

# ABSTRACT

OF THE

# REPORTS OF THE SURVEYS,

AND OF OTHER

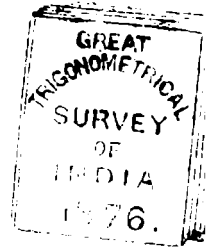
# GEOGRAPHICAL OPERATIONS

IN

# I N D I A

FOR

# 1873-74.



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1876.



## P R E F A C E.

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THE publication of the present "Abstract of Surveys" has been delayed so as to admit of some account being given therein of the interesting researches of General Cunningham in the Punjab during the seasons of 1872-3-4, and of the new scheme for the organization of Meteorological Stations and Observatories throughout India, the reports on which have but recently reached this Office.

CLEMENTS R. MARKHAM.

GEOGRAPHICAL DEPARTMENT,

INDIA OFFICE,

*February 1876.*

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# ABSTRACT.

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## I.

### INDIAN MARINE SURVEYS, 1874.

Since the publication of the "Abstract for 1872-73" surveys of portions of the coasts of British India have been actually commenced, and these may be considered as the first fruits of the newly-organized Department of Marine Surveys, which, under the able direction of Commander Taylor, will provide for the long neglected wants of the mercantile fleets frequenting Indian ports.

Previous, however, to the commencement of operations in India, Commander Taylor visited England for the purpose of conferring with the Hydrographer at the Admiralty, more particularly respecting the selection of suitable officers of the Royal Navy as surveyors. Every assistance was readily given by Captain Evans, and on his recommendation the Lords Commissioners of the Admiralty nominated six surveyors from the Royal Navy for service on the Indian coasts. There were, however, still important duties connected with the preparation of charts and the projection thereon of the land surveys unprovided for, and these required qualifications and training of a special order. To discharge these duties Mr. R. C. Carrington of the Hydrographic Office, who had been highly recommended by Admiral Richards, was appointed, his post being that of Chief Civil Assistant to the Superintendent of Marine Surveys at Calcutta. The Admiralty placed at the disposal of Captain Taylor all those original charts and records in their custody which were the property of the Indian Government, and that officer selected those which he considered requisite to take back to India. These originals, together with a goodly number of others that were found at Bombay doomed to destruction because frayed, insect-eaten, and dust-stained, but fortunately rescued just in time, are now safely deposited in presses at Calcutta, and a catalogue of them has been printed.

The catalogue of all the original and other documents deposited in the Marine Survey Office, Calcutta, has been compiled by Mr. Carrington. It comprises lists of the general and physical charts of India, and the coasts to the west, as well as of each section of the coasts of India from Karachi to Tenasserim, and of the Anda-

man Islands, Ceylon, the Eastern Archipelago, and China. Captain Taylor has also prepared a useful review of all the Admiralty charts of British Indian coasts, showing in what respects they are incomplete and untrustworthy, and what surveys are required to render them adequate guides for navigation. He cheerfully admits, however, that the Admiralty charts are the best obtainable, and suggests that some of the wrecks and accidents are due to the fact that most merchant ships obtain for their use inferior copies of the Admiralty charts not corrected up to date. Captain Taylor has also made notes of the survey operations necessary between the Pakchan river and Karachi. Pending the extension of the Great Trigonometrical Survey throughout the length of the territory of British Burmah, Captain Taylor does not recommend any minute maritime survey of the coasts, but supplementary soundings chiefly at the entrances of ports, where steamers now call or wish to call for commercial objects.

The requisite surveys in the order of their importance are those of the Cuttack coast from Point Palmyras to the south-west for a distance of 270 miles, the Great Megna Flats or shoal water off the mouths of the Brahmaputra and Ganges (the latter river being one of those which bring down alluvial deposits that render periodical examination an absolute necessity), the Cocos, Andamans, and Nicobar Islands, the entrance of the Sittang River, the Gulf of Cambay, the Chittagong Coast from Fenny River to the Nauf River, the coast of the Burmah from Nauf River to the Pakchan, with further examination of the Mergui Archipelago as far southward as the Seyer Islands, or perhaps to Junk Seylon. Coringa or Coconada Bay requires re-examination, owing to the silt brought down by the Godavari, which has had the effect of throwing the anchorage some two miles further northward. Future littoral changes may be expected at the mouths of all large Indian rivers, the Indus, Narbada, Tapti, Krishna, Godavari, Mahanadi, Ganges, Brahmaputra, Aracan, Irawadi, and the Salwen, and also at the bars of minor rivers, notably Mangalor, Cochin, Negapatam, Nar-sapur, Chittagong, Bassem, Rangoon, and Tavoy.

Though the working season had almost passed away before the surveyors had all reached India, yet a small amount of work has been done. Mr. Chapman in the "Constance" has made a survey of Kolachel port in Travancore; he has added to the soundings in Palk Bay and the vicinity of Paumben Pass, and has commenced a fresh examination of Cocanada port and the shoals off



## II.

## the GREAT TRIGONOMETRICAL SURVEY OF INDIA, 1873-4.

during the year 1873-4, the operations of this department produced the following results: 70 principal triangles, covering an area of 7,190 square miles, were measured, and of secondary triangulation an area of 5,212 square miles has been closely covered with points for topographical operations, an area of 3,650 square miles has been operated in *pari passu* with the principal triangulation but exterior thereto, and in the ranges of mountains north of the Assam Valley a large number of peaks have been fixed.

In the Himalayas 534 square miles have been topographically surveyed on the scale of one inch to the mile, 2,366 square miles in Kattyawar on the two-inch scale, and in Guzerat and in the Dehra Dun a total area of 753 square miles has been completed. Besides all this, much important geographical exploration has been done in Kashgaria and the Pamir Steppes and in Nepal and in Great Thibet and Nepal by native explorers.

The party under Major Branfill completed the revision of the southern portion of the Great Arc, about five-sixths of which had been already revised at the commencement of the present year, the last operations having terminated in 1871. The remaining gap was about 108 miles in length, and by its revision the last of the old links in all the chains of triangles, which might have been objected to as weak and faulty, have now been made strong and put on a par with the best modern triangulation. Search was made for one of Colonel Lambton's old stations, in a group of red sand hills, and eventually it was discovered that this must have moved 1,060 yards to the E.S.E., being in the direction of the prevailing winds in the locality, and at the rate of 17 yards per annum. This affords a very accurate measurement of the rate of progress of this remarkable sand-wave, which all efforts to arrest have hitherto proved unsuccessful. Mr. Bond, one of the Assistant Surveyors, had the good fortune to catch a couple of the wild folk who inhabit the hill jungles of the Western Ghats, and occasionally come to the villages with honey, wax, and sandalwood, to exchange for cloth, rice, tobacco, and betelnut. On examination they each proved to be 4 feet 6½ inches high, and, generally speaking, of a low type. After completing the triangulation, Major Branfill proceeded to reconnoitre the Straits of Manaar, with a view to connect, if possible,

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Coringa. Mr. Chapman in continuation of his surveys are narrowest Bahrein reefs<sup>1</sup> has also surveyed the N.E. and S.E. proved to be to El Katif and Deman, but not the regular approach unsuitable Bahrein by which the British India Steam Navigation Company and enter the place. Being beyond the limits of British India, none; work will for the future fall to the province of the Admiralty, and Capt. Taylor expected to have started the "Guide" to examine the mouths of the Ganges, but was only able to send her on 8th April to the vicinity of Diamond Harbour on the river Hugli, more with the object of testing the steam cutters and the fittings of the vessel. But her commander, Lieut. Coghlan, R.N., in little over a month, has made a beautiful sectional survey of the Hugli reach, with the Rupnarain river for two miles up, and the famous James and Mary Shoals. If all the river from Chandernagore to the Sand Heads were similarly sectionally sounded, the charts would be a worthy legacy to hand down to posterity.

The first chart compiled under the orders of the new Marine Survey Department has been received in England, and has been put into the engraver's hands. It is a chart of the West Coast of India from Sunmiyani Bay, north of Karachi, to Pigeon Island, in latitude 14° south. It has been compiled by Mr. Carrington from the surveys of Ethersey, Grieve, Selby, Constable, Taylor, Ward, Whish, Stiffe, and Williams, 1835 to 1862. It is on the scale of three inches to a degree of longitude, and the price will be two rupees. Captain Taylor proposes to issue three more charts uniform with the above, to embrace the whole of British India.

The number of wrecks and casualties reported in Her Majesty's Indian possessions, including Ceylon, during the year 1874, amounted to 40 and 29 respectively. The total number of lives lost was 85, and the total tonnage of vessels wrecked was 16,656. The officiating deputy Master Attendant remarks, that the majority of the vessels totally wrecked were native-built native vessels, and that hundreds of these vessels are annually constructed in British India without survey, or any competent authority to class or inspect them during the course of their construction. They are as a rule built of the cheapest and commonest materials, and barely nailed together. The native owners are exceedingly parsimonious, and pick up scraps of gear and fittings anywhere. The same officer is of opinion that steps should be taken to compel the owners to have them built under certain express conditions and fitted out properly.

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<sup>1</sup> See Abstract for 1871-2, p. 1.

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## II.

Taylor GREAT TRIGONOMETRICAL SURVEY OF INDIA, 1873-4.

of During the year 1873-4, the operations of this department produced the following results: 70 principal triangles, covering an area of 7,190 square miles, were measured, and of secondary triangulation an area of 5,212 square miles has been closely covered with points for topographical operations, an area of 3,650 square miles has been operated in *pari passu* with the principal triangulation but exterior thereto, and in the ranges of mountains north of the Assam Valley a large number of peaks have been fixed.

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the triangulations of India and Ceylon. The straits are narrowest at Adam's Bridge, but the islets composing the bridge proved to be mere sand-hillocks, often submerged by the sea, and quite unsuitable for stations. Northward, however, between Ramisweram and Jaffna; there are several islands composed of coral and sandstone; and on one of these, Kachi-tivu, halfway between Ramisweram and Neduven-tivu, two stations about a mile apart will be built, and from this base will be determined the positions of the two next stations on Neduven-tivu, which will be erected by the Ceylon Government. As the angles at the Kachi-tivu stations will necessarily be very acute, they will be measured by the superior instruments of the Indian Survey, the more symmetrical triangles beyond being measured by the Ceylon officers under Colonel Fyers, R.E., who is taking great interest in the operations, and doing all in his power to help. Major Branfill proceeded after this reconnaissance to lay a longitudinal chain of triangles on the parallel of  $9^{\circ} 15'$ , which will run eastwards from the Great Arc to the coast, and thence to Neduven-tivu, and from which a chain of triangles must eventually be carried up the Coromandel coast to Madras. On taking in hand the reduction of the observations and the calculations of the usual preliminary results, the difference between the measured value of the base line at Cape Comorin and the computed value brought down by the triangulation from Calcutta, viâ Madras and Bangalore, was barely appreciable, being 2.23 millionths of the length measured. No serious errors have been met with in the values of the sections of the Great Arc between the parallels of  $8^{\circ} 9'$  and  $18^{\circ} 3'$ , which were deduced from Colonel Lambton's observations at the beginning of the century.

The difficulties in the way of progress up the Assam Valley were explained in the abstract for last year.<sup>1</sup> This year the triangulation was advanced for 47 miles, to within a few miles of Sibsagar Station, greater rapidity of progress having been secured by building tripod stands for the theodolite and separate platforms for the observers, instead of the usual elaborate central masonry pillars. Various points were fixed in the Duffla Hills to the north and in the Naga Hills to the south-east; and connections have also been made with the stations of the Revenue Survey in the valley. The party sustained a loss in the death of Mr. G. A. Harris from fever, he being a very painstaking and worthy member of the Department.

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<sup>1</sup> Abstract for 1872-3, p. 10.

Captain Carter had a gap of only 54 miles in the triangulation of the Brahmaputra series (meridian of  $90^\circ$ ) to complete, but it was a work of some difficulty to accomplish this, as all triangulation had to be done before the usual jungle fires in March. Moreover the series lay almost wholly in alluvial plains, necessitating the construction of lofty towers and elaborate clearances between. Endeavours were made to establish a connection with the Revenue Survey, but as the plan of erecting tri-junction pillars has only recently been adopted in Bengal, the positions of the temples and banyan trees, under which the villagers hold their markets, had to be fixed instead.

The Jodhpur meridional series<sup>1</sup> was advanced a considerable distance northwards through the Desert of Marwar and Jesalmer, a region much dreaded on account of its desolate appearance, the frequency of its famines, and the distress and disease generally prevalent among the poorest classes of inhabitants, owing to the miserable food and unwholesome water on which they are compelled to subsist. The desert is covered with sand hills of a pretty uniform altitude, so that the advantages of a hilly country are lost, and short sides to the triangles are unavoidable. The principal triangulation was carried for 90 miles along the meridian, by a series of figures embracing an area of 1,552 square miles: Secondary chains of triangles have been extended from the main series, and sites for stations selected for 102 miles ahead of the principal triangulation. Between the Indus and Gurhágárh series, eastward of it, there will be only two principal series, the Jodhpur and another, on the meridian of  $70^\circ$ , the plan of having the main meridional series about a degree apart having been found to involve too great an amount of principal triangulation, the deficiency being made good by an increase of secondary triangulation.

The Eastern Frontier Series in British Burma had been stopped in 1870 owing to the financial embarrassments of the Government; the expenses being vastly greater in Burma than in any part of India proper. This is to be ascribed chiefly to the thinness of the population and the density of the forests, which, covering the whole face of the country up to the top of the hills, necessitate extensive clearances and the cutting of long lines. This year the Government directed the triangulation in Burma to be resumed and pushed forward with vigour, so that points might be fixed for the operations of the Revenue Surveyors in that province. Mr.

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<sup>1</sup> Abstract for 1872-3, p. 11.

Rossenrode was selected for the duty, and he arrived at Rangoon on the 7th November. The great object in British Burma is to keep the stations as much as possible on the hills, and so avoid the necessity of bringing the triangulation into plains crowded with luxuriant vegetation and dense forests. For <sup>se</sup>veral months Mr. Rossenrode was impeded by the <sup>u</sup>ncertainty of the jungle fires and unable to observe, and when the monsoon finally dispelled the haze, the whole country was submerged, the depth varying from one to four feet. The out-turn of work comprised a double polygon, covering 1,294 square miles, and in the preliminary operations stations have been selected for a secondary chain to connect Rangoon and Pegu.

Captain Herschel's departure to Europe necessitated the breaking up of the party which had been employed on astronomical and geodetic operations in the Madras Presidency. But the levelling, the object of which is to connect and reduce to a common datum the several lines and systems of levels executed for railways, canals, and other public works, these being very numerous in the Madras Presidency, and to check trigonometrical determinations of heights, was entrusted to Lieutenant Harman. He carried a line, 304 miles in length, from Gúti, through Bellary, to Karwar, where tidal observations will probably be made soon.

Turning to the topographical operations,<sup>1</sup> the completion of the survey of Kattywar within the next five years may be confidently looked to. The area completed in the season of 1873-4 by Lieutenant Pullan, whose party was weakened by the death of two assistants and the loss of a third, who became a lunatic, comprised about 2,201 square miles, which were surveyed on the scale of two inches to the mile by plane-tabling on a trigonometrical basis, with the addition of a large amount of traversing, in order to lay down the taluka boundaries, and for purposes of check. A survey of Rajkot, on the scale of 12 inches to the mile was also made, and a good deal of triangulation in advance for next year's operations.

The efforts to combine the work of the Revenue Surveyors in Guzerat with the scientific topographical survey were described in the Abstract for 1872-3,<sup>2</sup> and it now appears that, thanks to the unceasing efforts of the Trigonometrical Survey officers concerned, the valuable measurements laid down in the village maps can be successfully incorporated in the maps of the professional surveyors.

<sup>1</sup> Abstract for 1872-3, p. 12.

<sup>2</sup> Abstract for 1872-3, p. 13.

This end had been steadily kept in view by Colonel Walker, who was desirous of utilizing the measurements of the revenue surveyors, inasmuch as plane-tableing, which is the method usually employed by his officers, is unsuited for a rich champaign country like Guzerat, and a recourse to accurate chaining was therefore unavoidable. The Bombay Government co-operated usefully by sending a small but sufficient party of native surveyors to furnish details of the fiscal measurements, and indicating the positions of the principal pillars and marks for reference. By cutting up the village maps into triangles, with sides under three-quarters of a mile, all the boundaries given by them can be satisfactorily embodied on the professional maps. The scale finally adopted is that of four inches to the mile for the Khálsa villages, where the owner of each field pays his rent directly to the British Government, and each field has been surveyed fiscally; lands on the *tálukdári* and *inámí* tenure, villages belonging to the native states, and the Dang forests being surveyed on the two-inch scale, as in Kattywar.

A satisfactory amount of triangulation was accomplished, the topographical operations embracing a rather smaller area than in former years, when the scale was but half as great; but Major Hare expects that his party will soon be able to turn out nearly as much work annually on the four-inch scale as could be done in those parts where the Revenue Surveyors have not been at work, on the two-inch scale.

The maps completed show the wall, fences, and other divisions between the fields, the "numbers" by which the fields are registered and generally recognized, and all other fiscal details, besides topographical information. They will thus prove most useful for local and general administrative purposes to engineers employed in laying out lines of roads, canals, and railroads, and more particularly for local irrigation works, for which it is a matter of great importance to have a map showing the fields which are brought under irrigation, and the owners of which have to be taxed in proportion to the benefits they receive.

The importance of forest surveys has been recognized in India, and Captain Bailey, the new superintendent, was temporarily affiliated to Colonel Walker's department, to enable his establishment to be properly trained and organised. The Dehra Dun district was selected as the field of operations, and it was first intended that a re-survey of the whole should be made by Captain Bailey, as the increase of cultivation and formation of extensive tea plantations since Major Brown's survey in 1840 had been great.



But as the calls on Captain Bailey from all quarters became too numerous to enable him to finish his work, a portion of Captain Thuillier's assistants from the Kumaun and Garhwal Survey were drafted off to work on the non-forest tracts of the Dehra Dun; and a good out-turn of work was completed by them. The scale adopted was the same as that which, after the conclusion, had been fixed upon for the *pari passu* survey of the forest tracts, *i.e.*, four inches to the mile. This is the same scale as is used for the surveys in the British districts in the Bengal Presidency plains, and it was therefore deemed advisable to make use of a large proportion of native agency, as is there used, in order to train them for the new survey of the districts of Jaunsar, Bawar, Kangra, Kulu, and Spiti, which had been sanctioned by the Government and Her Majesty's Secretary of State for India.<sup>1</sup> The districts of Kangra, Lahaol, and Spiti, and the native states of Chamba, Tiri, and Garhwal, had been surveyed in 1849-54 on the scale of  $\frac{1}{2}$ -inch to the mile, but the object had been the delineation of the general geographical rather than the topographical features, so that a re-survey on a larger scale had now become necessary, and the larger amount of comparatively mechanical work offered a good opportunity for an extended use of native agency.

The remaining members of Captain Thuillier's party (Kumaun and Garhwal Survey),<sup>2</sup> under Mr. Ryall, executed a fair amount of triangulation (460 miles) and topography (534 miles) during April, May, and June, among the upper valleys of the Ramganga, Sarju, Gori, and Ralam rivers.

In the Abstract for 1872-3, an account was given of the pendulum observations<sup>3</sup> which had been carried on in India since 1865, and which last year were brought to a conclusion at Kew by Captain W. J. Heaviside, R.E. The results of the operations, as far as they relate to the observations made with the invariable pendulums of the Royal Society, have been since calculated, and they offer incontestible evidence in confirmation of the hypothesis of a diminution of density in the strata of the earth's crust which are under continents and mountains, and an increase of density in the strata under the bed of the ocean; and it is clear that elevations above the mean sea level are accompanied by an attenuation of the matter of the crust and depressions by a consolidation.

<sup>1</sup> Since disallowed, owing to financial reductions.

<sup>2</sup> See Abstract for 1872-3, p. 14.

<sup>3</sup> See Abstract for 1872-3, p. 16.

The reductions of the swings with the Russian pendulums and Captain Kater's convertible pendulum are not yet sufficiently advanced to enable any conclusions to be drawn regarding the results.

### TIDAL OBSERVATIONS.

In the "Abstract" for last year,<sup>1</sup> the preliminary arrangements were described, which had been made by Lieutenant (now Captain) Baird, for instituting tidal observations at three points on the coast and in the Rann of Kach, and a description of the masonry wells and their method of connection with the sea was also given. At the beginning of the field season of 1873-4, some experimental observations were made at Bombay; and here fortunately the discovery was made that there was a decided tendency for air to collect in the connecting pipes. This having been remedied by affixing stop-cocks to the pipes, a start was made for Okha Station; all the instruments and stores, European assistants and native establishment, having been embarked on board a pattimar or native sailing vessel. On the 5th November the landing of the stores and sinking of a masonry well—for the sandy soil had rendered this necessary—were commenced, and by the 23rd December everything was in full working order. The very next day, however, a large native boat drifted from her anchorage towards the station, broke the flexible piping in two places, and carried away the buoys and anchor. This led to various arrangements for protecting the piping and intercepting drifting vessels being made. At short distances round each station three bench marks, which had been carefully connected with the zero of the tide gauge, were sunk in the ground for future reference. Next year a series of levels will be carried so as to connect the tidal stations and determine their differences of level. It is very desirable, in order to obtain data for ascertaining the separate influence of each of the chief tidal constituents, that a series of observations should be taken for a year at least. During this time, periodical inspection would be absolutely necessary, and arrangements to that effect have accordingly been made. This inspection entails exposure and privation. In May the Rann of Kach was from six inches to a foot in depth, and Captain Baird and Mr. Rendell travelled on camel back. Later on during the monsoon, communication by boat became impossible, as

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<sup>1</sup> p. 54.

the native vessels could not venture out in such strong gales as set in, so a long detour round the gulf became necessary; while the common unmetalled roads in the black soil of Kattywar becoming all but impassable during the rains, often prevented Captain Baird from making more than a mile an hour.

The working of the gauges at Okha Station has been satisfactory. At Hanstal there have been short breaks in the continuity of the observations, owing mostly to the unavoidable deposit of fine mud in the piping and well. Nawandar, however, proved to be quite unsuitable for continuous tidal observations, as under the influence of the strong S.W. monsoon, the drift from a belt of sand hills to the south had formed an extensive sand spit on the line of piping, and the extreme end was thus buried in sand, where a few weeks before there had been a depth of 20 feet of water at low tide.

The preliminary results of the observations up to the end of September have been worked out by Captain Baird, and the extreme range is greatest at Hanstal, where it is 21·2 feet, or from two to four feet more than is given in the Marine Charts. Very fairly approximate values of the progress of the tidal wave up and down the gulf have also been obtained. Observations of barometric pressure, of the velocity and direction of the wind, and on the amount of rainfall have also been taken in order to separate local atmospheric influences from the true tidal constituents, which are caused by the varying positions of the sun and moon, and so materially increase the scientific value of the tidal observations.

Colonel Walker speaks highly of Captain Baird's labours, and of the trying nature of his duties, especially while inspecting the stations during the monsoon.

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the TOPOGRAPHICAL SURVEY OF INDIA AND WORK OF THE SURVEYOR GENERAL'S OFFICE, 1873-4.

of a year under review there were seven topographical  
of Bengal employed in the field, and the out-turn of work amounted  
wara, Hazar are miles of final topography, chiefly on the one-inch  
maps complete 23 square miles of triangulation in advance, results  
have been practically nearly the same as those obtained last season.  
general map of the Indian Archipelago are pronounced by the Surveyor General to be  
of the Indian Archipelago very full and large area having been returned  
review, three of the

As regards the

The <sup>re</sup> Captain Gwalior and Central India Survey,<sup>1</sup> under Captain Strahan, was engaged during 1873-4 in portions of the native states in the vicinity of Jhalra Patan, east of Neemuch, between the parallels of 24° and 25°.

A good description of the cities of Pertabgarh and Deola by Mr. Scanlan, 1st assistant surveyor of the party, will be found in the appendix to Colonel Thuillier's report. They are noted for the manufacture of a peculiar kind of jewellery which appears to be fashionable at present among Indian ladies, and consists of all sorts of shapes of green glass on which grotesque figures and hunting scenes are delineated, among which the lion is of such frequent occurrence as to suggest the idea that it was at one time much commoner than now. The secret of the manufacture of this jewellery is so jealously kept that the men will not permit their daughters to enter the workrooms, lest on marriage they should divulge its mysteries. Mr. Scanlan also furnishes an account of the curious troglodyte caves of Dhamnar, which were seen by Tod in 1821, and described by him in his Rajasthan. In the course of the survey some of the party met with some of the notorious Bhil tribes, but though a difference arose it was fortunately adjusted satisfactorily. The final topography executed covers an area of 2,783 square miles, and the triangulation 4,080 square miles.

No. 2 party,<sup>2</sup> under Mr. F. B. Girdlestone, was engaged along the great range of the Vyndhias, in the Nerbudda Valley, in portions of Nimar and Malwa, Barwani, Dhar, and Dewas. The area covered by the topographical operations amounted to 2,285 square miles, and by the triangulation, 1,000 square miles. The fall of the river Nerbudda between Mortakka and Kheri (73·5 miles apart) was taken and proved to be 147 feet, being at the rate of 2 feet per mile. Mr. Girdlestone visited the ruins of Mando, which are girdled by walls 30 miles in circumference, and situated on a plateau<sup>sur</sup> surrounded nearly on all sides by precipitous hills, the Vyndhias<sup>for</sup> forming a precipitous wall of 1,254 feet to the south. The enormous mass of mixed palaces, temples, and tanks, and of the year at and villages around, attest its former importance, it having<sup>solutely</sup> been three and a half centuries the residence of kings and<sup>ngly</sup> been Now it is inhabited by only a few wretched Bhils, a<sup>l.</sup> In May are rapidly decaying. The Vyndhia Bhils are c<sup>n</sup> depth, and their own cattle, and are far better off both i<sup>ack</sup>. Later on condition of life than their brethren in the Satpur<sup>ie impossible, as</sup>

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same name. They are a contented and humorous race when sober and take readily to Europeans, but when drunk (which they frequently are) are easily provoked and troublesome to deal with. Mr. Girdlestone furnishes a detailed description of Mahesar Fort in Nimar (Holkar's dominions). There are 30 pieces of ordnance within the fort, and at the time that the survey was going on there was a garrison of 215 men. Colonel Thuillier speaks in very high terms of Mr. Girdlestone's energy and devotion to his duties in spite of the difficulties and unhealthiness of the country.

The Central Provinces and Vizagapatam Agency Survey<sup>1</sup> operations, under Lieutenant Holdich, cover an area of 1,428 square miles of final topography among the broken rugged hills which continue the mountain system of the Eastern Ghâts, and extending across the Godavery River with a general south-western trend, finally merge into the high plateau of the Hyderabad country. The country is as a rule a densely forest-clad district, which, combined with the remarkable unhealthiness of the region, the difficulty of obtaining guides and supplies, the paucity of villages, and the annoyance experienced from tigers, greatly hindered the progress of the surveyors. The triangulation was extended over 1,800 square miles in the southern zemindaries of Bustar, a tolerably low, jungle-covered country infested by tigers. The villages are few and far between, the inhabitants being mainly Kois, an aboriginal tribe of the Dravidian or Gond family. Owing to the increasing difficulties of the country remaining for survey, about 9,000 square miles, the unprofitable nature and unhealthiness of the country.

Lieutenant Colonel Depree's party,<sup>1</sup> No. 4, was at work in the Rewah state, and the Mandla, Balaghat, and Bilaspur districts of the Central Provinces. The out-turn amounted to an area of 1,600 square miles of triangulation, and of 2,419 square miles of final topography, in addition to 3,812 acres of forest reserves in the Mandla district, which were surveyed on the large scale of four to the mile. A junction was effected by means of triangulation, Hazar revenue survey tri-junction masonry platforms in maps complete Raipur, while valuable aids to future settlement have been provided by the marking on the maps of all the points in the Mandla district. The nature of the Indian survey is favourable for transit, all the hill ranges being covered with heavy forest, and the entire surface

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<sup>1</sup> See Abstract for 1872-3, p. 20.

The ground of a stony character. It is anticipated that the remaining topography will not occupy more than a season or two, and the Central Provinces will then have been entirely surveyed.

A very good season's work was turned out by the Bhopal and Malwa Native States Survey<sup>1</sup> under Captain Riddell, amounting to 2,812 square miles of final topography round Sehore and Bhopal, and in some of the smaller native states in the Rajputana and Central India agencies, and 2,833 square miles of triangulation, in addition to the triangulation for a plan of Sehore, the head quarters of the Bhopal agency. Of the city of Bhopal, Captain Riddell remarks that it is over-crowded, the population amounting to at least 44,000, but that (unlike any other Indian city of his knowledge) excellent water is obtainable by simply turning a tap, the supply being derived from a reservoir, which in its turn is fed by steam from the lake 150 feet below. During the season 1874-5 this party was to have been under the charge of Captain Wilmer.

The arrangements made for the exploration and completion of the surveys along the north-eastern frontier and in the Manipur state were described last year. This year three detachments of No. 6 party were formed with the objects, 1stly, of continuing the exploration in the Eastern Naga Hills, south of the Sibsagar and Lakhimpur districts; 2ndly, the completion of the central portion of the Naga Hills or Samaguting district, and 3rdly, the filling up the blank or western portion of the Manipur Native State between the meridians of  $93^{\circ} 15'$  and  $94^{\circ}$ . All these objects were attained with the exception of a small strip in the Naga Hills 25 miles long, the total out-turn being 9,201 square miles of topography, over a most difficult tract of hilly and inhospitable country, and 3,100 square miles of triangulation. A considerable portion of the country visited and mapped was totally unknown, except by name, to the oldest and most experienced frontier officers; and the Lanier River which has long been supposed to drain into the Brahmaputra, has been proved to join the Namtonai or Kyandwein River, which debouches into the Irawadi, almost due west of Ava. The whole party had many great privations to undergo from bad and insufficient food, fever, and exposure in low pestiferous valleys and the snow-covered Eastern Naga Hills, while occasional acts of hostility on the part of the natives were sustained.

During the season 1874-5 the party was to have been employed

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<sup>1</sup> See Abstract for 1872-3, p. 20. t



in three detachments; two under Captain Badgley and Lieutenant Woodthorpe in the Eastern Naga Hills, and the third under Major Godwin-Austen, with the military expedition against the Duffla's.

The Rajputana and Simla Survey party (No. 7),<sup>1</sup> under Captain G. Strahan, extended its triangulation through portions of Ajmere, Jodhpur, and Jeypur, covering an area of 5,210 square miles, and 3,170 miles of final topography in Mhairwarra and parts of Udeypur and Jodhpur, besides completing large scale plans of Erinpura and Beawar. The country triangulated consists mainly of plain studded with sandhills, throughout which supplies, especially grass and water, were procured with much difficulty. A curious method of telegraphy by means of mirror flashes proved to be practised across the desert from Ajmere to Bikanir. It is used by the opium merchants, who thus make known the rate at which opium is selling in Calcutta. Mr. W. M'Nair, assistant-surveyor, furnishes a description of Ranpur Temple in the Aravalli range, a pile of buildings of imposing aspect, of sandstone, occupying a space about 250 feet square. It is devoted to the Jain religion, and pilgrims assemble thither from Guzerat, Bombay, Bhopal, and the North-West Provinces during the months of March and September, when a fair is held.

While in recess quarters Captain Strahan's party took up the Simla and Jutog large scale survey (24 inches to a mile), and besides completing a good out-turn of traversing, trigonometrical determination of heights, field sketching and drawing, a most artistic plan of Simla and Jutog was rendered by him on the scale of eight inches to the mile.

A large portion of the season's fair mapping, which embraces altogether an area of 21,383 square miles, has been reduced to the quarter-inch to the mile scale for the Indian Atlas. A compilation of a map of Assam, scale eight miles to the inch, uniform with that of Bengal, has been started; maps of Bhutan, Darjiling, Chindwara, Hazara, and Garo Hills, and various other miscellaneous maps completed, and the engraving of maps of Sind and of India have been proceeded with. The latter will be very useful, a good general map of India being a *desideratum*. Seven quarter plates of the Indian Atlas have been published during the year under review, three of them being complete up to margin.

As regards the photographic department, no less than 27,800

<sup>1</sup> See Abstract for 1872-3, p. 20.

<sup>2</sup> See Abstract for 1872-3, p. 21.

copies of outline maps of districts and divisions in Western and Northern Bengal were printed to meet the demands of the local administration for the purpose of aiding the famine relief operations. The increase of work in printing copies in this branch during the year was nearly 32 per cent. above that of 1873. The photo-collotype process for the reproduction of maps has unfortunately failed owing to climatic influences, and though it may eventually succeed with care, it will probably never suit for the printing of large maps. An excellent series of copies of casts in the caves of Cuttack has been nevertheless produced by it to illustrate Baboo Rajendralal Mitra's work on the Antiquities of Orissa. In the lithographic branch 214,153 complete copies of maps, plans, &c. were printed during the year, and a good portion of these were coloured by the process of chromo or color printing. The per-centage of out-turn of the three different descriptions of printing presses is as follows:—Photozincographic 40 per cent., lithographic 57 per cent., and copper plate 3 per cent. During the year the total issue of maps to all public departments on service and to agents for sale amounted to 38,022 copies, of the value of 51,531 rupees (5,153 $\frac{1}{2}$ .)

#### IV.

##### REVENUE SURVEYS OF INDIA, 1873-4.

During the season 1873-4 there were fifteen survey parties at work, eight in the Punjab and North-West Provinces, and seven in the Central Provinces, Bombay, Bengal, and Assam. The total number of square miles surveyed and mapped amounted to 19,901, or 3,389 square miles more than in the preceding season, while 9,422 square miles of country were also either triangulated or surveyed in boundary in advance for the field season of 1874-5.

Colonel H. C. Johnstone's party were engaged in the Dehra Ghazi Khan and Dehra Ismail Khan districts, the operations being confined to lowlands of the Indus' bed, stretching up to a little beyond the high bank on each side. The boundary survey of 374 villages was completed, as well as the interior survey of an area of 1,291 square miles. A comparison of the areas with those obtained by the Settlement Department cannot as yet be instituted, but the total areas of villages are said to agree well. On the other hand, the thakbusts or boundary maps of the river lowlands are badly made, according to Colonel Johnstone, and the mud boundary

pillars are continually being moved by the villagers or washed away by the movements of the river. Brick boundary pillars have now been erected along the high banks on both sides of the Indus. Levelling operations were undertaken in consultation with the Irrigation Department, and 476 linear lines of levelling were got through. During the season 1874-5 the completion of the survey of the River Indus and the lowland villages, as far north as Kalabagh, where the river emerges from the Salt Range, was to have been taken in hand.

The second party, under Captain Wilkins, completed 674 square miles of interior survey in the Delhi district, and 1,647 square miles of boundary survey in the Gurgaon district. All the marks of the Great Trigonometrical Survey that could be properly identified were incorporated. The fort of Tuglakabad and ground round the celebrated Kutub Minar were surveyed on the large scale of 16 inches to the mile. As regards the comparison of the settlement with the professional work, Captain Wilkins reports that the total areas of villages as determined by both surveys do not agree so well as they ought to, while the details have not been worked out far enough to admit of comparison.

In the Bhawalpur State two parties were engaged (the third, under Captain Andrew, and the 15th, under Mr. J. Campbell,) in the cultivated portions bordering on the Indus and Sutlej, and in the desert tracts to the south. The area of out-turn in the case of the first-mentioned party was 4,014 square miles, and of the second 3,051 square miles. The results are considered very good, as the difficulties of locomotion in the desert tracts, where the chain men often sunk up to their knees at each step, were very great: Throughout this tract the sand ridges uniformly extend north-east and south-west, being more precipitous on the south-east face than the other. The vegetation is very scanty, and the aspect of the country is simply that of an ocean of sand.

The four cadastral surveys in the North-West Provinces were again engaged in Muradabad, Muttra, Agra, and Humirpur. The total number of fields surveyed was 1,501,398, and these averaged apiece 1·16 of an acre in size, or rather larger than the average of the previous season. The work was carefully connected with the points of the Great Trigonometrical Survey, where such could be identified, and the agreement between the two classes of measurements was very close. Much delay in publication in the case of the Muttra party's work was avoided by the Settlement Department testing the classification in the field, after the usual test had been

applied by the European officers of the survey. Colonel Anderson reports that numerous and urgent demands for copies of the 16-inch survey sheets are made by the canal and railway departments, and civil officers, and that Mr. Prince, superintending engineer of the Light Provincial Railway, through being supplied with tracings of the Muttra survey, has been enabled to dispense with a special preliminary survey to enable him to determine the best point for the proposed railway across the Jumna and through Muttra. Mr. Prince also reports that he has found them wonderfully correct. The Agra party were to have taken up the 16-inch survey of the city, cantonment, civil station, and environs of Agra during the season 1874-5.

In the Lower Circle the eighth party, under Lieutenant Colonel Oakes, was employed in the Betul district and Aheri Zemindari of the Central Provinces, and an area of 1,466 square miles was covered by their operations, though an unusually hot and dry season occasioned much sickness to the party.

Mr. Lanc's party in the Bilaspur district and Aheri Zemindari rendered a total out-turn of 2,039 square miles, which was carefully tested by European agency. The Settlement Department had gone over the same ground five or six years previously, and the comparison of areas is satisfactory, the difference over the whole of four main circuits being  $4\frac{1}{2}$  per cent. The whole of the Aheri Zemindari, with the exception of a few patches of cultivation, is covered with high jungle, has a dense undergrowth of high grass and weeds, and abounds with wild animals, such as tigers, panthers, leopards, bears, wild hogs, and buffaloes, bisons, neelgyes, samburs or Indian elks, several species of deer, and others. There are three Government forest blocks of teak of a superior quality near Aheri, and the timber is carted to Nagpur or floated down to the Praneta River. A good deal of excellent teak is also found to the south-east, near the River Indraoti, and is being worked by some Marwari merchants, who float it down the Indraoti and the Godavari rivers.

In the Bombay Presidency two parties were engaged in the Nasik, Ahmadnagar, and Poona collectorates. The object of this, as was explained in last year's Abstract,<sup>1</sup> was to render the Bombay revenue survey available for the construction of accurate maps for the general purposes of administration. A total area of 1,744 square miles was topographically surveyed by Captain Coddington,

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<sup>1</sup> p. 25.

while the triangulation covered 3,000 and the traverse work 1,524 square miles. A connection was established with the Khanpisura series of the Great Trigonometrical Survey. The cost of the work has been much reduced since last year, being Rs. 37 5. 8. per square mile, as against Rs. 55. 6. 11. for the previous season. The party under Major Tanner completed an area of 1,440 square miles of topography, and of nearly 3,500 of triangulation in the Poona and Ahmadrnagar collectorates, the cost being Rs. 38. 15. 1. per mile. Major Tanner reports that the Bombay village plans when reduced to the scale of two inches to the mile fit in accurately with the Topographical Survey, and that as the plane-tabling is done from the tri-junction points of villages (which are always to be found on the local plans), the amalgamation of the surveys is attended with no extra labour in the field.

The 12th, Midnapur district, party completed an area of 941 square miles, and of the 180 miles forming the remainder of the tract the village boundaries have been surveyed. Major Sconce, the chief of the party, is described as one who takes great pains to improve his subordinates, and as a most valuable officer.

In the Goalpara and Darrang districts of Assam a total area of 1,425 square miles were topographically surveyed on the scales of two and four inches to the mile respectively.

In the Lakhimpur district an area of 1,287 square miles was topographically surveyed by the 14th party, under Captain Samuells. It was found necessary to measure a base line and proceed on triangulated data, as the operations of the Great Trigonometrical Survey had not yet been extended so far. The party was exposed to much sickness and hardship. Mr. Ewing was wrecked while floating down the Dihing, and all the property of his party was lost; and Mr. Swyny, through remaining too long at his post while suffering from fever, fell a victim to his devotion, and died May 26th.

A valuable and interesting descriptive report of this important and little known frontier region is given by Captain Samuells, and it has therefore been thought desirable to reproduce the substance of his more important observations.

The portion of the Naga Hills surveyed by the 14th, or Lakhimpur party, consists of a succession of ranges running parallel to the watershed, and varying from 25 to 30 miles in width. The watershed, or Patkoi Range, which divides the valleys of the Brahmaputra and Irawadi, has a general direction north-east and south-west and an average height of about 6,000 feet on the summit. The acute angle of the range is all of

work, which decreases gradually, till at the source of the Dihing River it is not more than 2,000 feet high. After this the range increases in height and joins the high hills and snowy peaks inclosing the east end of the Assam Valley. The hills are covered with dense forest except here and there near the villages, where small patches have been cleared for cultivation. On the lower ranges the India rubber tree (*ficus elastica*) is common, and forms a source of revenue to the Nagas, who wander about the jungles in the cold season tapping the trees and collecting the rubber. A great impulse was given to the rubber trade a few years ago by some of the European planters engaging in it. The price rose from Rs. 10 to Rs. 40 per maund, and the consequence was that the trees were tapped to such an extent that they were nearly all killed. The Nagas were not content with tapping the trunk and branches but exposed the roots and notched them also, and in some instances, when they were too lazy to climb the tree, they deliberately cut it down to save themselves trouble. The tea plant is very plentiful in certain localities of these hills, and a kind of brick tea is made therefrom by compressing the green leaves into hollow bamboos, where it ferments slightly, but it is neither dried nor roasted before use. Limes of various sorts are common throughout the jungle, and in some of the villages there are magnificent orange trees with a remarkably fine sort of fruit. On the higher ranges the cassia tree (*laurus cassia*) is very common. It is a species of cinnamon, but the bark is thicker than that of the true cinnamon, and its colour deeper. Salt springs were met with throughout the tract surveyed, while coal is found all along the foot of the hills, and generally seen cropping out on the banks of the streams which flow into the Dihing at the point where they leave the hills. It is of excellent quality, and has been worked at several places, but the want of local labour and the dearness of provisions prevented the working being remunerative. Petroleum has been bored for in one or two places. There are a great many types and clans of Nagas inhabiting the country surveyed. As a general rule, those inhabiting the ranges nearer the plains are all more or less demoralised from excessive indulgence in opium and strong drinks. There are constant blood feuds between the tribes, as their peculiarities and distinctions are intensified by the absence of communications from one village to another. A capital account of their manners and customs is given by Captain square miles remarks, with regard to trade routes between \_\_\_\_\_ that, though Europeans have been turned back

while endeavouring to cross into Tibet from the side of Dibrugarh, no physical difficulty exists in the way of communication across the Patkoi into Hukong and Upper Burma. In 1823 the Burmese army invaded Assam by a route east of the country surveyed, where there are no high ranges to be crossed, and returned the same way in 1825, carrying away many women and children, and much booty, and that even thus encumbered our light infantry were unable to overtake them and rescue the captives. Numbers of Singphos and Burmese cross backwards and forwards every year, and several parties of traders were met with who had come over to sell gongs, dhaos, and amber earrings. The reason assigned for the trade not being greater was that the traders chiefly wanted guns, gunpowder, and opium; and as the sale of these was prohibited by the British Government they preferred selling their goods in Burma, where these articles were procurable. Captain Samuells gives in an appendix a useful list of routes between Assam and Upper Burma.

## V.

## THE GEOLOGICAL SURVEY OF INDIA, 1874.

The regular work of this survey again suffered somewhat from the enforced absence of some of its members.

During nearly the whole of the year, Mr. H. B. Medlicott officiated as Superintendent during Dr. Oldham's absence on sick leave. Mr. W. T. Blanford was also absent for some time, being engaged in working out and passing through the press his notes on the natural history and geology of Persia. He returned about the middle of December, and proceeded to Surat to advise the authorities on the best way of obtaining a good water supply; after which he took up the general examination of Sind. Another member of the staff, whose services the Survey was deprived of for the year, unfortunately fell a victim to his over exertion in the cause of science. Dr. F. Stoliczka, who accompanied the Kashgar mission in the capacity of naturalist and geologist, was returning to India on a rich harvest of notes and collections, when he succumbed to Mr. emc cold and fatigue encountered in the extreme altitudes the Kamir Steppe and Karakorum passes, which had under-skaat thnstitution not naturally strong. Dr. Oldham remarks

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than nature with peculiar powers of observation and com-  
disc the coun in an accurate and careful school of geology and  
conducted as brought to his labours unbounded zeal, acute  
Malllected as large and carefully acquired knowledge, all of  
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which tended to render him one of the most useful and trusted of our colleagues. But in addition to this, his genial temperament, his sound judgment, and his hearty appreciation of work of any kind in others, together with his clear views of justice, and the unflinching expression of those views, made him also one of our most esteemed and beloved friends and advisers. His loss to the Geological Survey will be long and keenly felt."

The Palæontologia Indica, which forms a noble monument of Dr. Stoliczka's research and powers, will be continued by his trusted fellow labourer, Dr. Waagen.

Mr. Medlicott's time was pretty fully taken up with the current work, but at the urgent request of the Government of Bengal he visited the Garo Hills, whither it is now possible to proceed with safety, and discovered a strong seam of fair coal in one of several detached basins of newer secondary rocks in the heart of the hills, north of the main ridge.

Mr. Theobald, in a rapid examination of the area between the Ganges and Ravi, arrived at the conclusion that the great mass of the Siwalikh range on the east of the Jumna is composed of rocks belonging not to the Siwalikh group, but to the older and distinct Nahan group, and that on the further side of the Sutlej the Siwalikh rocks are bounded by the Una Dun. A large number of fossils of these areas have been received from Mr. Theobald, but want of space in the Geological Museum at Calcutta prevents their being opened out.

Mr. Wynne commenced the examination of the Trans-Indus salt region early in the season, being accompanied by Dr. Warth, who was to form a sound practical estimate of the commercial value of these extensive salt deposits. Mr. Wynne's researches proved that the Trans-Indus salt region (excluding the Kalabagh salt) comprises about 1,000 square miles of country between the British frontier and the River Indus, and Kohat and Banan to the north and south. It is very difficult to arrive at any fixed notion concerning the thickness of the beds, but nowhere can it be seen that the bottom of the salt is seen, and it is known to exceed a feet in thickness in some places. The salt is of a white all colour, and the greater portion of it is remarkably pure and less saline in taste than the Cis-Indus salt. The quarries were worked in 1650. There are two methods of quarrying: one by the absence of gunpowder and by detaching the salt in slabs or blocks from a capital rock by means of pickaxe and wedge, care being taken to make them of a uniform size. Owing to the remarkable difference between the two methods, the latter was turned back



colour between the Trans-Indus and Cis-Indus salt, it has been found expedient heavily to tax the latter, and impose a heavy fine upon all persons in whose possession the former was found to the east of the Indus. The area of consumption is very extensive, the radius exceeding 200 miles in length. Report even says that the Kohat salt is carried as far as Kandahar and Balkh, but this is uncertain. It is said that Government sacrifices a great deal by giving the Trans-Indus salt at so low a rate, but this point requires further research.

By careful and detailed investigation Mr. Wynne arrived at a conclusion of some interest, confirming previous ideas, that the rock salt dates from the old tertiary periods, no rock older than the salt having been noticed, and the salt itself appearing to be intercalated with the lower beds or almost the base of the nummulitic rocks. Mr. Wynne has since visited the country lying between the salt range and Kashmir boundary to the north.

Reference was made in last year's Abstract<sup>1</sup> to the interesting investigations in which Mr. King was engaged, in endeavouring to fix the correlation of the Godavari sandstones with established formations. He has established three zones in the Rajmehal series, two characterized by marine fauna, and a lower one by well marked Rajmehal plants, this last being closely superimposed upon beds containing specimens of the Kampti Damuda flora. The exploration of the Beddadanoole coal field was continued under Mr. King's superintendence, and some bands of poor coal and coaly shale were proved. The main coal may, however, turn out to be in the upper parts of the measure, which has not yet been examined. Mr. Vanstavern has put down some borings at Jugiapettah, alongside of those formerly made by Colonel Applegath, and where he believed he had found coal, but though the borings were carried down to the sub-crystalline rocks, not a trace of coal was discovered. Mr. King was actively engaged in January 1875 in an examination of the gold bearing reefs of Wynad.

Mr. Foote was first engaged in completing a survey of the ~~the~~ region of the Southern Mahratta region, after which he sketched the report on the small gold-bearing tract in the Dambal <sup>including</sup> ~~the~~ war. The smallness of the area and the scarcity of <sup>disc</sup> ~~the~~ <sup>than 20,</sup> ~~the~~ <sup>Mr. Foote then took up the region between the hill</sup> ~~the~~ <sup>collected as to</sup> ~~the~~ <sup>say it was</sup>

<sup>1</sup> p. 30.

ranges and the sea north of Madras, with a view of completing the sheets 76, 77, and 95.

Mr. Hughes' researches have been more of a directly economic kind, in connection with the manufacture of iron. At the close of the year he had re-examined the iron deposits of Kumaon. His opinion thereon (which confirms in the main various researches of the Geological Survey) is that there is abundance of ore and flux and fuel for operations on a limited scale. He then made a revised examination of parts of the Raniganj field, and his report thereon appeared in the "Records." His regular work did not commence till January, when, with Mr. Fedden's aid, he remapped the northern portion of the Warora coal field. On his recommendation borings were put down in the neighbourhood of Bander, and beds many feet in thickness were proved. This discovery is the more important as the locality of coal is the nearest yet known to that of the valuable iron ores of the country. Towards the close of the year Mr. Hughes was engaged in rendering general advice to two companies who propose to undertake the smelting of iron.

Mr. Fedden, as stated above, was occupied, in company with Mr. Hughes, in the Wardha valley field. At a place north of Warora he discovered some fossil fishes in the uppermost beds of the sedimentary rocks, and this will help to elucidate the age of the beds.

Some progress had been made by Mr. Ball in the borings of the Dudhi valley, when he was suddenly called away to Calcutta with a view to his visiting the Mergui Archipelago. This trip was subsequently abandoned, but he was unable thus to complete a large out-turn of work, although he had time to visit the wild district of the Luni Pathans west of Upper Sind, where some traces of lignite had been seen. A full account of his trip has appeared in the "Records" for 1874, p. 145.

The experimental borings for coal in the region of the Narbada were continued, but did not lead to any discovery, though at Sukakheri a depth of 491 feet was attained. Borings have been commenced in the Tawa Valley, with the object of saving 2<sup>000</sup> of rough carting from the Shahpur or Betul coal field. <sup>1</sup> and

Mr. Willson continued his mapping of the northern <sup>1</sup> tribes, the Bundelkund Survey. One of the chief points of <sup>1</sup> absence prevalence of quartz reefs or veins of a great size. A capital number. Two systems of trap dykes were also <sup>1</sup> by Captain being apparently younger than the great quartz reefs <sup>1</sup> between

Mr. Hacket resumed his labours in Rajputana, turned back

the greater portion forms a blank at present in the geological map of India. Mr. Mallet finished his examination of the coal deposits in British Sikkim and the Western Duars, where he considers there is some prospect of the Damuda coal being made serviceable by the adoption of some contrivance for the utilization of such powdery coal. His observations have led him to believe that the Damuda formation is here the lowest member of the rock series of the outer Himalaya ranges, the Darjiling gneiss being the topmost and youngest. This, if confirmed, is a result of importance, and will tend to establish a well marked common horizon between the rocks of the Himalaya and those of the Peninsula of India.

In accordance with the scheme for training natives as geologists,<sup>1</sup> mentioned in last year's "Abstract," there have been during the past year four apprentices attached to the Survey, and paid out of the Survey Budget. One of the four has now been attached to the Survey for nearly two years. Mr. Ball reports that he is attentive and willing to learn, but that his progress is very small and very unpromising. The other three, though receiving pay as apprentices, have been doing nothing in connection with the Geological Museum or Survey, but have been attending courses of lectures and instructions at the Presidency College. They are thus being paid for learning what apparently they ought to be able to prove their acquaintance with before their appointment.

Dr. Oldham expresses regret in his report that his Department has been hitherto unable to complete a general sketch map of the geology of India. This has been principally owing to the frequent calls made upon his officers for various extraordinary purposes (often not strictly geological), as well as to sickness and absence. Explorations of numerous isolated areas have been made; but without some knowledge of the intervening spaces, it is impracticable to correlate the rocks in one part with those elsewhere. Dr. Oldham has accordingly for some years devoted much attention to preparing separate descriptions and maps of certain divisions of the country. Besides papers relating to districts and collectorates, <sup>at</sup> the <sup>of</sup> the geology of the Central Provinces, of Orissa, of the Presidency, and of the North-Western Provinces have <sup>including</sup> published, while one of the Punjab is ready for press, <sup>disc</sup> <sup>than</sup> 20,000 gal will be soon taken up. <sup>the</sup> country, <sup>part</sup> 2, Vol. X. of the *Memoirs* was published, <sup>collected</sup> as the <sup>of</sup> the geology of Pegu by Mr. Theobald, and <sup>say</sup> it was cal.

<sup>1</sup> p. 32.

part of Vol. XI., containing a report by Mr. Mallet on the geology of Darjiling and the Western Duars.

The *Records* were issued quarterly as usual, and contained 23 papers on various points in the geology of India. Four are valuable summaries of the geological results obtained by the late Dr. Stoliczka during the mission to Kashgar, and one a note on the Altum Artush by the same hand. Of practical papers there are notes on the iron ores of Kumaon; on the raw materials for iron smelting; on petroleum in Assam; on the subsidiary materials used for artificial fuel; on the building and ornamental stones of India; on potash salts; on manganese ore; while descriptive notices are given of parts of northern Hazaribagh, the neighbourhood of Murree, of Kangra, of the Garo Hills, of the Luni Pathan country west of Sind, and of the Southern Godavari country.

Of the *Palæontologia Indica* the concluding parts of the cretaceous fauna of Southern India were published before Dr. Stoliczka's departure for Kashgar in 1873. The illness of Dr. Waagen, his successor, has prevented full progress being made, but two parts of the Kachh Cephalopoda have been completed. The later part contains an illustrated description of a very interesting form of rhinoceros (*r. deccanensis*) found by Mr. R. B. Foote in fluviatile deposits in Belgaum.

Large additions of books and publications have been made to the library; and some valuable collections of fossils from the Sivalikh range, the Rawal Pindi and Jhilm districts, the Milam pass to the north of Kumaon, and other localities, have been forwarded to the Museum by officers of the Survey.

## VI.

### THE ARCHÆOLOGICAL SURVEYS OF INDIA, 1872-3-4.

General Cunningham has published his fifth report,<sup>1</sup> containing the results of an archæological tour made by him through the Punjab during the cold season of 1872-73.

Yusufzai, where he seems to have broken ground, is known to be rich in ancient remains, and it is very desirable that, before they lessen and deteriorate, efforts should be made to secure them and unfortunately the bigotry of the people will suffer from their visit only the southern half or British district of Yusufzai tribes, sponding to the ancient *Penkolailis*). Dr. Bellew's absence of inhabitants as numbering 132 to the square mile. A capital of Yusufzai by Captain Bellew's remarks between Yusufzai and the Punjab, turned back

<sup>1</sup> Archæological Survey of India. Report for the year 1872-73. Part I. Calcutta, 1875.

times, judging from the numerous mounds of ruined cities and villages, the population must have been much denser, the water supply more plentiful, and the forests more abundant than now. Of the latter we have a proof in the fact that the Emperor Baber and his soldiers hunted the rhinoceros there; and as regards water, Yuzufzai offers many advantages for securing an artificial supply,—a fact which was not lost sight of by the keen-sighted and thrifty Buddhist population that held the country for so many centuries before the conquest of Mahmud of Ghazni brought in the rapacious Musalmâns. The population of the Yusufzai plain was probably about 300,000 at the time of the Muhammadan invasion, being more than double the present numbers, while the fertility of the lands from irrigation was referred to by the Chinese pilgrim Sung-Yung in A.D. 519.

An examination of the numerous mounds in the Yusufzai plain brought to light coins, sculptures, pieces of pottery, beads, and bones of men and animals. The coins prove that many of the mounds are the ruins of villages, which were occupied from a period preceding the invasion of Alexander, down to the time of Mahmud of Ghazni. The inscriptions found are in the Aryan character, and appear to show that most of the Buddhist monasteries and temples of Yusufzai date between B.C. 50 to A.D. 150. These buildings existed in the early centuries of the Christian era, but in the time of the last of the Chinese pilgrims, Brahmanism had made some progress, the king in particular being a determined Buddhist, though the people were still attached to the old faith. In the latter part of the period, Buddhism continued to decline, and though its remains still survive in numbers, the Brahmanical coins, which are still very numerous, show the ascendancy of the latter religion to have been complete during the two centuries preceding the Christian era.

Sattâmi-garhi, which was visited by General Cunningham, had been previously described by Dr. Bellew as built on the actual ruins of an old built town; and this opinion is borne out by General Cunningham, who, after examining the mounds of ruins, arrived at the conclusion that the circuit of the old town had been about four miles, including the suburbs, its population must have been more than 20,000 inhabitants. The people said it was the site of the country;—a theory strengthened by the fact that it was conjectured as the site for the great rock inscription of Alexander, which they say it was called Sattâmi or Setrâm;—names

which General Cunningham believes to be corruptions of the name of the famous Buddhist prince Sudâna or Sudatta.

It is mentioned by the Emperor Baber under the name of Makam. Several mounds in the vicinity of the place were examined by General Cunningham, but the two most interesting points in his researches are the discovery of the cave in the Kâramâr hill to the north-east, and the obtaining a faithful copy of the great rock inscription of Asoka. The cave has no special name, and contained only one room, according to the natives; whereas the cave of Sudatta, with which General Cunningham sought to identify it, contained two. But after a minute search he spied a small dark hole at one end, which, on being enlarged, proved to lead into a second chamber and establish the identity of the cave with that of Prince Sudatta. The identity was clinched by the discovery of a great block of stone 12 feet square, just in front of the cave, where Sung Yun says there was a great square stone on which it was said the prince was accustomed to sit.

According to the Buddhist legend, Prince Wessantara, named Sudâna and Sudatta, or the "illustrious giver," in the narratives of the Chinese pilgrims, was noted for his excessive liberality, which led him even to give away any of his possessions he might be asked for. At last he provoked the indignation of his people for giving away the richly-prized white elephant of Siwi to the Rajah of Kalinga, and was banished. The religious history begins at this point, and every spot connected with his after career possesses a monument commemorating the event. Sung Yun has called the city of Sudatta *Po-lu-sha* and *Fo-sha-ju* respectively; and the position assigned to it by the latter limits its neighbourhood of Shâhbâz-garhi, with which General Cunningham is convinced that *Po-lu-sha* or *Fo-sha* may be identified. He inclines to the notion that it corresponds with the Bazarria of Arrian and Quintus Curtius. A monastery, which stood on the spot where Sudâna's son and daughter were sold by the Brahmins whom they had been given in charity to serve as slaves, probably represented by some ruined mounds outside the walls of the old city; and the temple of the white elephant, according to Sung Yun, "contained stone images, very beautiful, very many in number, and a capital sufficient to dazzle the eyes," is now to be seen by Captain Hume's mound by the road to Karamar. At 50 miles N.E. of the city, Hwen-Thsang places the

which there was a statue in blue stone of the goddess Bhima. This is most probably the Kâramâr peak, 3,480 feet high.

The great inscription of Asoka is engraved in Arian characters on a large shapeless mass of trap rock, 24 feet long, 10 feet high, and 10 feet thick, the greater portion of the inscription being on the eastern face, but some being found on the western. After several attempts, a careful copy was successfully taken by tracing the letters out with ink, all doubtful portions having been examined in different lights. As no photographs can be taken, on account of the slope of the hill, this transcript is the most accurate copy that could be made. General Cunningham proposes hereafter to collate it with the Khalsi and other versions of Asoka's edicts. The present inscription establishes a fact of importance with regard to the rise of the Andhras, which it places back to B.C. 263, or contemporaneous with Asoka, instead of B.C. 21, the date hitherto accepted.

The ruins of Takht-i-bahi, so called from two small tanks or reservoirs (*ichai*) on the hill which had been previously examined at some length by Dr. Bellew, were next explored by General Cunningham. They are situated on the crest and northern slope of a projecting spur about 28 miles north-east of Peshawar, and command an extensive view of the surrounding country. The religious buildings are the most important, and consist of a *stupa* surrounded on three sides by chapels, an open court with lofty chapels for colossal statues, a monastery with cells, and minor edifices. The chapels were many of them dedicated to the memory of holy men or of powerful kings, whose statues were enshrined in them, in addition to a single figure of Buddha which each chapel most probably contained. The chapels, as well as the principal statues, would appear to have been gilded, as even now in Burma. Some, however, of the plaster statues have been simply coloured red. As the walls of some of these chapels are still from 25 to 30 feet in height, it is probable that the statues must have been nearly as lofty. — A view borne out by fragments of colossal figures found by Major Rawlinson and Sergeant Wilcher. The large court in which these figures are placed is situated between the monastery and the stupa, and its discovery is a valuable addition to our knowledge of the monuments of the old empire. A portion contains some platforms which General Cunningham has shown to be probably held about 33 persons. Outside of it on the north is a square unroofed quadrangle, with walls 30 feet high, which he has shown to have been used for the monthly meetings of the court. The whole is composed of a soft sandstone.

of the fraternity. The number of private houses still standing show that the place must once have been of some consequence.

Two and a half miles to the south-south-east of Takht-i-bahi are the ruins of Sahri-Bahlol, an ancient city, with a population in former days of about 3,000 or 4,000. The immense accumulation of rubbish would seem to place the date of its occupation as far back as 2,000 B.C. The place was probably very marshy at one time; and this, General Cunningham believes, may very possibly have been caused by the Cabul river having then flowed in a north-easterly direction towards Sahri-Bahlol instead of its present E.S.E. direction. The most conspicuous ruin is a lofty mound or stupa, (in all probability built to commemorate the place where Buddha gave his eyes in charity), which had been examined by Dr. Bellew, and had proved to contain human and other bones; while from the adjoining ruins had been obtained a quantity of miscellaneous relics, which are now in the Lahor Museum. General Cunningham is inclined to attribute the date 500 or 600 A.D. to the tope, while Sahri-Bahlol itself he would identify with the city mentioned by Hwen-Thsang, where the Rishi Ekasringa had resided before the time of Asoka. A long low mound in the vicinity of Dr. Bellew's tope yielded 10 statues, figures of Buddha, varying in size from the colossal to half size, a head of a king, with moustache, long hair, and a tall head-dress, and other sculptures. Several pieces of pottery, with a curious black shiny glaze both inside and out, were also discovered. One discovery of interest consisted of a broken *lingam* of white marble, with a portion of a single face of Siva, this being the only sculptured evidence of the former existence of Brahmanism found by General Cunningham in the Yusufzai district. Numismatic evidence, however, is frequent, coins bearing the bull of Siva being constantly found. The few coins brought to General Cunningham comprised several early Indo-Scythian specimens, showing that the place must have been in existence at the beginning of the Christian era.

The Buddhist ruins at Jamal-Garhi occupy the top of a hill overlooking the village, and about 500 feet above the level of the sea. The sculptures are more numerous and in better preservation than those in the other ruins; and several statues manifest distinct traces of having been richly gilded. They include two principal and other smaller blocks; a capital of a large stupa surrounded with a circle of columns, and a second, which adjoins, of all the buildings of which the walls are turned back



establishment, disposed in a series of courts or blocks of buildings. A notable feature in the sculpture of these chapels was the occurrence of several capitals of pilasters in the Indo-Corinthian style, with boldly designed volutes, and two tiers of acanthus leaves deeply and delicately chiselled. Some of them have small figures of Buddha, either sitting or standing amongst the acanthus leaves, and many still preserve traces of gilding. Some of the sculptures found in one of the courts were very good and interesting, including many statues of kings, *i.e.*, figures with mustachios, jewels round the neck and upper arm, and sandals on the feet.

The religious establishment on the hill of Jamal-garhi was supplied with water by an artificial reservoir in which the rain was collected. According to the inhabitants it is quite full in the rains, and generally lasts for the greater part of the year.

The ruins at Kharkai have not been examined yet, but some sculptures have been obtained from thence; and some which General Cunningham secured, three slabs, which, from the Aryan letters inscribed thereon, he considers were originally the three sides of a relic casket of Arya Deva, one of the most prominent disciples of Nâgârjuna, and a well known leader of the Buddhist church, about the beginning of the Christian era.

The ruins on the hill of Rânigat close to Nogrâm had been already described by Bellew, Löwenthal, and Cunningham, but, being just beyond the British frontier, have been as yet but superficially examined. They are deserving of more complete study, the neatness and accuracy of the architecture alone being described as wonderful.

General Cunningham devotes some pages to a detailed consideration of various inscriptions brought at different times from Yusufzai. One of these, a simple record of the building of a *stupa* by some pious Buddhist, derives special interest from the mention therein of King Gondophares (A.D. 21-51) of the Saxon *Legenda Aurea*, who is recorded to have received St. Thomas at his court. According to this legend, St. Thomas was sold to Gondophares as a slave, and the king, who said to have converted the king himself; but to have afterwards gone to the country of King Meodeus, by the name of the old city of Calamina, where he was eventually put to death, as some say, at Calamina. The account makes him out to have converted the king, and afterwards to have converted Malli (wife at the law, Migdonia, for which he was thrown into prison), and finally to have been put to death.

It is situated on the western bank of the Indus, opposite Attok, and is a stronghold of Raja Udi or Udi, which is composed of

General Cunningham would identify with the great Indo-Scythian race of Yuti or Yuchi, who became masters of the Kabul valley towards the end of the second century B.C., and had extended their arms over the Punjab and North-west India before the beginning of the Christian era.

General Cunningham also visited Shahderi, which he is more than ever inclined to identify with the ancient Taxila, partly because of its position, and partly because of the great extent of the ruins as compared with any others between the Indus and the Hydaspes. Some of his excavations have brought to light some Buddhist Vihars adorned with Ionic columns of pure Greek design, the first examples of this order which have yet been found in India. The bases of the columns of one of these Vihars correspond exactly with the pure Attic base, which, as in the Erectheium at Athens, was very commonly used with the Ionic order. But the capitals and volutes differ, so that altogether this unique specimen of the Indian Ionic seems to be of a ruder and more primitive type than some of the pure Greek examples. The temple is to all appearances that described by Philostratus (*see Vita of Apollonii*, II. 20), in which he saw tablets of brass, with representations of the deeds of Alexander and Porus in various metals, which may possibly be identified with the sculptured alto-relievs of the Buddhists. Twelve coins of Azas were discovered by General Cunningham, proving that the date of the temple was as old as 80 B.C.

Another Buddhist Vihar was excavated on the south bank of the Tabra Nala, and plans of a temple and of a great monastery and stupa at Sirkap were made; the latter, from its name Babar Khâna ("House of the Tiger"), being apparently the famous monument erected by Asoka to commemorate the place where Buddha had made an offering of his head to appease the hunger of a starving tiger.

The great Manikyala Tope had been visited by General Cunningham in 1863, but since then the whole of the lower part has been excavated, and the ground around cleared, so that on his visit he was enabled to make fresh measurements, and to measure carefully. It is built of huge rough blocks of sandstone, and is 127 feet in diameter; the height of the dome is 93 feet, and the height of the cylindrical base on which it rests is 15 feet. The absence of flights of steps facing the cardinal points led to the supposition of a capital terrace, and the whole was most probably built by Captain Cunningham. The carving of capitals shows a transition between the Indo-Corinthian style, and broad turned back

age are still plainly visible. General Cunningham's conclusions are that the tope was built originally in the time of Huvishka by his Satrap Karasiva, and after the lapse of several centuries repaired with Kankar facings and mouldings, about A.D. 720.

Some excavation 1,000 yards to the south-east of the tope revealed two gigantic heads of Buddha in coarse sandstone, the statues of which must have been fully 20 feet high.

In dealing with the antiquities of the Salt Range, General Cunningham gives a rapid sketch of the history of the table land between the Indus and the Jhiliam, touching upon the Kashmirian ascendancy, in order to explain and account for the existence of a number of old Hindu temples in the Salt Range, all belonging to the Kashmirian style of architecture, and apparently to the time of Avanti Varmma, the most flourishing period of the Kashmirian rule (A.D. 854-883). Mallot, the first place described, corresponds closely with Seng-ho-pu-lo or Singhapura, the capital of the Salt Range of Hwen-Thsang. The fort justifies the Chinese pilgrim's description of being difficult of access, as it has a precipitous cliff from 100 to 300 feet in height on three sides, and is protected by a fortified cliff on the fourth. The only remains of any antiquity at Mallot are a temple and gateway built of coarse sandstone, in the Kashmirian style of architecture. After leaving Mallot, Hwen-Thsang travelled upwards of eight miles to a stone stupa of Asoka surrounded by 10 springs of water. This General Cunningham had now pretty satisfactorily identified with the holy fountain of Ketas, above which there are still seven pools round three sides of a rocky spur. Across the bed of the stream above the holy pool, there is an embankment, which, in the days of Kashmirian rule, retained the accumulated waters of the valley for irrigation. Both at Ketas and at Mallot numerous coins of the early Indo-Scythian rulers were found; so both places may be assumed to have been occupied before the Christian era. Near Bhon 250 coins were discovered,

which were recognized to be pure Greek, of Heliokles and Antiochus, and the others as Indo-Scythian, as coins of the Hindu rulers, the Kadambas and Mudammadar rulers.

The large old cities in the plains of the Punjab are marked by the discovery of ruins, very similar to those on the Yusufzai, and are composed of bricks, and not of stones. It is probable that the present time to form the faintest idea of the Alexanderian then prevalent.

Yorkot is probably the loftiest of all the mounds, and is composed of sun-dried bricks, partly faced

with burnt bricks, built on a natural eminence on the bank of the Chenab. To the east there is a large sheet of water which doubtless occupies the place whence the many millions of dried bricks were obtained. Burnes visited Shorkot in 1837 and described it as a mound of earth surrounded by a brick wall and so high as to be seen for a circuit of six or eight miles. From it was obtained from it a coin of the Greek king Apollodotus; and General Cunningham received from Shorkot large parcels of Indo-Scythian coins, proving its antiquity. Besides the coins, beads of crystal agate, cornelian, &c., were found, as well as moulded bricks of various patterns, which are a characteristic feature of all the cities in the plains of the Punjab. Some of the bricks bore inscriptions dating apparently between 79 and 319 A.D.

The ruins of Harapa are the most extensive of all along the banks of the Râvi. They comprised, at the time of Masson and Burnes' visit, a ruined castle (now no longer in existence), a tomb of a gigantic Naogaja, and portions of a large square building with rooms surrounding a courtyard as in a Buddhist monastery. The walls were very massive, but the whole have now been removed and have sufficed to furnish brick ballast for about 100 miles of the Lahor and Multan Railway. Harapa is probably the Po-fa-to of Hwen-Thsang, the population of which was very dense, there being at the time of his visit 1,000 monks, besides 20 Brahmanical temples.

Depalpur was a place of much importance during the whole period of the Pathan rule, and had, according to tradition, 84 masjids, 84 towers, and 84 wells. The adjacent lands were watered by a canal drawn by Firuz Shah from the Sutlej. On the banks of this canal there stood at the time of General Cunningham's visit in 1838 a masjid ascribed to Firuz Shah, but this has since been pulled down to supply materials for civil buildings.

Tulamba was once a strong fort with an outer rampart 200 feet thick, but was abandoned in consequence of a change in the course of the Ravi, which took a more northerly direction, and cut off the principal supply of water. It was sacked and destroyed by Timur on his way to Delhi, but the fort escaped. The facings of the old ramparts were then removed to be used for the building of the new town. Several specimens of ornaments and articles brought from hence by General Cunningham.

Multan was formerly situated on two islands and several centuries ago this river changed its course. A capital was founded here by Captain Chesney in 1753, but it was abandoned by Captain Chesney in 1763, and the city of Multan was founded on the left bank of the Chenab 32 miles above Multan. It is now a like a fortified and mantled fortress, situated on opposite banks of the river, which has turned back

stands nearly 40 feet higher than formerly, owing to the accumulation of rubbish of centuries. The fort was a mile and a quarter in circuit, and had 46 towers or bastions, including two flanking towers at each of the four gates. The walled city was very nearly three miles round, and the whole circuit, including the unwalled suburbs, between four and a half and five miles, which agrees closely with Hwen-Thsang's estimate of 30 *li*. During high floods, however, the waters of the Ravi still flow down their old bed, and the ditches of the town are filled. In the time of Hwen Thsang there was a magnificent temple erected to the sun god Aditya, whose statue was of pure gold adorned with precious stones, and appears to have been greatly venerated. Both temple and statue are said to have been destroyed by Aurangzib, but General Cunningham has succeeded in satisfactorily identifying the site as being exactly in the middle of the fort. From a consideration of the legend of the building of the temple and making of the idol (as related in the Chach-Nama in Dowson's edition of Sir H. Elliott), as well as of the devices on three silver coins, each of which bears a rayed head like that of the Indian sun god, General Cunningham is led to ascribe its origin to Diwahij, the founder of a dynasty of kings which ruled over Multan and Sindh for 137 years prior to the usurpation of the Brahman Chach. The only Hindu remains at Multan are several gigantic stone rings called Mankas, similar to some at Harapa, and some fragments of statues in a temple, which are said to have been made by Ader, the father of Abraham—so complete has been the clearance of idolatry during the Muhammadan rule of upwards of 12 centuries.

In the absence of Hindu remains, General Cunningham sank several wells within the fort, but only one yielded objects of interest. In this one the presence of two coins of different dates at different depths tends to prove that the accumulation of *débris* has been about 22 feet in 2,000 years, or at the rate of  $1\frac{1}{2}$  foot per century. Glazed tiles and bricks were discovered, and arguing from the depth of the "layer" or stratum in which these occurred, a confirmation is afforded of the belief that glazed tiles were introduced by the Muhammadans, and that the older bricks were much larger than the more modern ones. Two layers of ashes were also discovered, and their positions corresponded very nearly with the conquest of Multan in A.D. 712, and the capture and massacre of Malli (which General Cunningham has identified with Mûltan) by Alexander's soldiers, when enraged at their commander's wound.

Multan may probably be identified with the Kaspatureos of Herodotus and Kaspeira of Ptolemy.

The Muhammadan remains at Multan consist of several of the long brick tombs assigned to Nao-gajas or "nine-yarders," as the existing tombs of Muhammadans fallen in action against Hindus are called throughout the North-West Provinces and the Panjab. Every one of these is described as a warrior and martyr, and the tombs are of gigantic size. It is a curious fact that Hindus as well as Musalmans pay their devotions at these tombs, and place lights before them on Fridays. The chief monument in Multan is the great tomb of Rukn-ud-din, the grandson of Bahâwal Hak. It is an octagonal building of red brick, bonded with beams of sissu wood, surmounted by a hemispherical dome, and about 100 feet in height, and, standing in a conspicuous position on the north-western edge of the fort, can be seen for a distance of 12 or 15 miles all round.

The rich district of Jalandhar formerly comprised the whole of the Upper Doabs between the Ravi and Satlej. It was also called "Trigartta" or the land watered by three rivers. The capital of the country was the city of Jalandhar, and Kot Kangra or Nagar Kot was the only stronghold or place of refuge in times of trouble. According to the legend, the famous Dánava Jálándhara from whom the name is derived was the son of the Ganges by the Ocean, who is considered the Father of Rivers. When the boy was grown up, the sea withdrew his waves and left a tract of country, extending 300 *rojanas* in length, as residence for him. This, General Cunningham thinks, would appear to be a traditionary remembrance of the fact that the sea formerly extended up the valleys of the Ganges and Indus, a fact which was demonstrated by the late Dr. Falconer in his "Palæontological Memoirs and Notes."

The Rajas of Trigartta or Jalandhara have played but an unimportant part in history, so far as we know, yet their names are so frequently brought to notice in inscriptions or in the Hindu history of Kashmir, or in the Muhammadan history of Delhi, that their genealogy is of some importance for reference, both to the historian and the numismatist. From various sources General Cunningham has been enabled to give their genealogy for a limited period, *i.e.*, from 1315 to 1847, A.D.

The old fort of Pathankot, situated in the middle of a narrow neck of land between the valleys of the Bias and Ravi, at the point

where they leave the hills, naturally became the great emporium between the two rich valleys of Kangra and Chamba, and the great cities of Lahor and Jalandhar. The name is said to be derived from the Hindu *Pathân* a road, and to have nothing to do with the Afghan Pathâns, but this point is uncertain. The old fort is now a mere mound, but it furnished bricks for the Bari Doab Canal. The bricks were of a very large size, a sure sign of Hindu origin as well as of a great age. Among the coins discovered were only two of the Hindu rajas of Kashmir, which confirms the historical fact that their rule did not extend east of the Ravi. The most curious specimens, however, were six early Hindu coins dating as far back as the beginning of the Christian era. They are thin pieces of copper, either square or oblong, with a temple on one face and an elephant on the other. Beside the temple are the symbols of Swasti and Dharma, and underneath it a snake, while before the elephant there is a tree surrounded by a Buddhist railing, with an Arian legend on two sides.

The famous fort of Kot Kangra or Nagarkot was probably built and occupied at an early date, but no present portion of it is older than the 9th or 10th century. It has played a conspicuous part in Hindu and Muhammadan annals, and its history, which is fully given by General Cunningham, has been a fluctuating and troublous one. The earliest notice of it is at the time of Mahmud (A.D. 1009), but it probably belonged before that for several generations to the Hindu rajas of Kabul, who no doubt hoarded the enormous treasure found there by Mahmud. The fort occupies a long narrow strip of land in a fork between two rivers and the precipitous cliffs on which it stands make it very strong, while on the town side a deep ditch has been cut at the foot of its walls. In Bhawan, a suburb of the city of Kangra, stand the famous temple of Mâtâ Devi, which was desecrated on several occasions by the Muhammadans. Terry, the chaplain of the Thomas Roe in Jahângir's reign, states of it, on the authority of Tom Coryat, that in Nagarkot there was "a chapel most richly furnished, being seced and paved with plates of pure silver, and variously imbossed over head in several figures, which they were shining bright." Thevenot, the French traveller, says that the pilgrims used to sacrifice parts of their body there, and is also related by Abu Fazl. According to the universal legends of the people, Akbar was told that Kangra was famous for several things,—1. Manufacture of new noses; 2. Treatment of various complaints; 3. Bânsrati rice; and 4. Its strong fort.

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ningham could learn nothing about the treatment of the eyes, but the repair of noses still goes on, although to a less extent than during the Sikh rule, when amputation of the nose was a common punishment. But people still come from Kabul and Nepal to be treated. The practice is to obtain the flesh for the new nose by cutting a piece from the forehead of the patient. This is sewn over the aperture and supported by rolls of cotton with quills inserted for breathing.

The famous temple of Jwâla Mukhi or "the flaming mouth," is built over a fissure at the base of a high range of hills about 20 miles S.E. of Kangra, from which fissure an inflammable gas has been issuing from time immemorial. The present temple of Jwâla-Mukhi is built against the side of the ravine, just over the cleft from which the gas escapes. It is plain outside, in the modern Muhammadan style of plaster and paint, with a gilt dome and pinnacles, and a gilt roof inside. The finest thing about the building is the pteroid folding door of silver plates, which so struck Lord Hardinge that he had a model made of it. The gas escapes

the ~~door~~ very slowly, and when pilgrims are numerous the oant Brahmins keep up the flames by feeding them with ghi. The flaming fissure is believed to be the fiery mouth of the goddess, whose headless body is said to be in the temple of Bhawan. The emperor Firoz Tughlak is said to have paid a visit to the temple on his way to Kangra, and the Hindus have pretended that this was a visit of worship, and that by thus propitiating the goddess he was enabled to take Kangra. It is however most improbable that the motive of the visit was anything but curiosity.

near the village of Anhiâra, where are some well-known slate quarries, possesses massive inscribed blocks of granite, an account of which was published by Mr. E. C. Bayley in 1854. General Cunningham has traced the inscription to the end of the first century, during the reign of the Indo-Scythian Kanishka.

In the small village of Chari, 8 miles E. of Kangra, the foundations of a temple of importance were discovered by Mr. Forsyth in 1817.

A carved stone with an inscription has been deciphered by General Cunningham, and proves to be Buddhist, being the only inscription of Buddhism he has seen in the Kangra valley.

The famous temple of Baijnâth stands in the village of Kiragrâma. It was discovered from an inscription from which it appears that the date of its construction was

This A.D. 804, and that it was repaired extensively at the end of the reign of the emperor Sansara Chandra II. in 1786.

General Cunningham's observations on ancient Indian architecture, General Cunning-

ham remarks that in the numerous ancient ruins of the Yusufzai country, two very distinct styles of architecture may be traced, which appear to have differed widely from the styles of Persia and Greece. These he has named *Indo-Persian* and *Indo-Grecian*. The former appears to have extended over the whole of Northern India, from Kabul to the banks of the Ganges, while the latter is found only to the west, in the districts of Peshawar, Rawal-Pindi, and Kashmir, or in other words, the ancient provinces of Penkolaitis and Taxila. The former may safely be looked upon as an older style, which was probably introduced by the Achæmenides during the period of Persian supremacy between B.C. 500 and 330, and prevailed over the whole of the Kabul valley and Western Panjâb previous to the occupation of the Greeks. The latter was most likely introduced by the successors of Alexander the Great. The prototype of the Indo-Persian style may be seen in the well-known pillars of Persepolis and Susa, the chief characteristics of which are a bell-shaped lower capital surmounted by an upper member formed of recumbent animals, back to back. The general prevalence of this style is perhaps best shown by the pillars represented in the bas-reliefs of Bharhut, Bodh Gaya, Sanchi, and Yusufzai. In Kabul, Kashmir, and the Panjab, the Persian style seems to have been superseded by the Ionic, Doric, and Corinthian orders of Greek architecture, which appear to have flourished there for several centuries. In India, where the supply of timber was abundant, the pure Greek style seems never to have taken root, and the builders of Mathura, Ujain, and Pataliputra adhered to the tall pillars, the bell capitals, and recumbent animal brackets of their Persian prototypes. But the early adoption of the beaded astragalus and the honeysuckle as ornaments of the monoliths of Asoka and of the gateway pillars and medallion borders of Bharhut, attests the influence which the finished beauty and harmonious symmetry of Greek forms had on Indian architects.

The only specimens of the Indo-Persian style beyond the Indus are the two lofty columns near Kabul which are called Surkh Minâr and Minâr Châkri, and the numerous bas-reliefs of the Yusufzai sculptures. In all of these may be seen the bowl-shaped bell capital which forms the connecting link with the architecture of Persia, as well as a base composed of a series of steps, a peculiarity characteristic of this style. The date of the Kabul monuments as General Cunningham is inclined to fix between B.C. 300 and A.D. 100, or three centuries earlier than that assigned by Mr. Fergusson in his *History of Architecture*. The

Yusufzai sculptures is still a disputed point, but he considers that they probably belong to pretty much the same period.

The earliest examples of the Indo-Persian style in India are at Bharhut, in the gateways and sculptures of the magnificent Buddhist railing which General Cunningham discovered towards the end of 1873.<sup>1</sup> Their date was probably from about 250 to 200 B.C., or certainly two centuries older than the Yusufzai sculptures. That the style, though probably the prevailing one of the period, was not indigenous to India, but was imported from the countries on the Indus, is rendered almost certain by the discovery of Aryan letters on the Bharhut gateway, characters which were never in use in Central India, and which must have been imported by foreign sculptors. Other specimens of the Indo-Persian style may be seen in the sculptures of the Buddha Gaya railings, the Mathura pillars, the Sanchi Stupa, the monolith of Buddha Gupta at Eran, and the pillars of the Narsinh temple.

As all the existing specimens of Indo-Grecian architecture seen by General Cunningham are limited to the riparian provinces of the Indus, he is of opinion that its adoption was confined to those districts. The different styles of Greek architecture must have been introduced into the Kabul valley and the districts adjacent to the Indus as early as B.C. 200. The total absence of specimens of earlier date than 80 B.C. may be accounted for by the devastation effected by the Indo-Scythian inundation.

As mentioned above, the Indians appear to have adopted each of the three great styles of Grecian architecture, the Ionic, the Corinthian, and Doric. The Indo-Ionic style is exemplified only in the Buddhist Vihar at Shah-dheri.<sup>2</sup> The Indo-Corinthian style is found in all the Buddhist ruins in Gandhara, Peshawar, and Yusufzai, and in Manikyala east of the Indus. The similarity of the capital to that of the genuine Corinthian order is obvious, and a detailed enumeration of the chief points of similarity is given. The likeness is easily seen in the ruins of Jamal Garhi, examples of which have been reproduced by General Cunningham in the shape of illustrations to his report. The base of a column at dheri-Bahlol closely resembles one belonging to the monument of Agrates, a representation of which is given by General Cunningham side by side with one of the former, its *torus* or round base having moulding being thickly foliated. No piece of shaft has from

The  
neck of

<sup>1</sup> See Abstract for 1872-3, p. 34.

<sup>2</sup> See above, p. 32.



yet been discovered, but from the bas-reliefs it would appear that flutes were not used, but that round and square shafts were in use, and that the latter were frequently adorned with figures.

These Indo-Corinthian pillars are by far the most beautiful examples of Indo-Greek architecture which have come down to us. The remains are very numerous, but nearly all imperfect, owing to the brittle nature of the slate out of which they were made, and the practice of manufacturing each capital out of several pieces clamped together by iron. As in some of the pure Corinthian examples, figures are introduced in the spaces between the acanthus leaves, the overhanging tufts of which form canopies. Here, however, the single figure or the chief one (where there are three) is always Buddha. From this circumstance, and the presence of Aryan letters as mason's marks, General Cunningham is led to fix the date of the pillars as cœval with the similar specimens found in the Baths of Caracalla, *i.e.*, about the first century before the Christian era. The substitution of Buddha was probably suggested by the establishment of the Buddhist religion under Kanishka, the Indo-Scythian king, temp. 57 to 27 B.C. Another innovation was the greater width of the capital and the consequent bolder treatment of the volutes and foliage. Some small figures of elephants discovered probably originally stood on the top of one of the pillars, four being arranged back to back.

The earliest known specimen of the Indo-Doric style, which are found only in Kashmir and the Salt Range of the Punjab, is the great temple of the Sun or Martand, *circa* A.D. 400. The style however had probably been long in use before that. The great ovolo of the capital and the hollow flutes of the shaft correspond closely with the pure Doric style of Greece. The specimen has been already described elsewhere by General Cunningham and Mr. Fergusson.

Mr. Burgess, the Archæological Surveyor of Western India, commenced his tour by a visit to the Buddhist caves at Junnar. These have been before described, but their chronological place among the other groups of Western India was uncertain. The Caves of Junnar are remarkably devoid of figure, ornament, or imagery, partly, no doubt because the façades of many of the caves have peeled off in the lapse of centuries. The caves mainly consist of *viharas* with cells adjoining for the resident monks. They afford many instances of the mutilation of Buddhist emblems and images, in order to convert them to Brahman purposes.

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The earliest examples of the Indo-Persian style in India are at Bharhut, in the gateways and sculptures of the magnificent Buddhist railing which General Cunningham discovered towards the end of 1873.<sup>1</sup> Their date was probably from about 250 to 200 B.C., or certainly two centuries older than the Yusufzai sculptures. That the style, though probably the prevailing one of the period, was not indigenous to India, but was imported from the countries on the Indus, is rendered almost certain by the discovery of Aryan letters on the Bharhut gateway, characters which were never in use in Central India, and which must have been imported by foreign sculptors. Other specimens of the Indo-Persian style may be seen in the sculptures of the Buddha Gaya railings, the Mathura pillars, the Sanchi Stupa, the monolith of Buddha Gupta at Eran, and the pillars of the Narsinh temple.

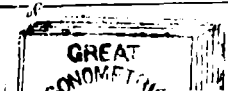
As all the existing specimens of Indo-Grecian architecture seen by General Cunningham are limited to the riparian provinces of the Indus, he is of opinion that its adoption was confined to those districts. The different styles of Greek architecture must have been introduced into the Kabul valley and the districts adjacent to the Indus as early as B.C. 200. The total absence of specimens of earlier date than 80 B.C. may be accounted for by the devastation effected by the Indo-Scythian inundation.

As mentioned above, the Indians appear to have adopted each of the three great styles of Grecian architecture, the Ionic, the Corinthian, and Doric. The Indo-Ionic style is exemplified only in the Buddhist Vihar at Shah-dheri.<sup>2</sup> The Indo-Corinthian style is found in all the Buddhist ruins in Gandhara, Peshawar, and Yusufzai, and in Manikyala east of the Indus. The similarity of the capital to that of the genuine Corinthian order is obvious, and a detailed enumeration of the chief points of similarity is given. The likeness is easily seen in the ruins of Jamal Garhi, examples of which have been reproduced by General Cunningham in the shape of illustrations to his report. The base of a column at Ahri-Bahlol closely resembles one belonging to the monument of Hierates, a representation of which is given by General Cunningham side by side with one of the former, its *torus* or round base moulding being thickly foliated. No piece of shaft has

from  
The  
neck of

<sup>1</sup> See Abstract for 1872-3, p. 34.

<sup>2</sup> See above, p. 32.



yet been discovered, but from the bas-reliefs it would appear that flutes were not used, but that round and square shafts were in use, and that the latter were frequently adorned with figures.

These Indo-Corinthian pillars are by far the most beautiful examples of Indo-Greek architecture which have come down to us. The remains are very numerous, but nearly all imperfect, owing to the brittle nature of the slate out of which they were made, and the practice of manufacturing each capital out of several pieces clamped together by iron. As in some of the pure Corinthian examples, figures are introduced in the spaces between the acanthus leaves, the overhanging tufts of which form canopies. Here, however, the single figure or the chief one (where there are three) is always Buddha. From this circumstance, and the presence of Aryan letters as mason's marks, General Cunningham is led to fix the date of the pillars as cœval with the similar specimens found in the Baths of Caracalla, *i.e.*, about the first century before the Christian era. The substitution of Buddha was probably suggested by the establishment of the Buddhist religion under Kanishka, the Indo-Scythian king, temp. 57 to 27 B.C. Another innovation was the greater width of the capital and the consequent bolder treatment of the volutes and foliage. Some small figures of elephants discovered probably originally stood on the top of one of the pillars, four being arranged back to back.

The earliest known specimen of the Indo-Doric style, which are found only in Kashmir and the Salt Range of the Punjab, is the great temple of the Sun or Marttand, *circa* A.D. 400. The style however had probably been long in use before that. The great ovolo of the capital and the hollow flutes of the shaft correspond closely with the pure Doric style of Greece. The specimen has been already described elsewhere by General Cunningham and Mr. Fergusson.

Mr. Burgess, the Archæological Surveyor of Western India, commenced his tour by a visit to the Buddhist caves at Jūnar. These have been before described, but their chronological place among the other groups of Western India was uncertain. The Caves of Jūnar are remarkably devoid of figure, ornament, or imagery, partly, no doubt because the façades of many of the caves have peeled off in the lapse of centuries. The caves mainly consist of *vihāras* with the cells adjoining for the resident monks. They afford many instances of the mutilation of Buddhist emblems and images, in order to convert them to Brahman purposes.

Mr. Burgess next visited Dabhoi, the principal objects of interest at which are the old walls and gates, which are said to have been built in the glorious reign of Siddharâja Jayasinha (A.D. 1093-1142).

Ahmedabad, which was next visited, was partly illustrated, about eight years ago, by a series of photographs taken by Colonel Biggs, and edited by Mr. Fergusson and Mr. Hope. Mr. Burgess considers, however, that it would be quite worth while to devote six months to the preparation of a volume on the architecture of the place, accompanied by a copy of the inscriptions. The suggestion of General Cunningham, to place religious buildings, no longer in use as such, under the civil authority of the place, with a view to their conservation, might here be adopted with the best results. Among the Kathis of Than, a village close to the main road from Wadhwan to Rajkot, snake worship still lingers, and there is a small temple devoted to it. At Junagadh there are numerous antiquities. The rock of Kâprâ Kodiâ is rapidly disappearing before the Nawâb's quarrymen, but in it there originally was a rock-hewn temple of great extent. The Uparkot or fort of Junâgadh is probably a rich mine of antiquities. It seems to have been the citadel of the old city, where the lieutenants of the Great Asoka and still later of the Gupta kings resided. It contains some wells cut to a great depth in the soft rock. Some rock-cut apartments, manifesting a high style of art, were discovered on the north of the Juma'ah Masjid at the time of Mr. Burgess' visit in 1869, and he suggests that beneath the enclosure of the Uparkot, which is now planted with custard apples, groups of buildings very probably lie hid, the débris above being unevenly scattered in heaps.

Of the Buddhist convents mentioned by the Chinese pilgrim, there are still remains, though four hundred years of Musalman dominion and strife have obliterated every trace of many of them. In the east of Junagadh, between the inhabited part and the walls beside the modern monastery of Bâwâ Pyârâ's, is a number of Buddhist caves. A quarry has been opened behind them, and it has already encroached on some on the north-west and east. Near the Uparkot is the mausoleum of the late Mâji Sâhiba, who died about three years ago, which is one of the finest buildings erected in Kathiawar during the present century.

The Great Asoka rock inscription at Junâgadh attracted Mr. Burgess' special attention, as complaints had been made that Government had not secured for the use of science the most perfect copies attainable of this and other contemporary monuments in



India. The first copy was made by the late Revd. Dr. J. Wilson, of Bombay, in 1837, and other copies have since been taken, but there were doubtful letters, which, however, Mr. Burgess thinks he has now satisfactorily settled. The 14 edicts into which the inscription is divided cover considerably over 100 square feet of rock, and facsimile impressions or *stampages*, by means of moistened paper, were taken by Mr. Burgess and an assistant.

After visiting some Buddhist caves a few miles west of Dhank and the Kâprâ Kodiâ caves between Pâthan and Siddhoar, Mr. Burgess repaired to Gumli, where he made a survey of all the temples.

An examination was made of the Naulakha temple, the walls of which are built of slabs of the common Kâthiawâd sandstone set on edge and clamped together, a mode of construction which has hastened the ruin of the edifice, for trees and plants which have once got their roots in between the slabs have split the wall. The carving on the outside is what has chiefly attracted notice to this temple, and four photographs of the sculptures were taken. A few yards from the outer enclosure is the spire of an old temple, of which the tower alone remains. Its walls, unlike the Naulâkhâ, are smaller and very carefully jointed. East of this is the ruin of an old Jaina temple, and east of this again is the Jethâ Wâv, which must originally have been a large and noble public well. Outside its western gate, of which now only two brackets remain, but which a few years ago might have been saved by a few props and cutting down the vegetation over it, there are a few pâliyas standing, the figures carved on which are mostly on horseback, the horses being covered with what looks like a thick quilt or chain armour.

On February 15th Mr. Burgess visited Nana Gop, and discovered in the village the shrine of an old temple, which is probably the only fragment standing of the old city, which appears to have covered a considerable area round the present village. Mr. Burgess considers the building as the oldest structure of the kind in Kathiawar.

After visiting Jamnagar and Mundra in Kachh, he came to Bhadresvar, the ancient city of which was formerly of great extent, but few buildings of which are now remaining. Mr. Burgess has reproduced the substance of a narrative furnished to him regarding the history of the place, but its chronology is very unreliable. The general plan of the temple is similar to that of the Jaina temples at Delwâdâ on Mount Abu. There are curious subterranean chambers connected with it, entered by lifting up flagstones in the floor. On occasion of danger from Muhammadans or others, the

idols were hurriedly deposited in these vaults, and sand thrown in after them to the level of the floor. A ground plan was made of this large temple, and drawings of several details. Two mosques, one of which is nearly buried in sand, were also examined here, as well as temples at Buoad and Anjar, which do not call for detailed notice.

Bhuj was reached on March the 9th, and the mausolea of the Râos of Kachh were here visited, but most of them were damaged by the earthquake in 1819. Râo Lâkhaji's is the finest and largest. Near Kedâ is the place of Pir Ghulam Ali, one of the prettiest places in Kachh. The buildings in it were examined by Mr. Burgess, and proved to have been erected about 80 years ago. The estate yields between 18,000 and 19,000 rupees annually, which is distributed in charity.

Marching northward to the shores of the Rann, Mr. Burgess reached Kotai, where are the remains of an old city, with several ruined temples of perhaps the earlier part of the tenth century. On one part of the hill foundations still remain, showing that whole edifices must have been carted away for building purposes elsewhere. Mr. Burgess then marched for some long distance along the shores of the Rann, and examined several reported temples, one in an old fortress on the top of an isolated rocky hill at Kanthkot. Sankesvar, though traditionally a place of great antiquity, contained but little of note. The country to the east and north-east of Jhinjuwada would probably repay a visit, but this must be undertaken earlier in the season.

Mr. Burgess' report of his operations, as narrated above, will be a more extensive one than that for last year, containing as it does the results of private researches made in past years. He hopes to finish the entire Survey in the course of two more seasons.

In consequence of representations made by the President of the Oriental Congress of 1874, the Secretary of State has addressed the Madras Government on the subject of appointing an Archæological Surveyor for Southern India, in the same way as has been done in the other presidencies. It has been pointed out that, with a few exceptions, the antiquities of Southern India, though equally important, have not attracted the same attention that had been bestowed by the Asiatic societies of Bengal and Bombay on the archæology of Hindustan before the organization of the present Survey. The difficulties attending an archæological Survey in the south are greater than those that operate in the north and west, on account of the greater variety of characters used in inscriptions and ancient documents, which are not easy to decipher; and on account

of the mixture of Sanscrit with forms of local vernaculars now little understood. There is only one man living who possesses *all* the qualifications required of an archaeological surveyor of Southern India. Mr. A. C. Burnell, District and Sessions Judge at Tanjore, combines, with a rare knowledge of the literary and religious history of Southern India, not only a thorough familiarity with Sanscrit and the modern Dravidean vernaculars, but also a unique acquaintance with South Indian palæography, a science which he has been the first to elaborate in a work recently published. The appointment of this gentleman to the post referred to has been suggested to the Government. It is probable that the whole question will receive the careful consideration of the Governments of India and Madras during the current year.

The first volume of Babu Rájendralála Mitra's "Antiquities of Orissa" has appeared in the shape of a large quarto, illustrated by 36 lithographed plates. It contains the results of the author's labours while engaged on the archæological mission to Bhuvanes'vara in 1868-9;—an undertaking sanctioned by the Government of India mainly at the suggestion of the Royal Society of Arts in London, who recommended the grant of a large sum of money for the purpose of obtaining casts of some of the more important sculptures of ancient India. The second volume deals with the antiquities of the different localities, but it has not yet been received in England.

A work on the primitive tribes and monuments of the Nilgiris, by the late Mr. J. W. Breeks, Commissioner of the Nilgiris, has recently been published by Government. Mr. Breeks' researches were undertaken in 1871, principally at the instance of the Trustees of the Indian Museum, Calcutta, who urged upon Government the desirability of making a collection of the arms, ornaments, dresses, household utensils, and agricultural implements, and all other products of the manufacturing skill of these aboriginal tribes, whose ancient and distinctive customs are now fast disappearing. The work referred to contains the results of Mr. Breeks' labours to attain this object. It forms a handsome volume in quarto, and is profusely illustrated by photographs.

## VII.

### METEOROLOGY IN INDIA.

The organization of the Meteorological Department of India has recently been sanctioned by the Government. During the early

part of 1875 Mr. H. F. Blanford had made a tour of inspection through the Bombay Presidency, Berar, the Central and North-Western Provinces, the Punjab, Oudh, and Madras, besides communicating by letter with the Government of British Burma, and the senior medical officer of the Andaman and Nicobar settlements. He had thus gathered ample information respecting the different systems in operation, their working and respective cost, and some practical acquaintance with their merits and demerits.

In his report, Mr. Blanford gives a brief notice of the principal features of registration as adopted in the different presidencies, as well as some notes on the general character of existing observations. He then proceeds to discuss the value of existing records, and in doing so arrives at the conclusion that a considerable portion of the registers of past years must be rejected as practically worthless; this being more especially the case with the barometric registers, one half of which may perhaps have to be rejected. The abstracts of registers for Bengal he considers generally trustworthy, though the data of temperature and wind movements fall short of the desired standard. The Madras reports are probably the best in India, but they have not yet been published; the abstract for 1874, however, is understood to be ready for the press. The published reports of the North-Western Provinces and the Central Provinces are of a more mixed character; and Mr. Elliott is now reviewing the past registers of the first, with a view to expunge such uncertain work as can be detected. Most of the published work of the Punjab, Berar, and British Burma, Mr. Blanford believes to be of little value, excepting perhaps the registers of rainfall. The observatories of Colaba and Madras in point of trustworthiness and accuracy furnish standards of excellence, below which all others must rank at various distances. There exist distributed through various Government offices a very large number of old rainfall returns. Some of these for Bombay have been recently examined by Mr. Chambers; and Mr. Blanford considers that light would be thrown on the irregularities of rainfall, were all these old returns brought together, examined, and discussed.

Mr. Blanford observes that the practical applications of meteorology which are most important in India are not those which have chiefly engaged attention in Europe and America. In extra-tropical countries the chief practical object is to obtain due warning of stormy weather. In India, however, it is only on the coasts of Madras and Bengal, and that only for a few months of the year, that a rapid and extensive interchange of reports (the most striking

feature of the European and American systems) is desirable, and this is not therefore the chief object of the system. On the other hand, in all that relates to the distribution and causes of rainfall, every part of India is profoundly interested. The primary requirement of a meteorological system is, that the information should be obtained from as wide an area as possible, and not only from the lowest stratum of the atmosphere on the plains and at the sea level, but also from the higher strata accessible to observation at hill stations. It is desirable, moreover, that low-lying and elevated stations (where such are available) should be grouped in pairs. Thus, in Southern India, Coimbatore on the plain, serves, to contrast with Wellington in the Nilgiris, while Hoshangabad and Pachmari, Deesa and Mount Abu, Purneah and Darjiling, Bareilly and Ranikhet, and Ludhiana and Simla, will afford similar valuable contrasts. Some stations on plateaux, such as Hazaribagh, Seoni, Sagar, Poona, and Belgaum, although not far from low-lying stations, will be retained on account of the special influence supposed to be exerted on the movements of the atmosphere by these plateaux. Coast stations and those situated at a short distance inland are also retained or established in somewhat close proximity, since such difference of position induces a very considerable difference in temperature, humidity, and wind direction at certain seasons of the year. With these exceptions, the observatories have been sought to be distributed as equally as the nature of the country and the existence of suitable stations will admit of. A few have been weeded out where stations have been unnecessarily crowded.

With regard to the kind and scope of the observations, it has been determined, with a view to economy, to restrict comprehensive registration to the smallest number of stations that will serve for the purpose.

With the exception of the Bombay Observatory and the extensive tracts occupied chiefly by native states, viz., Rajputana, Bhandarkand, Chutia, Nagpur, Hyderabad, Jeypur, and Ava, the number of observatories already established or sanctioned is sufficient for present purposes, although some changes here and there may advantageously be made.

The first of the three classes into which the stations have been arranged (exclusive of those at which rainfall only is registered) will accordingly comprise the Madras and Colaba Observatories, a new one at Calcutta, the site of the present one at the Surveyor-General's office, one at Allahabad, and one at Lahore. They will

be the central controlling observatories at which continuous registration will be carried on by autographic instruments. At the same time they will be depôts for verifying and issuing instruments to the inferior stations, for training schools for observers, and as far as may be for officers who may have the charge of the minor observatories. Experimental enquiries, of which several are urgently required, will be carried out at these observatories under the direction of the reporters. Of the second-class stations there will be 21, and here hourly observations will be recorded on four days in each month, and two sets of observations on other days; while at the remaining stations, which are 70 in number, and will form the third class, only two sets of observations will be recorded daily at the hours of 10 a.m. and 4 p.m.

As regards telegraphic communication of reports to the local and central reporters' offices, Mr. Blanford does not propose its adoption, except in the case of the storm-warning system on the west and northern coasts of the Bay of Bengal. Hereafter, however, it may become a necessity. Mr. Blanford lays particular stress on the necessity of bringing registers together speedily for investigation. To hope for the same success in prediction in India as has attended the storm-warning system in Europe and America, the same careful watching of meteorological changes as they occur day by day must be adhered to.

The results will be published in two forms. To meet local requirements, daily observations, weekly or monthly abstracts, &c., will be published in the local gazettes or newspapers. The annual results for the whole of India and Burma will be brought together and issued in one general report.

If the system now sanctioned is allowed to remain in operation for some years, it may confidently be anticipated that a real approach will be made towards acquiring a knowledge of the chief laws by which Indian meteorology is governed. It has hitherto been possible to lay down with any approach to accuracy the courses of the isobaric and isothermal lines for a limited portion of Northern India only. It will now be possible to introduce uniformity in the systems of meteorology in different provinces, to secure the reduction of all observations to the same standards, and thus to afford, for the first time, data for a complete discussion of the phenomena of the monsoons and their peculiarities in so far as they are connected with local causes.

Mr. Blanford's report (the eighth) on the meteorology of Bengal for 1874 was issued last year. It comprises general reports of meteorological returns,

more or less, complete for 16 stations in Bengal, three in Assam, two in Madras, one in Arakan, two in the Bay of Bengal, and two in the North-West Provinces. In addition to the above, there is given, as in former years, a summary of the registers communicated by the meteorological superintendents of other provinces.

The meteorology of the year 1874 affords striking contrasts when compared with that of its predecessor. In many respects, however, the atmospheric phenomena were very similar to those in 1872, and in less degree to those in 1870. The south-west monsoon was remarkable, both at its commencement and at its close, (as was also that of 1872,) for the number of storms which occurred in the Bay of Bengal. In 1873, on the other hand, but one cyclone was reported in the bay. In the commencement of the monsoon in June 1874 the rainfall was generally very scanty in southern and western Bengal, in the northern parts of Orissa, and on the Arakan coast; while throughout the whole of Behar, the North-West Provinces, the Central Provinces, and the north-east of the Assam Valley it was much above the average. In July and the greater part of August the area of deficient rainfall extended further northwards and westwards, including part of Behar. During this period, throughout the greater portion of the Lower Provinces, there was an almost complete, and, as far as recent records extend, an unprecedented failure of the monsoon rains. During the same period in 1872 there was a marked, although much smaller, deficiency of rainfall over the greater portion of the same area. On the other hand, it may be said that in 1873 the rainfall was almost confined to the two months of the year, July and August, when it was in many places much above the average. With the slackening of the monsoon current in 1874 and the advent of variable winds a change took place, and, as in 1872, the rainfall became unusually heavy all over Bengal in the months of September and October. On the other hand, the rainy season of 1873 may be said to have ended early in September.

The points of resemblance between the peculiarities of the rainy seasons of 1870, 1872, and 1874 are remarkable, and afford some grounds for the hope that, even before the physical causes of such peculiarities shall have been satisfactorily explained, some use may be made of them empirically in predicting the probable course of certain seasons for some time beforehand. A forecast of this nature was called for by the Government of India in the latter part of July 1874, when considerable apprehensions were entertained regarding the prospects of the principal rice crop of the year. A

comparison of the peculiarities of the rainfall up to the end of July with those of past years, and the general similarity of the meteorological circumstances with those in 1872, induced Mr. Blanford to submit the opinion that the rainfall in the latter months of the monsoon would turn out as favourable as in 1872. This forecast, fortunately, was fully realized.

A report on the disastrous Midnapur and Bardwan cyclone of the 15th and 16th October 1874 has been prepared by Mr. W. G. Willson, officiating reporter to the Government of Bengal. The centre of the cyclone, moving in a north-north-western direction, passed over the Sandheads about noon on the 15th, passed to the west of Saugor Island, and struck the coast line about long.  $87^{\circ} 37' E$ . Near Midnapur the course of the cyclone re-curved; the centre passed about 15 miles to the east of that place between midnight and 1 a.m. of the 16th, and the vortex passed over the town of Bardwan between 6 and 7 in the morning. Between 1.15 and 3 of the afternoon of the same day the central calm was passing over the town of Berhampur, the storm having then greatly diminished in violence. The centre after this followed a more easterly path, passing to the westward of Bogra, and over the junction of the Tista and Brahmaputra, and the storm finally broke up on the western ridge of the Garo Hills, approaching, but not reaching, Goalpara, in Assam. The diameter of the body of the hurricane was, in round numbers, about 50 miles; but outside this circumference, especially on the eastern side, a heavy gale of wind extended to some distance.

The total solar eclipse on the 6th of April 1875 was observed at Camorta, in the Nicobars, by an Indian expedition under Captain J. Waterhouse, Assistant Surveyor General, an English expedition under Mr. R. Meldola and Professor Tacchini. The principal object of the present observations was to extend and apply the knowledge thus gained since 1871 regarding the chromosphere, to ascertaining as far as possible the chemical constitution and physical condition of the regions of the solar atmosphere extending from the photosphere to the furthest limits of the corona, of the height to which the successive layers of vapour extend from the photosphere, and of the order in which they thin out. The Eclipse Committee of the Royal Society had recommended that the operations should be mainly photographic, and that an endeavour should be made to obtain photographs of the spectra given by the different layers of the coronal atmosphere, spectroscopes being used in conjunction with telescopes for obtaining line spectra, and prismatic



cameras being employed for the purpose of obtaining images of the chromosphere and coronal atmosphere. The principal instruments of the Indian party (to whom Professor Pedler, of the Presidency College, Calcutta, was attached,) consisted of the Dodabetta equatorial camera, a spectroscopic camera, with Janssen's slide, spectroscope, and heliostat, and the great 9-in. Browning reflector from the Madras Observatory.

Unfortunately, all these preparations proved abortive, as, although every arrangement had been made, and everything was in readiness at Camorta, whither both parties had repaired, thick clouds came up and obscured the sun during the whole period of totality, so as effectually to prevent the successful taking of any observation. This was all the more to be regretted, as at Mergui, where it was at first intended to have located one party, there was an absolutely cloudless sky. Owing, however, to the incomplete manner in which the English party had been equipped and organised, this division of the forces proved impracticable.

## IX.

### GEOGRAPHICAL EXPLORATION, PUBLICATIONS AND NEW MAPS.

The account of the exploration by one of the native explorers attached to the Great Trigonometrical Survey of the journey made to the Namcho or Tengri Nur Lake in Great Tibet, has appeared in Colonel Walker's last report. The party consisted of a semi-Tibetan, who had been thoroughly trained for the work, with four assistants engaged from border districts. They passed through Kumaon into the Tibetan province of Hundes or Guarikhorsum, and thence followed the south bank of the Brahmaputra to Sligatz, where they found there was a regular route to the Tengri Nur Lake, frequented by traders in borax, salt, &c., and also by pilgrims, whose character they determined to assume. Having purchased some of the long-legged sheep (the only means of carriage that would answer), they crossed the Brahmaputra, and having reached the Khalamba pass (17,200 feet above the sea), found themselves in the basin of the Tengri Nur Lake. The country is peopled by nomads, and a species of white bear is said to commit great havoc among the cattle. The party found all the streams hard frozen; springs of almost boiling temperature were frequent, and bore a similarity in some respects to the geysers of Iceland, one attaining the height of about 50 feet. A remarkable feature in them is that in winter the falling water is converted into

ice, and forms a hollow pillar of ice round them. The Great Tengri Nur Lake proved to be called Namcho or Sky-Lake, from its great altitude (15,200 feet). It is a splendid sheet of water, about 50 miles in length, by from 16 to 25 in breadth. It receives the waters of two considerable rivers and several minor streams, but has no exit. To the south the lake is bounded by a splendid range of snowy peaks, flanked with large glaciers, culminating in the magnificent peak Jang Ninjinthangla, probably 25,000 feet in height. The range was traced for nearly 150 miles, running in a north-easterly direction. To the north no high peaks could be seen, and the country appeared to be a succession of rounded hills with moderately flat ground in between them. Immediately north was a small lake, called Bul or Borax lake, from the borax, which is there produced in large quantities, and supplies both Lhasa and Shigatze. The party made the circuit of the lake, but their examination of it was brought to a close by the appearance of a band of robbers, who stripped the party so completely that they were forced to make their way to Lhasa as fast as they could. In Lhasa they managed to raise a little money by pawning their instruments, the large aneroid being fortunately mistaken for a gigantic watch. The proof of the existence of a great snowy range to the north of the Brahmaputra is interesting; the Himalayan system, even at that distance, say 160 miles from its base in the plains of India, showing no signs of getting lower. The country northward is called Jámaáta De, and is independent of Lhasa. It is inhabited by a lawless set of people, and for a considerable distance northward is described as being very much the same as that round the lake, but 60 marches to the north-east there are said to be signs of a more civilized country. Koko Nur Lake is said to be  $2\frac{1}{2}$  to 3 months' journey north of Namcho, and the caravan road thither and to Jiling or Sinning runs from the east end of Namcho. An attempt will be made to despatch an explorer along this route, and so connect the Indian Trans-Himalayan explorations with a place that has been fixed by the regular survey operations of the French Jesuit Missionaries.

The explorer's route survey extends over 320 miles of what has hitherto been veritable *terra incognita*. Latitude observations were taken at 10 places, and heights by boiling point and aneroid observations at 24 places. The geography of an area of about 12,000 square miles has been elucidated, and one northern tributary of the Brahmaputra has been thoroughly explored, thus giving us an idea as to how far back the northern watershed extends. The general

accuracy of the explorer's work is satisfactory, and he has shown a large amount of skill, observation, and determination.

Another trained Asiatic explorer made his way from Pitoragarh, in Kumaun, through Nepal, into Great Tibet, and back across the Brahmaputra by the Gunduk river into British territory. More than one of the Nepal streams are crossed by means of a single rope stretched across, from which the traveller suspends himself, monkey fashion, by his hands and feet, carrying his luggage or merchandise on his chest. For those, however, like the Asiatic explorer, whose nerves are not equal to this feat, slings are provided. Slavery exists throughout Nepal, and all castes are sold into slavery, the father having power to sell his children; but this step deprives them of caste. It is said, however, that Jung Bahadur intends to abolish the entire practice. The Brahmaputra was crossed by the explorer about  $83^{\circ} 55'$  E. longitude, (where it is about 250 feet wide, and has a very gentle current,) on boats made of yak's hides sewn at the ends, and attached to sticks at the sides. On his return journey the explorer passed through Sansen, where there is a fort, gun foundry, and manufactory of small arms. Inside the fort, the walls of which are about 12 feet high, and made of brick and mortar, are two-storied brick buildings, which are used as the magazine, court-house, and treasury. Formerly 1,100 men used to be stationed here, but now there are 1,800, who are drilled by two discharged subahdars of the Indian native army. All over Nepal, in fact, military organisation is being amplified. Although the explorer was prevented from advancing further into Tibet than the vicinity of the Brahmaputra, he has contributed much valuable information concerning the Nepalese kingdom, our knowledge of which is still very fragmentary.

The geographical results of the Kashghar mission, reference to which was made in last year's Abstract,<sup>1</sup> have been considerable; and Captain Trotter may well be congratulated on the success of his labours, carried on as they were in mid-winter. To the north of Kashghar he carried a survey through the Artysk valley, up the Russian frontier at Lake Chadyr Kul; and though he was unable to strike off eastwards to the Terekty pass, and returned the road from there to Kashghar, he has satisfactorily compared his work with that of the Russian geographers. He subsequently surveyed about 150 miles of the road from Kashghar to the

<sup>1</sup> See Abstract for 1872-3, p. 61.

east, as far as the Belowti pass, 90 miles from Ush-Turfan, while Captain Biddulph surveyed the road from Kashghar eastwards to Maralbashi. But no opportunity was afforded for reconnoitering any portion of the long belt of almost unknown country at present ruled by the Atalikh Ghazi, which extends eastwards for a distance of probably over 700 miles beyond the points reached by Captains Trotter and Biddulph, nor of the road to the west leading into Khokand *viâ* the Terek pass.

Captain Trotter afterwards surveyed the route from Yangi Hissar to Tashkurghan, and then westwards *viâ* Aktash, over the little Pamir, and ascertained that the Barkut Yassin lake of the Mirza on this plateau is one of the sources of the Aksu or Murghabi, and thus, in all probability, the chief source of the Oxus. Captain Trotter continued his survey down to Kila Panja in Wakhan, and was enabled to send a native surveyor down the Panja river to Ishkashim, and then struck northwards into unknown ground, and followed the course of the Panja for nearly 100 miles, finding its direction to be very different from what has hitherto been supposed. His furthest point was Kila Wamar in Roshan. An important exploration has since been made, from Fyzabad and Kolab up the river, to a point believed to be not far from Kila Wamar, by Colonel Montgomerie's havildar.

From Panja Captain Trotter returned to Atkash and Yarkand *viâ* the Great Pamir, passing the lake discovered in 1838, and named Victoria by Lieutenant Wood, R.N. The pandit who accompanied Captain Trotter as far as Tashkurghan on the outward journey returned thence by a more direct route to Yarkand, carrying a traverse survey along an entirely new piece of road.

While Captain Trotter was absent in Wakhan, one of the Hindu pandits was sent by way of Sanju to Khotan, with instructions to penetrate as far eastwards as possible. He traversed the ancient road to China as far as the Sorghak gold fields, and then returning to Keria, struck southwards along the road to Rudok, crossed the Kuen Luen range and the great table lands of the higher Himalayas in the western confines of Chinese Tibet, and reached the village Tinob, which is about 20 miles to the north of Rudok. Here he was stopped by the Chinese officials, and nearly turned back again when on the road he came, but eventually he was permitted to go direct to the Pangong Lake. His work was very carefully executed, and has stood the usual tests, and has shown the necessity of Brahme corrections being made in the work of 1865-66.

His elaborate and interesting volume of his survey operations

in connection with the mission has been published by Captain Trotter. It contains descriptive letter-press of the divers routes surveyed, appendices giving lists of the various observations, routes, &c., and is illustrated by a map of Eastern Turkistan and plans of Arkand, Khotan, and Kashghar.

The official account of the work done by Sir Frederic Goldsmid and the officers employed on the Persian Frontier Commission<sup>1</sup> is still in preparation, but will probably be published in a few weeks.

The map of Persia<sup>2</sup> executed by Major St. John is still in the hands of the engravers, Messrs. Stanford, of Charing Cross. Its completion is looked for at no very distant date. The map of Western Asia prepared by Captain Felix Jones, I.N.<sup>3</sup> has been completed, and is now in the Geographical Department of the India Office, awaiting such decision as may be arrived at with regard to its reproduction. Its scope and general character have been described in previous Abstracts; the compilation, execution, and drawing are most elaborate; and it altogether claims notice as a very remarkable specimen of cartographic skill.

Among the maps prepared in the Geographical Department of the India Office during the year 1874 may be mentioned a map of the Hyderabad circar of Warungul in 12 imperial sheets; and lithographs of 15 original drawings of surveys made by officers during the Afghan war which Colonel Fraser Tytler had amassed during his sojourn in Afghanistan in 1838-42. They contain topographical information respecting the Herat valley, the upper valley of the Helmund, the lower course of the river, and the country between the Helmund and the Argundab, which has never been published on any map.

The value of a trustworthy book of general reference as to the geography, history, and resources of India has long been admitted, and much money has been spent by Government in efforts to obtain such a manual. In 1855 the work of compiling a gazetteer for all India was initiated by the Court of Directors, and the work proceeded in a desultory way until 1869, when the necessity of taking steps to ensure uniformity in the gazetteers of the various provinces was forced upon the Government from several quarters.

On the 3rd July 1874, Mr. Hunter, who was then

ing to which all local gazetteers should in future be prepared, and for the consolidation into one work of the whole of the materials that might be available. In accordance with these instructions, Mr. Hunter visited the different provinces of India, and submitted a plan for an Imperial Gazetteer. One main feature of this plan was, that the local gazetteers should be prepared in consultation with a central editing officer, who should be charged with the duty of seeing that they were prepared on a uniform system, so that they might easily be incorporated in due course into an Imperial Gazetteer. The plan was adopted, and Mr. Hunter was charged with the duties of central editor in addition to those of compiler of the Bengal Gazetteer.

In consequence of the enormous cost of literary labour and printing in India, the work of compiling and printing the Bengal Gazetteer goes on in England, while the work of amassing statistics and making enquiries on the spot is intrusted to five local assistants. Dr. Hunter, as editor, divides his time between inspection of the work in England and India. Five volumes are now published, furnishing the statistical account of 13 out of the 37 districts comprising the Lower Provinces of Bengal. These five volumes deal with an area of 45,844 square miles, and a population of 21,768,747 souls. The accounts of the remaining districts are in various stages of completion.

Dr. Hunter's report on the progress of the gazetteers throughout India has not yet reached England.