This was also the opinion of Dr. Robinson ("Lat. Bib. Res.," p. 70). It may thus safely be referred to the second century A.D. To the same date belongs