

THE SURVEY OF PALESTINE.

A PAPER READ BEFORE THE BRITISH ASSOCIATION.

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THE country included under the name of Western Palestine, and to which the present Ordnance Survey is confined, is bounded by the Jordan, and the sea, and extends from Dan to Beersheba. It contains approximately 6,600 English square miles. The desert shuts it off on the south, and on the north the line taken will follow the River Leontes and extend along the parallel of latitude to the sources of the Jordan near Banias—the ancient Dan.

The country thus bounded may be divided into five geographical districts. Two of these are on the south, where the geological formation is a gentle anticlinal, giving a high and difficult hill country, of an average elevation of about 3,000 feet in the centre, with a broad plain on the west, whilst a rapid descent on the east leads to the great crevice of the Dead Sea. The hill country is that of Judæa. The great plain is that of Sharon. Between these two lies the less remarkable feature of the Shephalah, a low range of hills of a cretaceous limestone not conformable with the Dolomitic beds of the watershed.

North of Nablus (the ancient Shechem) the character of country changes, the central watershed divides into two, giving one chain of hills running north-west and terminating in the great bluff of Carmel, which rises 1,300 feet above the sea, whilst a second chain continues due north and separates the Jordan valley from the great plateau extending between the two ranges, and generally known as the plain of Esdraelon. The fourth district is the difficult hill country of Galilee, and the Safed range with a mere strip of plain on the coast, for the plain of Sharon narrowing suddenly is bounded by Carmel on the north, and in Phœnicia the hills come down almost to the sea itself. Last, but not least, the Jordan valley forms an absolutely distinct division, differing in climate, in fauna, and in flora, and inhabited by a different race. Commencing at about sea level on the north, it descends to 600 feet below that level at the Sea of Galilee, and thence to nearly 1,300 feet, the level of the mean surface of the Dead Sea below that of the Mediterranean.

Of this extent of country many districts are but little known. The plain of Sharon, Carmel, the greater part of Judæa, and the central line of the country, have been often visited. Philistia, or the south-western plain, was almost unknown before the time of Captain Warren. The country of the Beni S'ab, or Shephalah, west of Nablus, had been quite

an unknown country until surveyed by the present party. The Jordan valley was best known by Captain Warren's rapid reconnaissance, but the district between this and that included in Major Wilson's work was almost a *terra incognita*. The Sea of Galilee has been carefully explored by the latter officer, but an unvisited district said to contain synagogues and other remains of interest exists north of this lake. Wherever the present survey party has gone over new ground it has met with places of extreme interest and obtained results of great value.

The work which is now being carried on consists in a regular trigonometrical survey to the one-inch scale of the whole country thus described, together with supplementary researches, antiquarian, Biblical, and physical. It was first commenced in October, 1871, by a party of Royal Engineers, consisting of two non-commissioned officers under command of Captain Stewart, R.E. Mr. C. F. Tyrwhitt Drake volunteered to accompany the expedition and give them the advantage of several years of acquaintance with Syria and a good colloquial knowledge of Arabic. The expedition met with a serious check at the outset in the severe illness of the commander, who was obliged, by medical advice, to return almost immediately, and subsequently to resign his appointment. Meantime Sergeant Black, R.E., was left to prosecute the work unaided, the party being under Mr. Drake's care. He at once proceeded to measure a base and extend the triangulation, connecting it with the Ordnance Survey of Jerusalem, and advancing north towards the plain of Esdraelon, where it was proposed to obtain a check by measurement of another line. Thus, by June, 1872, 560 square miles had been surveyed and finished, and the party rested for a while at Nablus.

Meantime I had been appointed to succeed Captain Stewart in the command, and arriving in the country joined the camp at Nablus and immediately recommenced the out-door work. By September the second base line had been measured and found to give most satisfactory results. The triangulation was thence extended with fine well-shaped triangles towards the north, and the great plain completed, the party remaining for the two winter months in a house in the German colony at Haifa, under Carmel, and employing the fine days in completing the map of this ridge. In March, 1873, they turned their faces southward, connecting on the east with the former work and extending it to the sea-coast. In April Mr. Drake left for England, his health being impaired by the climate, and it was not before six months had elapsed that he was able to return.

May was spent still in the plain of Sharon, and in June the Shephelah was surveyed, a district almost entirely unknown, and into parts of which no European had as yet penetrated. Another non-commissioned officer was at this period added to the strength of the expedition.

During the heat of the summer the party retired to the Antilibanus, and visited Hermon and Baalbek. In October the work was recommenced and extended south of Jerusalem, whence the party proceeded to the Mar Saba desert, and so arrived at Jericho and the north shore of

the Dead Sea about the middle of November. Here another serious check was experienced in an attack of fever from which Mr. Drake suffered extremely, whilst many of the native servants were dangerously ill. It was found necessary to retreat to Jerusalem, and the bad weather set in almost at the same time. The unexampled severity of the winter, with other causes, delayed the expedition until the end of February, when they again took the field and advanced up the Jordan valley, the survey of which was completed up to the Sea of Galilee (in spite of the most unfavourable weather) by about the middle of April. The plain of Sharon was then completed, and in May of this year I returned on duty to England, bringing home the results of the two years' work. The non-commissioned officers in the meantime remained in Jerusalem occupied with various indoor duties. The survey extended at this period over 3,000 English square miles, including the whole of central Palestine from Nazareth on the north to Bethlehem on the south.

According to the latest reports from the sergeant in charge of the party they were all in good health and busily employed with sedentary work. But one sad exception has to be made. Mr. Drake, who had recovered very rapidly from his first attack of typhoid fever, and had accompanied the party during the trying spring passed in the Jordan valley, was again seized in Jerusalem. In spite of the great kindness and care of a skilful English physician, his liver became affected, and on the 23rd of June he died. His name is well known to geographical circles as a hardy and energetic explorer, and his loss will be severely felt by the expedition in its future work.

The map has been prepared on Sir Henry James' system of tangential projection, in sheets containing 30' of longitude and 20 of latitude, giving about twelve sheets in all. Of these, six are complete, and three have been brought home to England. The remaining four sheets include some very difficult country, but the most delicate and dangerous part of the work, the survey of the Jordan valley, has been already successfully completed, and there is every reason to hope that the future success will be equal to that of the work already accomplished.

The principles of the survey may now be briefly described. The first base was very carefully measured with chains corrected before and after use, by means of a standard steel chain, graduated for the temperature of the spot. It was connected with the trigonometrical point at Jaffa, which is taken as the initial point for calculation of the difference of longitude, Jaffa having been fixed by the Admiralty from the known longitude of Alexandria. The mean length of the line was 4.3 miles. It was checked by observations to a point opposite the middle, the whole length being calculated by the angles thus obtained from the measured length of a part. The triangulation was thence extended eastward with lines from three to ten miles in length, and connected with Major Wilson's points at Jerusalem. Thence it was carried north to the plain of Esdraelon, where the second base was established. The length of

this base was four and a half miles, and the difference between its measured and calculated lengths gives an error of .03 per cent. This was considered as extremely satisfactory for the style of work expected, and especially when the difficulties presented by the mirage and other atmospheric phenomena, the destruction of cairns, and the peculiar form of the triangulation, extending over 60 miles in length by about 10 in breadth, are considered.

The ends of the base, after it had been laid out with a five-inch theodolite, were marked by cairns, the southern one being set roughly in mortar, with blocks of considerable size. The base was traced on a distant point, so that by calculation it could be extended about eight miles further. Observations for latitude were taken from the southern end, and a true astronomical bearing; it was measured and checked like the plain of Sharon base, and every precaution taken to insure accuracy. A fine line, almost at right angles, was obtained between two good points on Gilboa, and on the volcanic cone of Sheikh Iskander, east and west of the plain of Esdraelon. The average length of the side of a triangle was in this part some 15 miles, but in the Judæan hills it is never greater than 10 miles.

Besides this check thus obtained on the work, several others were established. The vertical heights, starting from the sea-level at Jaffa, and brought through the centre of the country, were carried down to the dome of the Convent on Carmel. The height of this was then obtained by a simple trigonometrical process from the length of a line measured on the beach. Further checks are also obtained along the shore by the measured height of buildings in the sea used as trigonometrical points. The heights across the country were compared with the very accurate levelling by Major Wilson, R.E., and the difference was about four feet in the level of the Dead Sea, a very satisfactory proof of the character of work in the new survey. Further checks and very long lines will be obtainable on working out the observations sent home for calculation. One of these gives a fine line of over 35 miles, observed both ways, and immediately connected with a true astronomical bearing. Being nearly north and south it will serve as a check for longitude. Another line has also been observed both ways, from Carmel to Hermon.

A check of the longitude was obtained by comparing the minaret at Acca, as fixed by the triangulation, with its position according to the Admiralty. The agreement was very satisfactory.

The observations thus obtained and checked are calculated at once, and the points laid down by the calculated lengths. The detail is then filled in by the following system of interpolation. From each trigonometrical point a large number of observations read to the nearest minute are taken of all prominent objects, village towers, mosque domes, cross roads, prominent trees, or any other easily distinguishable point. The intersections of the line, from two or more stations, when scored by protraction, are considered sufficient to fix these secondary points.

The work from each camp is then divided into four, and sheets of tracing paper prepared, upon which the stations and fixed secondary points are shown, and the remaining detail is filled in upon the ground by interpolation with the prismatic compass, from observations taken to three or more of the fixed points.

With practice, from eight to twelve square miles per man can be completed by this means in a day, and thus, in four days, the whole amount, averaging about 100 square miles, is easily finished. Allowing two days for the trigonometrical observations, one for plotting, one for finishing, one Sunday, and a day for archæological work, this gives an average of ten days for a camp.

The rate of work on first starting was about sixty square miles per month. By the time of my joining, it had risen to 100; from that date till the winter 1872-73, it increased to about 150; and from then till October, 1873, it was about 180. From that time, the party being augmented by one man, it has continued steadily to give an average of 280 square miles completed monthly, and there seems no reason why this average should decrease in future work as long as double theodolite parties and four detail sketchers can be maintained.

The whole of the work is done on horseback, and the method pursued would be most especially fitted for military reconnaissance, where prominent points could be laid down from the map and detail sketched from the horse's back, by interpolation, with the compass.

But one other part of the map work remains to be noticed—the execution of the hill shading. This is done by myself in on separate prepared sheets. Each surveyor is provided with one of Abney's improved clinometers, with which he takes occasional observations of characteristic or peculiar slopes, marking them on the ground. He also sketches the shape of the hill-tops on the spot, and, from these notes, together with a good general acquaintance with the piece of ground being surveyed, it is quite possible to represent the hill features with an accuracy proportionate to the scale. I have found also that a series of outline panoramic sketches from the various stations is very useful for the execution of the hill shading, as well as for geological purposes.

The principal heights are obtained, as already explained, by angles of elevation and depression. For minor points we are contented with corrected aneroid observations, of which we have now secured altogether upwards of 1,500, or one to every two square miles of country.

The method of correction is as follows:—The aneroids are read every morning in camp with the mercurial, the readings being kept in a book devoted to meteorological observations. The observations are made at wells, ruins, valley junctions, springs, hill-tops, or any other place which can easily be identified on the map by its name. A small pocket thermometer is kept with the aneroid under the same conditions and read with

it. The attached thermometer is also read with the mercurial, and the aneroid is again read on return to camp. By these precautions the correction of the aneroid reading is made very exact, and although we have not discovered any law of variation for the pocket instruments, still, considering the elevations not to exceed generally 3,000 feet above sea-level, the results are likely to prove satisfactory. As, however, the constant transport of the mercurial is liable to destroy its perfect accuracy, it will be desirable to check the heights of camps obtained by it. This will be easily done by means of the levelled heights of a great number of the camps, and in other cases by the aneroid readings at the trigonometrical stations whose heights are known.

Astronomical observations are taken at every camp, both to serve as a rough check during the progress of the work (although the accuracy of such a method is not comparable to that of careful triangulation), and also to keep a record from time to time of the variation of the compass. True astronomical bearings of the longer lines are also obtained, as, for instance, that of the check base, which was traced on a distant point, and of the line already mentioned from Hermon to Carmel. The other observations are for latitude and for time, and have all been satisfactory, the most important being a series taken from the summit of Hermon, by means of which, with a true bearing, the latitude and longitude of this mountain will be very accurately fixed. In addition to this, Hermon will finally be fixed by triangulation, and its height obtained by two vertical angles, the one to the mercurial station at Bludan, the other to the convent on Carmel, which is fixed by immediate measurement from sea-level. This mountain forms, in fact, an outlying point, to which long lines can be obtained from most of the principal points in the survey.

I may now turn to another department of the work, which is of the greatest importance, namely, the nomenclature. Nothing is more striking in Palestine than the manner in which the original Hebrew names are still to be found under slightly modified forms in the Arabic. Very often a later Roman name by which a town may have been known in Herodian or early Christian times has altogether disappeared, and the original Biblical name has reasserted itself. Beisan, the ancient Bethshean, was subsequently known as Scythopolis, a name now entirely lost. This is but one instance out of many.

The collection and correct spelling of these names, as tending to throw invaluable light on the geographical passages in the Old and New Testaments, and especially in the early books of Joshua and Judges, forms a most important and anxious part of the survey work. The danger of only receiving a fictitious or wrong name in unexplored parts is very great, as ignorance, stupidity, suspicion, and perverseness, alike incline the natives to give a lying answer to the plainest question. The practice obtained by the non-commissioned officers has proved throughout most important in this department.

The names, which are kept in lists arranged alphabetically for each

sheet, are invariably obtained from natives belonging to the neighbourhood. They are checked by reference to at least three persons. They are written down in English on the spot, and on the evening of the same day are pronounced by the surveyor in presence of the native guide, and of a competent Arabic scholar. This latter duty was the main responsibility of my late colleague, who had an unusual familiarity with colloquial Arabic. The greater part of the names have been gone through with an educated native scribe, and no pains has been spared throughout the course of the work to ensure correctness both of the spelling and pronunciation of the word, and also of its position on the map. A sort of test of this accuracy is found in the numerous identifications which spring up as the work proceeds. As an instance, I may mention the identification which I have just been able to make of the Kurn Surtabeh, as being the Altar ^{Ad} mentioned in the book of Joshua. The requirements were all fulfilled, but the name appeared to be lost, until I found marked on our map the Tal'at Abu 'Ayd, or ascent leading to 'Ayd, as the name of a broad valley north of the mountain. This satisfactory confirmation of the other evidences is the result of the systematic collection of every name of however little its apparent importance at the time. Nor is this a solitary instance of the subsequent importance attaching to a name apparently obscure and of doubtful antiquity.

The number of names collected is very large; it averages seven or eight times that on the best existing previous map. On the Jerusalem sheet alone there are considerably over 1,600 names, and although in the less densely populated parts, such as the great plain of Esdraclon, and the other broad corn plateaux, the number is smaller, still it seems probable that scarce a single name of any interest or importance can have been omitted. In a country like Palestine an average of two names per square mile is greater than would at a first glance be expected. The care and attention bestowed on their correct location will, it is hoped, render the map invaluable in settling the disputed points of the ancient geography.

The main object of the map, as first projected, was indeed antiquarian. The thorough examination of the country, with notes of all existing ruins and indications of sites worth excavating, formed the main part of the instructions. Natural history, geology, and physical geography, were also to be studied as far as circumstances and the aptitude of the observers allowed. This work, therefore, forms one of the main labours of the party, and often delays the actual survey considerably.

The method pursued is as follows:—Every ruined or interesting site is visited and noted on the spot. Such as contain nothing of importance are not specially reported, but merely included in alphabetical lists arranged for each sheet of the map.

Any, however, where distinguishable relics are still to be found, are at once reported and visited by myself. All buildings, dating earlier than the times of Turkish occupation, are planned with more or less

detail according to their importance. Of the ruins, no less than 350 are noted on a single sheet of the map. The special plans and surveys, including the sites of Jewish and Roman towns, temples, churches, synagogues, tombs, crusading castles, sections of aqueducts, artificial caves, and early Christian convents, none of which have been previously planned or explored in a satisfactory manner, now number more than seventy. We have added seven churches to those planned by De Vogüé, and obtained in the unexplored country two sites of towns, evidently of some importance, with traces of the public buildings, and details indicating date, sites never before visited and entirely unknown.

The plans are executed in various ways. Cæsarea was surveyed by a traverse with the 5 in. theodolite, the buildings measured with a chain, and placed by compass angles from the points fixed by the traverse. At Beisan we had a base given by a short trigonometrical line, and used this with a triangulation, which was plotted, the details being filled in with the compass, and the principal buildings measured and plotted to a scale of 20 ft. to the inch. Athlit was executed by a compass traverse which, with pacing, plotted in a very satisfactory manner.

In the survey of caves the best method is the determination of main lines by a compass bearing, and the plotting of the walls by offsets, as in a traverse; the same method is also very useful in the planning of the complicated systems of catacombs found in many parts of Palestine. For such buildings as the ruined churches and convents, direct measurements of the walls are preferable; but in all cases where the work is not plotted to scale on the spot, it is most necessary to remember that numerous cross checks, and a great number of measurements, save time and ensure accuracy in the subsequent working out. Where possible the site is always revisited, plan in hand, and any trifling inaccuracy corrected on the spot.

It may be interesting to enumerate some of these ancient sites with the more striking identifications resulting from the survey, and to give some account of the geological notes which have been kept throughout the progress of the work.

In his interesting work on rude stone monuments, Mr. Fergusson accuses the Palestine Exploration Fund of being too busily employed in map-making to find time for the investigation of the real antiquities of the country. To this accusation our work happily gives a complete answer. Whereas no single example of a rude stone monument was known in western Palestine at the time of this publication, Mr. Fergusson will be delighted to hear that we can now point to four which are of undoubted character. The first is a cromlech with sepulchral barrows, mentioned by Mr. Drake in an early report. By the curious constructions north of Jerusalem, known as the Kabûr beni Israim, is another fallen rude stone monument. Apparent remains of a third exist east of Jerusalem, and a fourth of very large stones is found near the plain of Esdraelon. In addition to this we have found some very curious monuments south of Jerusalem, which may very probably be

sepulchral mounds of early date. We have also collected flints from various parts of the country, although I failed to find any in the traditional tomb of Joshua, where they are mentioned by a French explorer.

There is no doubt that a very exaggerated estimate has generally been made of the antiquity of ruins in Palestine. Many which have been commonly called Jewish or Phœnician, turn out on close inspection to be Crusading or Saracenic, and our results are often valuable only in a negative sense. The traces of Jewish art are hardly worthy of notice, and the general impression produced is that their constructions were neither magnificent in proportions or design, nor durable in materials. The various rock-cut cemeteries, and traces of ancient cultivation, are almost the only undoubtedly Jewish remains in the country excepting the synagogues first discovered and described by Major Wilson.

The interest of the country from a Biblical point of view consists in the identification of sites from etymological and literary argument. Amongst the interesting identifications made by the survey party may be mentioned the altar 'Ad, already referred to, the site of Ænon where St. John baptized, Zaretan in the Jordan valley, Gilgal—a confirmation rather than a discovery, the hill Scopus, north of Jerusalem, and amongst the less definitely indicated in Scripture, the Rock Oreb and winepress of Zeeb, mentioned in the book of Judges, the probable tomb of Samson, with the sites of the town of Archelais, Ecbatana, and Sozuza, and a number of obscure Biblical names interesting as fixing the boundaries of the various tribes.

Passing from this period to that of the Roman occupation of Palestine, the ruins become far more numerous and important; they include fine roads, long aqueducts, temples, theatres, race courses, and city walls. Among the principal sites are Cæsarea, Ecbatana, Antipatris, Jericho, Scythopolis, Tantara, Sebaste, and a host of minor places of interest. All that remains above ground has been noted and sketched, measured and planned. At Cæsarea the temple built by Herod and dedicated to Augustus was discovered close to the Crusading Cathedral. To this group belongs the newly discovered town of Deir Serûr, probably the ancient Sozuza. Its fallen tower blocks, some 10ft. in length, its fine round arches; its semi-classic mouldings, its walls of finely drafted masonry, and the great synagogue or temple, with tessellated floor and walls 8ft. thick, all point to this ruin as a place of no little importance. To this same period also belong several groups of finely ornamented rock-tombs of semi-classic Greek character, mostly new discoveries, and resembling closely those already well-known at Jerusalem. Many buildings also, like those at Jebel Fureidis (the Ancient Herodium) are now for the first time thoroughly explored, and properly planned, although they have been known for a considerable time, among which may be enumerated the tomb of Joshua at Timnath, a site of no common interest, and perhaps one of the best authenticated identifications yet made in the country.

The next step brings us to the early Christian times, for of the troublous period after the destruction of Jerusalem, there are scarce any topographical indications, unless we except the site of Bether. This strong and almost impregnable site, where, under Barcochebas, the Jews made their last stand in revolt, is the modern Bittér, and close to it, in a natural fortress, are ruins which still keep the name (as discovered independently by Captain Warren, and afterwards by myself) of Khirbet el Yahúd, Ruin of the Jews, a traditional title, for which no reason is now assigned by the natives.

The great building ages of Justinian and the Crusaders have left many noble monuments throughout Palestine. Amongst the principal works of the first period may be mentioned the two great convents of St. John, on Jordan, and of the traditional Gilgal, erected in the Jordan valley, and never before planned. In the wild hill country of Judæa we also discovered another fine ruin, known as Deir Kal'aah, the Convent Castle. The details of its architecture are of extreme interest, as throwing light on the disputed question of the date of that style which is found not far away in the Jerusalem Golden Gate. Five convents in all were here discovered at no great distance apart in a district previously almost altogether unknown.

The Crusading works occur in every part of Palestine, and are invariably magnificent. The finest ruins, however, are at Athlit, the Castel Pelegrino, where first the pilgrims of the 12th century touched the soil of the Holy Land. Its magnificent masses of masonry, its strong bastioned walls, its great vaults, running the whole length of the town, with groined roofs and sculptured capitals, show the splendour which it must have displayed in its palmy days. The work has more than once been taken for Phœnician masonry, and curiously enough in the neighbourhood is the only Phœnician tomb we have yet seen in the country, but the pointed arches and other details of architecture leave no doubt as to the origin of the town.

From this landing-place a chain of forts leads across Carmel to Nazareth, and south to Ramleh and Jerusalem. Wherever an important military position is to be found throughout Palestine a Crusading castle will also be found. The workmanship of its outer walls, large, strong, and well cut, of hard limestone or harder basalt, and the details of its interior, remarkable for beauty and finish in the stonework, the places of the old portcullises, the secret posterns, the winding turret-stairs, the groined roofs, the chimneys, and sculptured niches, are all of interest to the architect. The knowledge of art and skill in choice of good material, both attest the cultivation of the builders. The numerous churches, with even finer finished stonework, frescoes, &c., rude graphitæ, walls thick enough for a castle, and capitals of florid execution, are still more worthy of study. Of one of these, the great church at Ramleh, now a mosque, I am, I believe, the first to have made a plan, and no church yet seen in Palestine exceeds it in size or workmanship.

Last in order come the Saracenic works, fortresses and khans, mosques

and minarets. They are distinguished by the smaller size of the masonry, by the different form of the arches, and by a peculiar cement, harder even than the stone, and found in no other work in the country. In many instances Saracenic additions to Crusading work are noticeable, and in some few it is difficult to know to which era to ascribe the work.

It will be seen, therefore, that we have added something of interest to what was already known on archæological questions in Palestine from the earliest to the latest period of its history. A glance at our lists enables us to say what exists at any spot marked on the map, and to give a fair estimate of the antiquity and importance of the remains, which can often be dated by comparison with examples of known periods.

In conclusion I would point out the observations made with regard to the physical character of the country, and especially as regards the main features of its geology.

The comparison of ancient and modern physical characteristics of the country, both as regards the natural features and in respect to the cultivation of the land, will be one of the most interesting outcoming results of the survey.

For data as regards climate, we have now four meteorological stations established in the country, where barometrical and thermometrical observations are taken daily with great regularity; the first at Jerusalem, the second at Nazareth, both in the hill country, the third at Jaffa on the sea-coast, the fourth at Gaza in the plain. In addition to which, we carry with us in camp a full set of meteorological instruments, a mercurial barometer, wet and dry bulb, maximum and minimum, a minimum ground, and a black bulb-thermometer. With these also are a rain gauge and a set of ozone papers. Many of the observations are interesting. It is found that with the east or khamzin wind—a most trying and depressing weather—there is an entire absence of ozone in the air. We notice also that mirage is not dependent on heat alone, but requires a certain amount of moisture to develop it fully. The barometric observations in the Jordan valley are very curious; the rise and fall of the instrument appeared to have no reference to the storms which we experienced, whereas in the hills the barometer is a safe guide.

The comparison of the rainfall and seasons with those of ancient historical times will, therefore, be obtained with great accuracy.

In addition to this we are able to show for the first time on the map the condition of the country as regards vegetation; gardens, orchards, and oliveyards are marked, as are also the districts covered with thickets or *hish*, which on the western slopes are very extensive. The map shows also the Forest of Sharon, hitherto unknown, and consisting only in stumps of felled oak trees towards the south, whilst in the northern part of the plain the trees still extend over the country for miles. The palm trees of the Jordan valley, mentioned as late as the 7th century, have disappeared from Jericho, but in the northern basin, near the site of Scythopolis, we found a great number of stunted trees, many of which have individual names.

The general result to which the work seems to point is, that in the seasons, rainfall, and natural vegetation, modern Palestine resembles very closely that of Biblical times. There is, however, a very marked change in its cultivation, and the extent of the ancient fertility will be approximated, it is hoped, when the map is complete.

The ancient cisterns, pools, aqueducts, and methods of water supply and irrigation, are all carefully marked on the map, and their date—Jewish, Roman, Christian, or Saracenic—is generally pretty easy to determine. The terraces, wine and oil presses, vineyard walls, and dry-stone towers, which appear to be of great antiquity, are carefully noted. Signs of ancient cultivation are often observable in the wildest of the present thickets, and there is no doubt that the vine, now almost unknown, was once cultivated throughout the whole hill country of Palestine and along the edge of the plains.

Not less important is the study of the geology of Palestine. As a contribution to what is already known, I have prepared a sketch map, showing the main divisions of the strata, and in the more interesting parts the boundaries have been carefully determined. This map will form a sort of reconnaissance, from which a professional geologist may advance to the study of details, and by the use of which much time and trouble may be saved. The special observations of dip and lithological character throughout the part of country surveyed amount now to nearly 200. No such general description of the geology has, I believe, been as yet made. The most famous work on the subject is that by M. Lartet, the French geologist. The study he has given to the part of Palestine which he visited personally is minute and accurate, but his map, which in many parts is an absolute blank, in others is disfigured by false conclusions, drawn apparently from hearsay evidence.

The main results of the geological survey at present may be enumerated as follows:—

In the north we have been able to show the geological construction of the plain of Esdraelon, and have discovered an important volcanic centre and upwards of forty basaltic outbreaks hitherto quite unknown. We have marked the extent of country covered by black basalt south of the Sea of Galilee never as yet shown. The trappean outbreak on Carmel has also been carefully examined and sections made of its formation, with observations of the dip of the strata, which are very curious. South-west of the mountain we found a tertiary volcanic lake, and traced the outbreaks along the west as far south as Jaffa. The map shows the upheaval of the coast-line, and by fossils obtained along this formation it will be possible to fix the geological data. Three or four interesting sections are now extended across the country, as in the latitude of Nablus, where the nummulitic limestone is found on the upper part of Ebal and Gerizim, and in the line of Jerusalem and of Nazareth.

The most valuable observations are, however, those which refer to the depression of the Jordan valley, and I may, perhaps, be permitted to enlarge rather more fully upon these.

The western shore of the Dead Sea is bounded by steep, precipitous cliffs, at the feet of which are marls and conglomerates belonging to an ancient sea-level. At the top of the cliffs are other marls of a similar character, giving a second level, and from these the marl hills rise rapidly to a third level, that of the Bukeya, or raised plain, situate at the feet of the main chain of hills and below the convent of Mar Saba. This gives a series of three successive steps, each of which seems at some period to have formed the bed of a lake under conditions similar to that of the present sea. There is, however, a very curious feature observable, the narrow valley running north and south and separating a line of chalk cliffs immediately adjoining the Bukeya from the hard dolomite beds of the main chain. It is, in fact, evidence of a fault or sudden fold in the strata, the existence of which seems to have been hitherto unsuspected.

Advancing north we find a broad basin north of the Dead Sea in which Jericho stands, and which has an exact counterpart on the east side of the valley. The same contortion of the strata is remarkable, and the higher level is occupied by beds of a reddish marl, and of the famous stinkstone or bituminous limestone, evidence that at this early geological period the lake existed under conditions similar to those of the present Dead Sea.

From this point we succeed in tracing an ancient shore line at a level equal to the second step for a distance of over twenty miles up the valley. From thence a narrow gorge with strata less violently contorted extends for some ten miles. The valley then broadens again, and the shore deposits and red marl reappear and extend along the side of the upper basin south of the Sea of Galilee.

I have submitted these observations to professional geologists, and their opinion confirms that which I formed on the spot—that the Jordan valley was caused by a sudden and probably violent depression in times subsequent to the late cretaceous period; that it presented at first a chain of great lakes, and that no less than three levels for these lakes are to be found, the area of the most ancient being the greatest; that the effects of denudation or other natural causes working gradually have continued since the time of the first great depression to lower the level, and that the evaporation increasing with the increased temperature the area of the lakes has also diminished. Finally, that the same action is in all probability still slowly proceeding, as evidenced by changes in the depth of water in the Dead Sea during modern times.

I have endeavoured to show briefly the method and results of our work—physical, antiquarian, and geographical. Much of interest yet remains if health and means do not fail us. The plains of Philistia, the southern shores of the Dead Sea, the numerous ruins of southern Judah, have yet to be explored. In the north, Phœnicia still is unvisited, with its ruins, inscriptions, and natural subjects of interest, including the newly found mines of Saida. The Sea of Galilee and the mountain of Safed, where synagogues and ruined towns as yet unknown are reported

by travellers, still demands patient research. I hope, however, that if our future success be equal to that we have already obtained, we shall be able by the summer of 1876 to commence the publication of the Ordnance Survey of Palestine as completed from Dan to Beersheba.

CLAUDE R. CONDER, Lieut., R.E.,
In Command Survey of Palestine.

14th July, 1874.

THE JERUSALEM RESEARCHES.

LETTERS FROM M. CLERMONT-GANNEAU.

XI.

JERUSALEM, May 31, 1874.

I HAVE just rediscovered, within the Haram, an inscription] of some importance, pointed out by several Mussulman authors. Up to the present time we have not been able to establish its existence: it is a stone on which are inscribed the dimensions of the Haram measured at a very ancient period.

Ancient Arabic inscription giving the dimensions of the Haram.

The Arab chronicler of Jerusalem, Medjr ed Din (p. 29 of the text edited at Boulaq), after having recorded that Hafiz ibn Asakir assigns to the Haram 755 royal cubits of length and 465 cubits of breadth, quotes this passage of one of his predecessors, the author of the *Muthir el Ghoram*, from which he repeatedly borrows:—"I saw, a long time ago, in the north wall, above the door adjacent to the Bab ed Douidiariyé, inside the surrounding wall, a slab on which are inscribed the length and breadth of the Haram. These measurements do not agree with what we have stated above. It is there said that the length is 784 cubits, and the breadth 455; the nature of the cubit is specified, but I was not able to see if it was the cubit mentioned above, or another, on account of the writing being injured."

The Persian Hadji, Nasir ibn Khosrou, who came on pilgrimage in the year 438 (A.H.), and consequently before the Crusades, saw this slab also. "On the northern side, which is contiguous to the Dome of Yakub (on whom be peace!), I observed an inscription on a tablet, to the effect that the Mosque was 704 yards long and 455 yards by the 'malak' (measure)."—*Major Fuller's translation.*

This inscription I have just found by accident fitted into the wall of one of the many Arab *Médrésés* which adjoin the northern face of the Haram; it is immediately to the right, coming out of the *Bab el Almé*, which seems to correspond to the "*Bab ed Douidiariyé*:" of the