

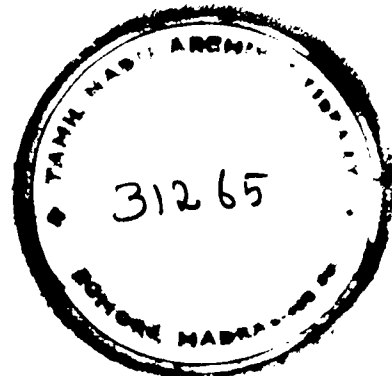
ABSTRACT
OF THE
REPORTS OF THE SURVEYS,
AND OF OTHER
GEOGRAPHICAL OPERATIONS
IN
INDIA
FOR
1876-77.

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MARINE SURVEYS OF INDIA, 1876-77.

THE Indian Marine Survey Department is now in active operation, and the general report for 1876-77 (the second issued) shows the completion of many urgently needed pieces of survey work at various points along the coast of British India. Among these Commander Taylor's inspection of the Burmese coast calls for prominent notice, a trip partly prompted by the fact that the British India Steam Navigation steamer "Moulmein" had struck on a rocky shoal in Tavoy River in September 1875, and in the following February the steamer "Mahratta" had struck on another rock in the same river, whilst neither of these dangers was marked on the charts. In the course of this tour Commander Taylor visited Akyab, Bassein, Rangoon, Amherst, Moulmein, Tavoy, Mergui, and the Pakchan River, besides the ultra-Indian ports of Kopah and Junkseylon. Commander Taylor came to the conclusion after this inspection that no large port of British India required surveying so much as Amherst, and accordingly made arrangements for its survey by Lieut. Jarrad in the "Clyde" in the season 1877-78. The Admiralty Chart of Tavoy proved to be very erroneous; but subsequently Commander Taylor discovered an older survey of Tavoy executed in 1824 by Lieut. (afterwards Captain) Robert Moresby, of the Bombay Marine, which, proving to be far better than the published chart, was photozincographed and issued (with a few corrections) for local use. For the intricate passages between Mergui and Pakchan no sailing directions exist, but Commander Taylor proposes to issue these in the form of hydrographic notices, explanatory of the normal trading route between Moulmein and Pakchan, touching at Tavoy and Mergui, with some useful remarks on the extended voyage along the Siam coast to Penang. Below Pakchan Commander Taylor has made a sketch showing the soundings in the entrances to the Kopah River, which has important tin mines, but no trace of such a fine river as depicted on the existing chart. Of Junkseylon or Salang a pretty good survey was obtained from Captain de Richelieu, commanding the Siamese Royal gun-

boat "Coronation," an officer who was trained in the Royal Navy, and is a good and energetic surveyor. The new survey of Junk-seylon differs greatly from the old one, and the new chart will be a great boon to the British India Steam Navigation Company and the coasting trade. On the whole Commander Taylor's cruise was a most fruitful one, and he considers that a two months' cruise among the islands of the Mergui Archipelago would fairly supplement the charts of Ross and Lloyd, while the naturalist would have ample scope for making good collections of the fauna and flora, the islands being densely wooded and rich in metals.

Commander Taylor made some full reports as to how Rs. 30,000 could be best spent in the interests of False Point Harbour, a question to which his attention was invited by Government. He is of opinion that Dr. Hunter (in his "Orissa") is mistaken in supposing that the Mahanadi is scouring out a harbour here, the process being rather one of silting, though to a very slight extent. The muddy matter deposited has caused False Point to advance at the rate of about 40 yards annually since 1835. Commander Taylor considers False Point to be a most valuable and safe port for small vessels, and the key to Orissa.

A visit was also paid by Commander Taylor to the harbours of Marmagao and Carwar, with the object of testing their relative merits as sheltering anchorages during the S.W. monsoon. On the whole he considers Marmagao the superior of the two as a natural harbour.

Among the surveys executed, that of Madras Roadstead by Lieut. Jarrad, R.N., calls for notice. Considerable difficulty was encountered in making the tide gauge work, owing to the force of the waves even at $4\frac{1}{2}$ fathoms depth, but eventually the gauge worked well, registering the heights of the tides every 15 minutes. The result of the survey was an elaborate chart with soundings sectionally taken in lines 250 feet apart, as far as the 10 fathom line. This survey was afterwards extended by Lieut. Hammond, R.N., to a distance of $3\frac{1}{2}$ miles north and south of the pier. A survey of Chittagong (Karnafuli) River was commenced by Lieut. Hammond, with the main object of making the approach to the river better lighted by night. Commander Taylor also repaired thither, and, having inspected the Norman Point and Kootubdeah lights, and determined the place to which the former might most advantageously

be removed, he directed the abandonment of the survey, as cholera (first induced by the tainting of the water through the calamitous storm wave) had become very rife.

Another survey of importance was that of Moulmein River, executed by Lieut. Jarrad in the "Clyde." Sounding work was much impeded by the great strength of the tidal stream during spring tides, but nevertheless an elaborate sectionally-sounded double-elephant sheet was completed comprising 105 square miles of water closely examined and 36 miles of coast trigonometrically laid down. Lieut. Jarrad obtained a true bearing of Double Island Light House from Amherst Point, and discovered it to be $1\frac{1}{2}$ miles to the westward of its true position, notwithstanding that the island and adjacent coast had already been shifted a distance of $4\frac{1}{2}$ miles to the eastward of the positions shown on the Admiralty Chart. Lieut. Jarrad also measured a meridian distance between Amherst Point Pagoda (Moulmein River) and Diamond Island (Cape Negrais) with eight chronometers, the errors of which were determined by six sets of observations of equal altitudes of the sun's limbs and centre. The "Clyde" then proceeded to Akyab to complete the survey of that port (commenced last year), but the prevalence of cholera unfortunately prevented it. The completion of this survey is urgently required, since both as a harbour of refuge, and as a place of export of rice, Akyab is much frequented, and several wrecks have lately occurred in the vicinity.

In the Marine Survey Office a tabular statement has been under preparation showing the cost of erection and maintenance of all lighthouses and light vessels of British India, together with their positions, distinction, characteristics, &c. The annual list of the same, published in its abbreviated form, has been issued for 1877, and the annual returns of wrecks and casualties for the years 1876 and 1877 have been also prepared. Arrangements were not completed during the year under review for the establishment of a Chart Depôt at Calcutta, but recently the Lords Commissioners of the Admiralty have signified their assent to the sale and hand correction of Admiralty Charts by the Indian Marine Survey Department, so that it may be anticipated that a General Chart Depôt, based on the well-tried and excellent system of the Hydrographic Department of the Admiralty, will soon be in full working order in Calcutta.

The charts issued during the year from the Drawing and Compiling

Branch under Mr. R. C. Carrington comprise the following, Madras Roadstead (20 inches to the mile); False Point to Mutlah River, showing the approaches to the Sand-Heads; Puket or Tonkah Harbour, with part of the east coast of Junkseylon; Salang Island or Junkseylon by Captain A. de Richelieu; Tavoy River; Goa and Marmagao Roadsteads (a much-needed chart, no chart of this important anchorage having hitherto existed); False Point anchorage; Kopah Inlet; and a magnetic chart of the Indian Ocean, showing the curves of equal magnetic variation. Besides these, photozincographed copies of Admiralty Charts have been issued, various miscellaneous drawings and tracings have been prepared, and no less than 3,279 charts have been corrected for newly discovered dangers, new lights, buoys, &c.

The natural history researches under Dr. James Armstrong, B.A., M.B., F.L.S., of the "Clyde," have included a fair ornithological collection, among which were two specimens of a bird apparently new to science, *Totanus Haughtoni*, and several interesting specimens of Echinoderms, Crustaceans, and Molluscs. The greater part of the collections was made in the eastern part of the Irrawaddy Delta, where the marine zoology is extremely small and scanty, but the littoral fauna on the contrary is abundant, a crimson stalk-eyed crab (*Ocypode platytarsis*) especially swarming in such numbers as to give the beach in parts the appearance of an extended surface of crimson.

The more immediately pressing marine surveys are the bay and river of Jaigurh, the Chaul Kadu, and other reefs off Alibag, below Kenery island (which, combined with some sectional soundings in the harbour, would enable a useful chart to be compiled of the approaches to Bombay, exhibiting the coast line from Mahim to Chaul on one large sheet), Anjanwel or Dabhol river mouth, and the banks and shoals recently sprung up off Gogah and Bhaunagar, which is now being connected by rail with Wadhwan on the Bombay, Baroda, and Central India Railway. Tuticorin, Cochin, Beypore, and Mangalore are also to be examined during the ensuing 12 months or so by Mr. Morris Chapman, I. N.

In November 1879 it is anticipated that the new surveying steamer will be ready, and she will be able to carry nearly all the Surveyors of the Department. The more important surveys then requiring attention will comprise the Orissa Coast from Dhumra

River to Chilka Lake; the Ganjam Coast to Bimlipatam; Akyab Port and its approaches, including the Oyster Reef light; entrance to Bassein River, including Diamond and the Phaeton shoal with Alguada reef, also the coast adjacent; the mouths of the Irrawaddy River; the Baragua flat; the Krishna shoal and coast line into the Gulf of Martaban and as far round as Amherst; and, lastly, the Gulf of Cambay, an important field for survey, as its shore line and banks have undergone great changes during the last 40 years.

The above surveys will probably occupy the Department for about the next five years, but Commander Taylor expects to be able to arrange also for the examination during that period of ports where high banks and shoals periodically grow or change, such as False Point, Coconada, Dhumra River mouth, and Chittagong; also preliminary sketches of hitherto uncharted small ports, such as Sandoway, and Gwa on the Burma coast, of Bhaunagar, Gogah, Shial-bet and Diu Head on the Kattywar coast, as well as Cheduba Strait, the coast in the vicinity of Tavoy, and the Andamans, where several good anchorages are reported, which would be of great value to vessels leaving India in June, July, and August. Another locality requiring attention is the Mergui Archipelago, where a two or three months' tour is needed.

The Drawing Branch, having produced five general charts of the coast of British India, wishes to publish large scale sheets of many localities where trade has greatly increased during the last two or three years. On his periodical tours round the coast, Commander Taylor has ascertained from the various local marine and mercantile authorities many of their urgent requirements for the improvement of navigation which in numerous cases have been met by the Drawing Branch. Commander Taylor is engaged, amongst other labours, in preparing a corrected edition of the West Coast of Hindostan Pilot, as also a first edition of an East Coast of Hindostan Pilot, a work the necessity of which has long been felt by navigators in these seas, so many ports having lately sprung into use of which no mention whatever is made in any sailing direction extant.

The preparation of the annual return of Wrecks and Casualties in Indian Waters is an important duty which has been assigned to the Marine Survey Department, and the returns for 1876 and 1877 were duly issued by the Department, with charts showing the

positions in which the wrecks, &c. occurred. They were compiled and prepared by Mr. R. C. Carrington. The return for 1876 testifies to a larger number of *recorded* wrecks and casualties than any year since the wreck chart was first compiled in 1865; but, although some portion of the increase is no doubt due to the disastrous cyclone of October, yet the majority may be perhaps attributed to the means adopted for obtaining information of every casualty, so that the year under review does not in all probability present actually a larger catalogue of disasters. There were altogether 46 ships of 23,866 tons wrecked (31 of which were British and 11 native craft), with a total loss of 92 lives. There were 64 casualties to vessels, with a loss of four lives, 49 of the casualties being to British vessels. Compared with 1875, this shows an increase of 21 in the number of wrecks, of 27 in the number of casualties, and 31 in the number of lives lost. In connexion with the last must be mentioned 400 lost in the *Hydree* and 428 in the *Javad*, both wrecked in the Red Sea, but not indicated in the limits of the Wreck Chart.

During the 12 years, 1865-1876, the annual average number of reported wrecks and casualties has been 54, the average total tonnage of which was 18,072, and the number of lives lost 79.

The wrecks of the native craft are described as principally due to the rottenness of the vessels, these being very badly constructed, and not fit to encounter the ordinary monsoon weather. Condemned ships are purchased by natives, patched up and sent to sea, and the Marine authorities are powerless to interfere. One vessel wrecked in 1877 had been allowed to go to sea in a rotten condition. In many instances there are neither charts nor compasses on board. A large number of casualties in 1876 were caused by the heavy cyclone at the head of the Bay of Bengal. Of total losses by fire the same year, the *Caulderbout* and *Mysore* were burnt at Calvetty in British Cochin, during the conflagration which destroyed the town on 7 January 1876.

The *China* and *Asia* were burnt through the carelessness of the crew, and three other vessels, as well as a few in 1877, from unascertained causes. A large number of collisions occurred in both years, which were due mainly to the carelessness or unskilful management on the part of the Master or Pilot. Incorrect charts are a very frequent cause of disaster, and it is hoped that the

numerous charts, sailing directions, and notices issued by the Marine Survey Department will partly remedy this. The charts issued by that Department and the Admiralty are kept corrected up to date of issue, and are sold at a low price, yet it has been estimated that about one half of the whole number of British vessels are navigated by old or incorrect charts.

It appears worthy of consideration under these circumstances whether it would not be possible to compel by Act of Parliament all owners of vessels to be responsible for the supply of correct official charts to each of their ships, and insist that no Master should leave a port without having notified what chart he is carrying for the purpose of navigating his vessel. Chronometers, compasses, steering apparatus, and the gear of a ship generally, are as a whole well looked after, and it seems very desirable that the provision of correct charts be so too. Mr. Carrington adds that an experience of nearly twenty years has shown him that a greater amount of carelessness exists among masters of vessels in connexion with this matter than in any of the responsible and laborious duties devolving upon them.

The number of reported wrecks and casualties during 1877 considerably exceeded that of any former year. It was marked by no particular cyclone storms or extraordinary atmospheric disturbances, and the only conclusion to be arrived at is that the former statements have been incomplete. The order lately issued by the Government of India to the various Marine authorities enjoining the observance of greater punctuality in communicating information of wrecks and casualties has doubtless caused a considerable increase in the numbers reported. There were 65 ships of 26,847 aggregate tonnage wrecked, with a total loss of 138 lives; and of casualties there were 98, with a loss of 4 lives. The year 1877 will be remembered as a fatal one in connexion with the wrecks of the *Cashmere* and *Meikong*, near Cape Guardafui, and the total loss of both vessels and cargo.

The question of erecting a lighthouse on or near the Cape is now under the consideration of the various Governments interested, and it has been proposed to defray the cost by tonnage dues levied at Suez.

During the year 1876-77, the personnel of the Marine Survey Department consisted of the Superintendent, 2 Deputy Superintendents, 6 Assistant Superintendents, 1 Superintendent Drawing and

Compiling Branch, 1 Medical Officer and Naturalist, besides clerks and subordinate officials. There were three vacancies, all among the Assistant Superintendents.

The cost of the Department for the year under review was 14,048/.

II.

GREAT TRIGONOMETRICAL SURVEY OF INDIA, 1876-77.

During the year 1876-77 the out-turn of the above Department has been as follows:—Of Principal Triangulation, 67 triangles have been measured, covering an area of 5,019 square miles, and astronomical azimuths of verification have been measured at two of the principal stations. Of Secondary Triangulation, an area of 5,400 square miles has been closely covered with points for the Topographical Survey; an area of 3,100 square miles has been operated in *pari passu* with the principal triangulation, and in an area of about 23,600 square miles, lying mostly in portions of the Himalayas, which are inaccessible to Europeans, a number of points have been fixed which will be valuable for geographical rectifications. Of topography 5,303 square miles have been surveyed on scales of $\frac{1}{2}$ inch, 1 inch, and 2 inches to the mile, and geodetic operations, determinations of longitude, and geographical explorations beyond the frontier have been also carried out.

The Madras coast series was conducted northward towards Tanjore by Captain Carter, who took charge of the party from Lieut.-Colonel Branfill. Every endeavour was made to identify the old stations of Colonel Lambton, erected in 1800, but only in one case was this successful, a circumstance which shows the necessity of taking measures for the permanent protection of the stations. Colonel Branfill records some interesting notes on the nomenclature of the district, which are included in the Appendix to the Report. Lieut. Harman carried the Assam Valley Triangulation to within a few miles of Sadiya, and effected a junction with the work of Lieut. Woodthorpe, of the Topographical Survey, in spite of heavy rains which flooded the country to a great depth. From the Eastern Frontier series in British Burmah four chains of secondary triangulation were carried in various directions over the face of the country, and a number of points have been thus fixed for the opera-

tions of the Revenue Survey whenever financial considerations will permit the latter, which has been strongly recommended by the Chief Commissioner, to be taken up.

The main chain of the Eastern Frontier triangles was carried forward by Mr. Beverley for a distance of 92 miles along the Tenasserim Coast as far as 14° S. latitude, or nearly as far as Tavoy. The "Three Pagodas," a well-known boundary mark between Siam and Tenasserim, unfortunately could not be fixed, owing to bad weather. The connexion of Bangkok, the capital of Siam, with the Great Triangulation of India is of great importance, as the distance by sea from Tavoy to Bangkok is over 2,000 miles, and a direct triangulation by land, being but little over 100 miles, would be of great value as a check upon the various Marine Surveys which have been made along the coast.

Captain Rogers having completed the Jodhpur Series took up the Eastern Sind Series, and carried it northward for a distance of 125 miles through the Thar and Parkar, Jeypore and Jeysulmere deserts, where sandhills and lack of water greatly hindered progress. The above comprised the whole of the principal triangulation completed during the year.

With regard to the Topographical Surveys, a good out-turn of work was rendered by Major Pullan, who was in charge of the Kattywar party, and was employed in the south-western part of that peninsula. This Survey has progressed so far that the preliminary triangulation will be extended into Cutch next season with a view to the detailed survey of that tract. The maps recently published are remarkably clear specimens of photozincography.

The Guzerat Topographical Survey progressed under the successive control of Lieut.-Colonel Haig, its normal chief, Lieut. Gibbs, and Captain Carter, and an area of 1,988 square miles (described as a very satisfactory out-turn) was surveyed on the scales of two inches to the mile for British districts and one inch for Native States. An excellent historical and statistical account of the country was furnished by Lieut. Gibbs, who has contributed valuable papers to previous reports. Most unfortunately this young officer, whom Colonel Walker describes as one of the finest and most valuable of the officers of the Department, died of cholera on the 21st November 1877.

The Survey of Kumaon and Garhwal, which had been in abeyance

during the season of 1875-76, was completed in 1876-77, though an exceptionally late and severe winter hindered the early resumption of operations in this lofty region. Mr. Ryall in his survey of Hundes and neighbouring peaks ventured across the frontier, but this fact was very soon reported to the Tibetan officials, who however gave him leave to complete his work on condition that he did not cross the Sutlej. The Byans Valley was surveyed by Mr. Peyton, who reports that during the season there is considerable traffic on the main road, and that several parties of Tibetan traders bring down by this route to Kumaon flocks laden with salt and borax. The average height of the survey work of this party actually lay above 16,000 feet above the level of the sea.

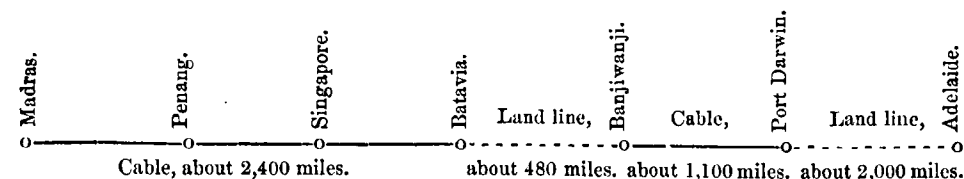
The spirit-levelling operations of the Survey, which have hitherto resulted in numbers of level charts (so useful for canal and railway purposes) of Oudh and the North-West Provinces, have during the year been represented by 358 miles of levelling about Broach, Surat, and Baroda.

Colonel Walker gives a very full description of the method of analysis of the tidal observations in the Gulf of Cutch and at Tuticorin, coupled with the method by which the atmospheric influence on the tides has been calculated. The results are not satisfactory as regards determination of atmospheric influence, but the observations will be again analysed to ascertain whether they can be made to yield more consistent results. Arrangements have already been set on foot for starting systematic observations, under Captain Baird's supervision, at Aden, Bombay, Karwar, and Madras.

The geodetic operations for telegraphic determinations of longitude were carried on by Captains Heaviside and Campbell. These are of great value in checking astronomical and trigonometrical measurements, and during the year under review, besides three arcs of longitude measured between Vizagapatam, Madras, Bellary, Mangalore, and Bombay, the last link in the chain of geodetic connexion between England and India was completed by the telegraphic measurement of the distance between Bombay, Aden, and Suez, the arc between Suez and Greenwich having been measured during the observations for the transit of Venus in 1874. The effect of this measurement is to establish a new value for Madras Observatory ($80^{\circ} 14' 51.3''$ E. of Greenwich) to which all

Indian longitudes are referrible, and to increase the distance hitherto supposed to exist between the two countries by 2,000 feet.

This telegraphic connexion of the longitudes of India and England will probably bear fruit in a further extension of the operations to Australia in the manner shown in the diagram.



Direct signalling would probably be practicable through the cables joined up between Madras and Batavia, so that the measurement might be made in one operation with astronomical stations at the two ends. Then the section, Batavia to Adelaide, might be measured with signallers at only the ends of the intervening cable. The land wire of about 2,000 miles across Australia is a formidable section to work through; but Captain Campbell (who has visited the proposed line with the view to examine the practicability of the arrangements) is of opinion that the dryness of the climate will probably secure success.

In the Head Quarters Office, Major Herschell has continued his researches into the results of pendulum observations for determining the influence of local attraction; and in the Computing Office, the final reduction of the north-east quadrilateral, that section of the Great Triangulation which includes all the principal chains of triangles situated to the north of a line running from Sironj, in Central India, through Calcutta to the Eastern Frontier, and to the east of the meridian of Sironj, has been completed. The second volume of the Account of the Operations of the Survey is still passing through the press.

The forthcoming work of the Great Trigonometrical Survey during the next five years will probably include:—

Principal Triangulation.

- (1.) Extension of the eastern frontier series from Tavoy through Tenasserim towards Singapore, with a branch to connect Bangkok, the capital of Siam.

- (2.) Completion of the Eastern Sind series on the meridian of 70° between the parallels of 27° and 29° .
- (3.) Completion of the Madras Coast series between Madras and Tanjore.

Secondary Triangulation.

- (1.) Minor chains in Burma.
- (2.) A chain along the western frontier of Sind up to Quettah, and from Quettah to Dera Ghazi Khan.
- (3.) Other minor chains possibly in some of the spaces between widely separated principal chains.

III.

TOPOGRAPHICAL SURVEYS AND WORK OF SURVEYOR-GENERAL'S OFFICE,
1876-77.

The Report on the Topographical Surveys of India and of the Surveyor-General's Department for 1876-77, is the last report issued by General Thuillier, and, besides the usual review of the topographical surveys of India for the past season, contains a very brief account of the various operations conducted under his incumbency as Surveyor-General from 1861, and as Superintendent of Revenue Survey from 1847.

During the past season the number of executive parties was seven in Northern India and two in Mysore, but at its close the Central Provinces and Vizagapatam Agency Survey party, which had completed its work, was broken up; the N.E. division, Central Provinces party, was amalgamated with the Rajputana party, and, owing to the famine, the two parties in Mysore were reduced and amalgamated into one, so that at present the Imperial Topographical Surveys are reduced to only six parties.

The topography executed during the season amounted to 18,909 square miles, on scales varying between half and six inches to the mile, and the triangulation to 22,119 square miles. Much of the geographical data obtained in the Naga Hills, in the eastern frontier of Assam, and in the Central Provinces, is perfectly new, and a good deal in Malwa, Khandesh, and Rajputana, furnishes reliable topography in place of the very rough routes and sketches from which the old existing maps were compiled. The cost of the season's operations (all heads) was 4,81,958 rupees (1,21,161 rupees of which was defrayed by Mysore), and the mean average mileage rate is

25 rupees, 8 per square mile, or somewhat in excess of the previous season; an excess, however, which is duly explained. On the whole the results are said to be very favourable and promising.

The party under Captain C. Strahan, No. 1 (Gwalior and Central India), was engaged in a difficult country along the great water parting of the rivers draining eastwards into the Bay of Bengal, and those which flow westward into the Gulf of Cambay. The contrast between the former, which is a fine open country, forming part of the Rajputana plateau, and the latter, which is a dense forest and jungle-covered tract intersected with watercourses and narrow valleys, is described as very striking. Besides a fair out-turn of field topography, large scale plans of Gwalior fortress and Morar cantonments were completed. A graphic description of the character of the country surveyed finds place in the Appendix to the Report. It is calculated that about seven more seasons will enable the remaining area allotted to this party to be completed.

To the immediate south of the above party an exceedingly good season's out-turn was completed by Captain Wilmer and Lieut. Gore (who were in charge of the Bhopal and Malwa Survey party), their work lying on either side of the Vindhyan Range; still further to the south was engaged the Khandesh and Bombay Native States Survey party, under Mr. Horst, one section thereof mapping out on the 1-inch scale the hilly native states north of the Nerbudda, and the other surveying on twice the scale the revenue-paying portions of the Khandesh plains on both sides of the Tapti.

An important survey has been brought to completion in Eastern India during the season under review. The Central Provinces and Vizagapatam Agency Survey was originally organised in 1844, from the Madras Survey, for the survey of Ganjam and Orissa, and has now completed an enormous area of country amounting to 72,144 square miles, extending over eight degrees of longitude, and embracing 170 sheets between the Nizam's territories and the Central Provinces on the west, and the Bay of Bengal on the east. The region to the north-west of the last-named party, a wild hilly and inaccessible country forming one of the chief water partings, or, as it might be termed, the backbone of India, was occupied by Colonel Depree's party, which has also arrived at the conclusion of its labours, after having surveyed in the course of 22 years all the Chota Nagpore division with its tributary states, and the north-east portion of

the Central Provinces, an aggregate of 51,805 square miles. This party has been now amalgamated with No. 7, which has still a very large tract of country to cope with in the western half of Rajputana.

The Khasi, Garo, and Naga Hills Survey has been again divided into three sections, under Major Badgley, in the vicinity of Shillong, under Lieut. Woodthorpe, to the south-east of Sadiya, on the upper Brahmaputra, and under two other assistants in the Khasi, Garo, and Kamrup districts. The difficulties encountered by these parties (particularly by the second one in its remote operations on the confines of Burma) were great, and the out-turn of work was small, but nevertheless satisfactory. An interesting description of the country traversed is given by Lieut. Woodthorpe and Mr. Ogle in the Appendix to the Report. General Thuillier estimated that there was about three years' more work to complete the survey of Assam, and, as this will include the accumulation of information regarding the trade routes between Assam, China, and Burma, he strongly urged its vigorous prosecution. It is stated, however, that it has since been discontinued.

Lieut. Leach in charge of No. 7 party was engaged on a large scale survey of Simla during the hot season, and on the Rajputana Survey in the field season. Lieut.-Colonel Depree will be the future chief of the party (consequent on the amalgamation of the Nos. 4 and 7), and he will proceed to complete the large remaining unsurveyed area, which is estimated to occupy about 12 years.

In Mysore survey operations were very much impeded by the famine, which has since led to the re-transfer of one of the two parties there employed to Head Quarters. This reduction will more than double the probable time of completion of the survey, which will thus take about 12 years more.

During the year under review Colonel Godwin Austen retired from the public service. This officer's name is well known in connexion with the survey of Kashmir under Major Montgomerie, where he completed much difficult surveying work amid the lofty mountains and enormous glaciers of Little Tibet and the neighbouring regions, with surveys in Bhutan (with Mr. Eden's mission, and during the ensuing military operations, 1863 and 1864), and in the Daphla expedition of 1875. The whole of the Khasi, Garo, Jaintia, and North Cachar Hill Districts, and a large portion of the Naga Hills and Manipur, Western Bhutan and the Daphla Hills were

surveyed under his superintendence. Colonel Godwin Austen during his long employment on the Survey made many valuable observations of the geology and zoology (especially ornithology) of the regions in which he served, which have enriched a variety of scientific periodicals.

Under General Thuillier's administration, first as Superintendent of Revenue Surveys, and next as Surveyor-General, the total out-turn surveyed by Topographical, Revenue, and Cadastral Survey parties, on scales varying between 1 and 32 inches to the mile, has been 796,928 square miles, or more than one-half of British India. In the Engraving Branch it is noticeable that since the transfer of the engraving work to India in December 1868, 50 new quarter plates have been completed, and 26 new quarter plates of the Indian Atlas have been taken in hand, besides 18 old ones revised. The quality of the engraving of more recent plates is in some cases excellent, and bears favourable comparison with the best English work.

It may not be inappropriate here to glance at General Thuillier's career in India. He entered the service in 1832, and succeeded Colonel Wroughton as Superintendent of Revenue Surveys in 1847. In 1851 he published (with the assistance of Captain R. Smyth) the "Manual of Surveying for India," a valuable work, and the official text book for Indian surveying officers. A new edition of this book revised and brought up to date was brought out by Colonel Thuillier two years ago. In 1861 he was made Surveyor-General of India, which appointment he has, like the late Sir Andrew Waugh, held for just 17 years. He has thus been connected with the Survey Department for over 35 years. The great area of country surveyed and mapped out during his administration is a noble monument to the success of his labours. The Secretary of State for India expressed himself regarding General Thuillier to the following effect, in a Despatch to the Governor-General of India:—

"During a service in the Department of more than 41 years, General Thuillier has devoted himself with energy and perseverance, of which it is difficult to speak too highly, to the task of securing an accurate survey of British India, and the results attained under his personal superintendence, amounting as they do to more than half the total area of the entire country, are such as to merit my hearty congratulations."

The areas still remaining for topographical survey are as follows :—

	Square miles.
Gwalior and Central India - - -	7,000
Khandesh - - -	4,800
Bhopal and Malwa - - -	9,000
N.E. Frontier and Naga Hills - - -	10,000
Rajputana - - -	54,500
Mysore - - -	22,000
Kattywar - - -	4,300
Guzerat - - -	25,800

Of late the question has been often asked, When will the whole of the survey of British India be completed? It is to be observed that not only do the unmapped regions require to be surveyed, but that the development of the economic wealth of the country, and the increased value of land render necessary larger, more detailed, and more accurate surveys of tracts which, in the first instance, were but roughly plotted out. The urgent demand on financial grounds for large scale cadastral surveys in the permanently settled districts of the N.W. Provinces points to the adoption of the same measures for the whole of Bengal and Behar, a question of considerable importance, and one which shows that the Survey Department of India has still a long career of usefulness before it.

IV.

REVENUE SURVEYS of INDIA, 1876-77.

Eleven Revenue Survey parties were at work during the year 1876-77, being one less than in the previous year, No. 9 party formerly employed on the Azamgarh Cadastral Survey, having been told off for the task of revising the cadastral survey of Azamgarh, Agra, and Hamirpur. Two detachments were in addition employed on special work in Chota Nagpore, and Assam. The total out-turn of the year, omitting the Assam *lakhiraj* survey, is 12,544 square miles (as compared with 11,175 square miles surveyed the previous year), on scales ranging from 1 inch to 32 inches to the mile, the increase being under every scale of survey except the 16 inch

cadastral, in which case the reductions were due to the fact that No. 9 party were employed on revision instead of new work.

Colonel H. C. Johnstone, who for several years past has been engaged on revenue surveys in the districts in the north-west of the Punjab, during the year 1876-77 was surveying in the districts of Rawalpindi, Dera Ismail Khan, and Bannu, and completed an out-turn of over 2,000 square miles of detailed survey on the scale of 4 inches to the mile. This survey has been hitherto most creditably conducted, the out-turn being an increase over that of last season, and the cost per square mile having steadily declined from Rs. 59-5-6 in 1873-74 to Rs. 32-3-6 in 1876-77. The comparison of areas with those of the *thakbust* rendered by the settlement department continues to agree well. Colonel Johnstone's relations with the frontier tribes have always been of a friendly description, and although the survey was at first positively objected to by them, his tact enabled him to overcome their scruples in the end. Some idea of the number of passes leading from the highlands of Afghanistan and Baluchistan into British India may be formed, when we learn that in the Dera Ismail Khan district alone the number of the principal passes leading into the hills to the west is thirteen, of which the Gumal and Tank passes are the most important, the former being plentifully supplied with water, extending almost up to Candahar, and being the great highway of the *kafilahs* proceeding thence to Hindostan. Details regarding these passes will be found in the elaborate maps of the Bannu, Dera Ismail Khan, and Dera Ghazi Khan districts prepared in the Surveyor General's Office. The survey of Rohtak and Sirsa districts was conducted by Captain E. H. Steel, and that of the former completed during the season under review; that of Sirsa will be probably completed in April 1879.

The N.W. Provinces cadastral surveys on the scale of 16 inches to the mile progressed in the Moradabad, Budaun, Muttra, and Banda districts, in the first two under Captain Barron, and in the latter under Colonel F. C. Anderson. The general average rate per acre for these cadastral surveys had been gradually and partly uniformly decreasing since their institution in 1871 down to four annas in the year 1875-76. The cost of survey in the Banda district during 1876-77 has been 4 annas 4 pies, a slight increase over this average.

In Agra, Hamirpur and Azamgarh, Captain Andrew has been engaged on the difficult task of revising the cadastral surveys, both by checking the work in the field and in the office.

The total out-turn of the Eastern Soane Irrigation Survey (32 inches to the mile) was 376 odd square miles, exclusive of part of the Soane River. The size of the fields was very small, averaging from one to three twentieths of an acre in area. On completion of the past season's work Mr. Johnson was transferred to take up the cadastral survey of the Jaunpur district of the North-West Provinces, but a portion of his party stayed behind to complete the Patna District Survey. A survey of the same scale (32 inches to the mile) has progressed in the Khurdah estate in the Pooree district, but at the high cost of 14 annas 9 pies per acre, a rate said to be due to the minute scale of the fields, and the difficulty in getting the Ooriyas to officiate as Amins. The Western Soane Irrigation Survey under Major Sconce was extended over 355 square miles at an average cost of 7 annas 5 pies per acre. The reproduction of these sheets formed a specially heavy undertaking, and arrangements have consequently been made with a Calcutta firm for the job, towards which the Bengal Government have made a grant of 3,000/. The area allotted to this party has been reduced, so that the efficient establishment will be available for work elsewhere after next October.

The 12th or Midnapur District Survey under Mr. W. Lane, and (subsequently) Captain Wilkins, completed an out-turn of 1,554 square miles on the 4 and 1-inch scale. The comparison of the village boundaries with the thakbust maps supplied by the Settlement Department was not satisfactory; the revisions were very numerous, and in a very many cases the thakbusts did not agree one with another. The area remaining to be surveyed amounts to only 43 square miles, which was to have been completed early this year. The whole party has been, under Captain Andrews, transferred to the District of Cuttack, where it will take up the cadastral survey of the irrigable area amounting to about 362 square miles.

The Dearah or alluvial lands survey in the districts of Fureedpore and Backergunge covered an area of 952 square miles surveyed on the 4-inch scale, near the estuary of the Megna River, the scene of the disastrous cyclone wave of 1876. Of the Dhanwar and

Chota Nagpore estates, surveys on the 16-inch scale were carried on. The former, begun in the previous season, was completed during the season under review, but in both cases much difficulty and delay arose from defective demarcation, which, as Major-General Vanrenen points out, should in every case precede survey.

In the Bombay Presidency the total area rendered by the 10th or Nasik, Poona and Ahmadnagar district party, under Major Macdonald, amounted to 2,202 square miles on the 2-inch scale, an out-turn described as excellent, and accomplished at the rate of Rs. 26-4 per square mile on completed work, being less by Rs. 2-15 than the previous season's average. No details at all were taken from the settlement maps, the revision survey not having been carried over the tract referred to, and the only existing maps being from 25 to 30 years old. To the east the part surveyed was flat and open, but a good deal broken up in parts, and intersected by a net work of large and small streams. The country on the west is broken, undulating, and in parts hilly; in the vicinity of the Ghats it is a mass of hills, some of them very rugged and precipitous. On account of the severity of the famine the eleventh (Poona and Sattara) party was transferred to other districts, and 1,870 square miles of topography were completed in ground of a more hilly description. Little use was made of the Bombay Revenue Survey maps, the operations being chiefly carried on in the hills, but Major Tanner expects to have a number of very good maps available for next season's work. A lakhiraj survey was at work in Assam, on behalf of the Assam Settlement establishments.

An important reduction of scale has been ordered by the Government of India to be carried out in the case of future non-cadastral surveys in the North-West Provinces. Hitherto the practice has been to survey, on the 4-inch scale, those districts in the North-West Provinces, in which no 16-inch cadastral surveys were to be instituted. The object of this was to provide a survey large enough to admit of the muzawar or village-by-village definition, the standard unit which has hitherto been carried out in all its integrity in every province and presidency from the Indus to the Brahmaputra. It was also intended as a check on the native *Khasrah* or basis of the settlement operations, though the Government of the North-West Province had carried out a new and revised settlement without

its assistance, a proceeding which might, it was feared, cause loss to the Government revenue.

The Government, however, were of opinion that in these districts where settlement had long since been brought to a close, and the Khasrah Survey carried over the whole district, it would be unnecessary to effect a professional survey on the 4-inch scale showing details of cultivation, fallow and waste, and that all that would be required in such cases, would be a 2-inch survey on the topographical scale on which the village boundaries might be shown.* A report on the effect of these orders, on the time which the work will probably take to do and its cost, will be eventually submitted.

There is a good deal of cadastral survey work remaining to be done in the districts where the various parties are still engaged, and assuming them to work at their present strength they will be occupied thus:—

	Years' work.			
Banda	-	-	-	2
Mirzapur	-	-	-	2 to 3
Jaunpur	-	-	-	5
Kurdah	-	-	-	5
Cuttack	-	-	-	2
Chota Nagpur	-	-	-	5
Soane Irrigation	-	-	-	1

Two of these parties may not improbably be transferred to Burma, where there is many years' work. The Moradabad cadastral and the Budaun 4-inch surveys are now being completed, and a proposal has been made to transfer the party employed thereon to Ghazipur, where there is five years' work.

Of Revenue 4-inch survey there is four years' work to be done in the Trans-Indus and Rawal Pindi districts, and five in the Sirsa and Hissar districts, while of Revenue 2-inch topographical survey the two parties in the Bombay Presidency have in their present districts (Nasik, Ahmednagar, Sattara, and Poona) sufficient work to occupy them for the next three or four years. There are 16 districts in the North-West Provinces, of which the maps and

* Letters from the Officiating Secretary to the Government of India, Nos. 679 and 23, dated 10th November 1877 and 15th January 1878. Proceedings, Surveys, (Revenue, Agriculture, and Commerce).

records were destroyed during the mutiny, and of which a re-survey is required for topographical purposes on the 2-inch scale. This work was commenced by one party last year, and a second will probably be employed on it next year. The aggregate area to be completed is 33,600 square miles, and the annual out-turn of work of a single party being about 1,400 square miles, there is about 12 years' work for two parties.

The Bombay Revenue Surveys are conducted entirely under the Settlement Department, and are not intended to supply maps for purposes of general administration, their object being simply to afford the requisite basis of information to assist the Government in determining the amount of land revenue to be paid by the cultivator.* Although the object and operation of these surveys are somewhat different from those hitherto mentioned, the present abstract would be incomplete without some reference to them.

During the year ended 31st October 1877, nine Bombay Revenue Survey and Settlement establishments (or one in excess of the previous year) were employed in measuring work alone, the majority of them being engaged in the Western Districts of the Dharwar Collectorate and in Kanara. In these districts rice cultivation prevails to a very large extent, the dry crop holdings are as a rule small, with very irregular boundaries, and the country is also much cut up with hills and streams, all of which makes measuring a matter of difficulty. The total number of acres measured was 643,856, being a decrease amounting to 160,700 acres as compared with the work of the previous season, attributable to the difficulties referred to. The quantity of "classing" executed (this being the process of determining the exact class in which the land should be ranked in respect of its degree of productiveness and general value, and the amount to be contributed by it to Government) was 497,384 acres as against 967,796 acres executed during the previous season with a somewhat larger establishment. The total cost of the survey during the season under review was Rs. 194,104 or about 19,410*l.*, as against Rs. 218,883 or 21,888*l.* the previous year, the decrease being

* A concise, but tolerably exhaustive, account of the method of measuring and classing in the Bombay Revenue Surveys will be found at page 193 of the second edition of the "Memoirs on the Indian Surveys."

principally caused by the transfer of officers and establishments to duty in connexion with the famine. A portion of the cost was defrayed from the revenues of the Kolhapur State, in which territory part of the survey progressed. The average cost of the survey per acre was 5 annas 2 pies, which was above the average of the last five years, viz., 3 annas 11 pies, the difference being caused by the smaller out-turn of classing and measuring.

In the Poona, Nasik, and Ahmednagar Collectorates four measuring establishments, under Colonel G. A. Laughton, were employed for the entire season, and one for a period of two months; the total out-turn being 340,447 acres as against 506,417 acres completed during the previous season. Besides the above a party was engaged throughout the season in erecting special boundary marks for the use of the Topographical Survey party.* Only one party was engaged in classing, and the out-turn rendered by it was 132,908 acres, being considerably less than the previous season, when there were two and a half parties at work. Between six and seven per cent. of the entire area was tested by European officers, and 22 of the Survey "numbers" were found to differ by more than 20 per cent. from the original measurements. The settlement was introduced into 221 Government villages in the Nasik and Ahmednagar Collectorates, and resulted in an increase of 7,582 $\frac{1}{2}$., or over 37 per cent. on the previous year's collections. The total cost of the department here was less than that of the preceding year, but the cost per acre was more than 30 per cent. higher, owing partly to the reduced establishments, and also to the minute sub-division of land in all the talukas bordering on the ghats, and the necessity of nearly all the establishments having to move twice during the working season from the plain to the hilly country.

In Guzerat, under Mr. N. B. Beyts, six parties were employed in measuring, classing, and city survey. One of these was engaged in the survey of the Dangs forest, a tract of which over 244 square miles, or fully one third have been already surveyed. The rate, which appears to be 74 Rs. 12 annas per square mile, is considered high, and the remainder of the operations will be conducted by the (late Trigonometrical) party under Colonel Haig. An area of

* See page 19.

95,371 acres was classed in the Panch Mehals and Ahmedabad and Surat Collectorates.

Mr. J. Gibson's parties, composing the Ratnagiri Survey, were engaged in the Collectorate of the same name, and in the Bhor and Sawant Wari States, in the duties of measuring and classing, the total area being 201,546 and 135,616 acres respectively, showing an increase in the former and a decrease in the latter as compared with the previous year's out-turn. The settlement was introduced into 22 villages in Tanna and Sawant Wari, the increase of revenue being over 38 per cent.

In the Hyderabad Collectorate in Sind, under Colonel M. R. Haig, five establishments were engaged on revision survey and two on classification. The revised settlement was introduced in the Sukkur and Sehwan talukas, the gain to the Government assessment far exceeding the amount expected by the Settlement officer. Settlement work is said to be much behind hand in Sind, and the revision remains to be carried out in twenty-one talukas of the Hyderabad and Shikarpur Collectorates, where the present settlements are no longer suited to the circumstances of the districts. The Government anticipate, however, that affairs will shortly improve, owing to the increase in strength recently given to the survey.

Taking the results for the year, there were 2,160,059 acres measured and 1,559,515 acres classed in the Northern and Southern Divisions of the Bombay Presidency, being a decrease of 299,202 and 536,143 acres in the two branches respectively. The cause of this was the serious famine of the year, which stopped measurements, classification, and introduction of fresh settlements, and caused many officers and men to be detached for famine duties.

The Madras Revenue Survey will be found described at page 188 of the Memoir on the Indian Surveys (2nd edition). The original scheme of survey has since been considerably extended, and, as now organised, is said to combine the operations of a revenue or cadastral survey with those of a perfect topographical survey on a trigonometrical basis. The revenue survey proper, with few exceptions, is confined to land paying revenue to Government on the ryotwary system. Lands held on other tenure, ranges of hills, and tracts of

waste land or forest of inferior value are excluded from this minute field survey, and topographically surveyed on a scale of two inches to a mile. The operations in Government lands are as follows:— The village boundaries are first settled, every turn of the line being marked with stone; then disputes are disposed of, irregular boundaries are adjusted, very small villages are amalgamated, and very large villages are sub-divided. After these preliminaries, the field boundaries are permanently marked with stone, and every holding is registered. Main circuits of from 50 to 100 square miles are carried out by the theodolite, the angles being checked by observations for azimuth at about every 50 stations. Village boundaries are also surveyed by theodolite, and check lines within the village, forming minor circuits of from 100 to 200 acres, are run. While the boundary work, which has been connected with the Great Trigonometrical Survey, is being plotted, the fields are measured by chain in triangles, so that when the measurement books are handed into the office, the map is ready to receive the fields. After correction or distribution of errors, the area of each field is computed by scale, and the sum of the areas so obtained is compared with the traverse area. The village map is then sent out for insertion of topographical details. In zemindary and hill tracts the details are put in by the plane table. The district and taluq maps are compiled in the Central Survey Office at Madras. Village maps are reproduced by lithography for the use of the Settlement Department. Taluq and district maps are also lithographed; photo-lithography has been in use in the Survey Office since 1873.

Up to the close of 1875–76 the area mapped, on the scale of 16 inches to the mile, in the Madras Presidency was 40,407 square miles, and 3,655 square miles are in course of survey. Topographical surveys, on the scale of 1, 2, and 4 inches to the mile, have been extended over 17,393 square miles, while 1,480 square miles are in course of survey, and 3,000 square miles are being surveyed by an Imperial survey party. The total number of village maps published is 13,420, while 75 taluq and seven district maps have been completed.

During 1875–76, revenue and topographical survey operations progressed in the Ganjam, Bellary, Cuddapah, North Arcot, Salem,

Coimbatore, Madura, Trichinopoly, and Godavari districts. Special surveys were also carried on in the Nilgiri Hills and in the Wynaad Taluq of the Malabar District. The total expenditure on survey, demarcation, and lithography, was 71,543l.

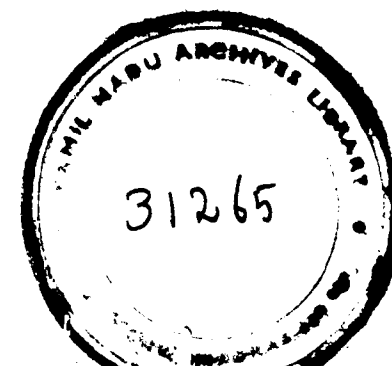
During the year 1876–77 six survey parties were employed in thirteen districts, and 967 square miles of field demarcation were completed, 1,637 square miles of field survey, 3,198 square miles of boundary demarcation, and 4,853 square miles of boundary survey, besides much miscellaneous work. There is a falling off in the out-turn of work in 1876–77 as compared with the previous year, but this is said to be in reality less than what it seems to be. Besides the field work a great deal was done in preparing village and other maps, and of the former class 4,714 square miles were mapped on the 16 and 4 inch scales.

The season was very unfavourable owing to the prevalence of famine, and many officers were detached for employment on famine relief duty. It is computed that there still remain 12,681 square miles of village survey, and 31,473 square miles of topographical survey to be completed before the entire Presidency is mapped out.

A scheme for the re-organisation of the department has been sanctioned by the Government of India, whereby the subordinate establishments hitherto distinctively employed on demarcation and field survey, will be amalgamated, and the salaries of the superior officers revised.

Little progress has as yet been made towards utilising the geographical materials collected by the Revenue Survey for maps of the country. The primary object of the department was to complete a revenue survey, and thus help to secure the benefits of a settlement of land assessment which should be based on accurate data, and this fact, coupled with the expense of the extra establishment which the compilation of maps would necessitate, caused the postponement of any measures towards that end. The Secretary of State, however, has drawn attention to the need of such maps, and in the scheme referred to an increment has been made to the Central Office grant, by which it may be possible to establish a small but distinct topographical and geographical section, and thus to ensure steady progress in reduction and compilation.

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V.

GEOLOGICAL SURVEY OF INDIA, 1877.

The field work of the Geological Survey consists of two kinds; the preliminary examination of unknown ground, and the more detailed study of rocks, of which the general features have been already laid down. During 1877 two regions have been geologically explored for the first time, Kashmir and the upper basin of the Chenab, where Mr. Lydekker has been at work, and a wild hilly belt of country some 300 miles long between the Mahanadi and the lower reaches of the Godavari, which, although completely surveyed topographically, is one of the least frequented regions of India. Of Kashmir, Mr. Medlicott observes that hitherto flying observations had been recorded, and bold speculations based thereon, but Mr. Lydekker's observations, of which he gives a summary, are the first systematic ones recorded. Colonel MacMahon, an amateur geologist, has compiled a geological map of the Simla region, and has suggested an explanation of the disturbance of the strata, which Mr. Medlicott considers of possible great importance, especially with reference to the gneissic rocks, which he regards as the same as the central gneiss of the main range.

The other newly reclaimed area is between the Mahanadi and the lower course of the Godavari, a wild and hilly country, the topographical survey of which has just been completed, and which Mr. Ball has now examined from a geological point of view. Examples of "high level laterite" were found near and in the Eastern Ghâts, this being a level capping between 50 and 10 feet in thickness, which is found on most of the highest summits, whatever may be the structure of the under-lying rocks, and is still one of the greatest puzzles of Indian Geology. Mr. Hacket also traversed new ground in Rajputana, south of Ajmir.

Dr. Feistmantel and Mr. Hughes have been engaged in researches into the Indian coal measures, the former with regard to the palæontological features of those in the Damuda valley, and the latter between the Wardha valley and the Godavari in the Nizam's dominions, where coal out-crops have been actually found and will be worked. Both these investigations have in one sense formed part of examination of the Gondwana system, which has been further

elucidated by the work of Mr. King, below Sironcha in the Godavari basin, and Mr. Foote, up the course of the Krishna in the Nellore and Guntur districts.

In the Satpura basin four different series of borings for coal have been put down, one to the depth of 720 feet; but these have been attended with but little success, though Mr. Medlicott considers that at Mohpani on the Sitariva, where the only out-crop exists, much more might be done. Unfortunately the ground here is in private hands, and Government cannot interfere.

In Northern India, Mr. Wynne was occupied in mapping out the Potwar or Rawalpindi plateau, between the Salt Range and the mountains to the north, a region of complicated geological structure. The mapping of Sind west of the Indus was completed during the season by Messrs. W. T. Blanford and Fedden (the former of whom also explored the route to Sonmiani), and a valuable collection of organic remains has been got together in the the last two seasons.

During the year Vol. XIII. of the *Memoirs*, with views and coloured maps of the Rajmahal Hills, and Wardha Valley coal fields, was issued, and Vol. XIV. containing Mr. Wynne's description of the Salt Range was nearly completed, three fasciculi of the *Palæontologia Indica* were also published. The *Manual of the Geology of India* and the geological map of India are expected to be out very shortly.

As regards the future work of the department, the first labours will be to get a preliminary knowledge of the large area still remaining, in which no delineation of the geology, however roughly, has as yet been attempted. The largest of these blanks is the great area extending from Sirsa in the Punjab, to Guzerat; much of it is occupied by fossiliferous rocks that will demand close attention; but the preliminary boundaries might, in Mr. Medlicott's opinion, be traced in two or three seasons. In the adjoining area of the Trans-Indus Hills there is also a gap from Sind to Kohat; the accessible ground here is so narrow that one season might suffice to demarcate the leading features. There is still a large unknown area west of the Weinganga and Godavari, to map which, in the most general way, one season would hardly suffice. The remaining notable area is along the Malabar coast and round to Trichinopoli; stratified rocks are reported to overlies the gneiss in that position, but nothing

certain is known of their extent or age ; it would take two seasons to acquire a safe general knowledge of this tract. There are also certain areas, such as that of the Satpura coal basin, of the lower Nerbada valley, and of the great coal basin of South Rewah, which, although marked in the index map to the annual report as " mapped, reported on, and published," require close examination. In the Himalayan region a good beginning has been made for future progress, and it is to be hoped that a few more years' work will disclose the simpler features of the ground to the north-west of the Chinese and Nepalese frontier. In the hills of Eastern Bengal and Assam much interesting work awaits the survey, but it is doubtful when it can be taken up.

VI.

ARCHÆOLOGICAL SURVEYS.

The country hitherto explored by the Archæological Survey of India, under General Cunningham's direction, includes about two-thirds of the whole extent of Northern India, from the Indus to the mouths of the Ganges. Some portions of the Punjab and of Western Rajputana still remain to be examined as well as southern Oudh, and the whole of the country to the north of the Ganges and eastward of the Gandak River. The hill districts of Kumaon and Garhwal are also still unexplored. A large experience has convinced General Cunningham that many of the places which have already been visited will most probably yield fresh discoveries by excavation. Much difficulty has been experienced in getting information regarding the existence of antiquities owing to the combined ignorance and apathy of the people, so that the surveyors have often passed by unwittingly within a few miles of some interesting buildings or some valuable inscription. Making allowance for these drawbacks, however, it is probable that all the *principal* remains in about two-thirds of Northern India have been now examined, and that any future discoveries of importance will be due to excavation.

The last report received on General Cunningham's Archæological investigations was Volume V. of the series, giving an account of the interesting researches at Bharhut in the cold season of 1872 (see "Memoir," 2nd edition, p. 270). In the spring of the present year a statement was received showing the state of the

preparation of the various reports, and a brief account of the work of each of his assistants in each season since 1872-3. A similar brief annual report on the work done is to be submitted at the close of each working season.

During the cold season of 1873-4 General Cunningham paid a flying visit to Bharhut, where the sculptured railing of the Great Stûpa was discovered. He then examined the remains near Jubbulpore, and at Bhera Ghât made a plan of the curious circular colonnade with its 64 female statues, which Mr. Beglar photographed. Many interesting inscriptions of the powerful Kulâchuri dynasty of Chedi were obtained in this locality, and two important inscriptions of the Gupta period. At Khandwâ, Burhânpur, and Asirgarh General Cunningham obtained several inscriptions, and at Bhândak he explored and measured the Buddhist caves and rock houses and several Brahmanical temples. He then proceeded to Mârkandi on the Wardâ River, where he made plans of the fine group of temples, and copied all the inscriptions. From thence he returned to Bharhut, where he spent a considerable time in excavating the buried railing which once surrounded the Great Stûpa. He closed the season's work by a visit to Kosani (the ancient Kausâmbi), where he obtained a considerable number of terra-cotta figures with Buddhist symbols, including also several children's toy-carts in terra-cotta of the Gupta period. During the same season Mr. Beglar explored the eastern portion of the Central Provinces. He visited with General Cunningham the ruins of Tewar, Karanbel, and Bhera Ghât, and then diverged eastward to explore a variety of places, including the little known and almost inaccessible fort of Tipagarh, Rajam, where the remains are old and interesting, and Balod and Dhamtari, where he found some ancient temples, and two inscriptions of the powerful Chalukya family. Mr. Carlleyle's work during the season consisted in the exploration of a number of ancient sites in the districts of Agra, Aligarh, Etah, and Bulandshahr in the Gangetic Doab as well as many of the principal sites in Kohilkhand. Among the latter the most remarkable was the old city of Sambhal, where the Masjid of Baber was found to be an old Hindu temple altered and adapted to Muhammadan worship. In the Doab the old places were of comparatively little interest, excepting the great mound of Indorkhera, about seven miles from Anupshahr, near the road leading to Aligarh.

Here Mr. Carlleyle spent the whole of the hot weather and rains of 1874 and the greater part of the cold season of 1874-75, and made a thorough exploration of the mound, in which he was fortunate enough to find an inscribed copper plate, bearing the name of Skanda Gupta, with the written date of 146 Samvat, a discovery which disposed of the hitherto accepted reading of the Kakaon pillar inscription which was made to fix the death of Skanda Gupta in 141.

In 1874-75 General Cunningham returned to Bharhut to complete the excavation of the sculptured railing in company with Mr. Beglar, who was chiefly employed in making photographs of the sculptures. From Bharhut he proceeded to Mâlwa, in the vicinity of which he examined several ruins and found several valuable inscriptions. On his return he explored the great fortress of Singorgarh and the temples at Majholi and Baturiband. Mr. Beglar spent the early part of the season at the Stûpa of Bharhut in making photographs of all the principal sculptures. He then proceeded into the Rewah territory to examine the ruins at Amarpâtan, Tâla, Mukundpur, and others, near the junction of the Saone and Banas rivers, including the unique solitary temple at Chandrebe. From thence he visited the ruins at Kakarsiba, the caves and ruins of Mara and remains at Udaypur or Rabkop, the capital of the small state of Udaipur in Chota Nagpore Division. The caves near Sirguja were then explored, and copies taken of the inscription known as *Sita likhni* or "Sita's writing." He then examined the ruins of Sambhalpur, and marching through the Saura-Malia States reached Gumsar and Ganjam, where he made photographs and impressions of the great inscription of Asoka engraved on the rock of the Jaugada Fort. From thence he visited the antiquities at Bhanpur, Chandeswar, and many other places near the Chilka Lake, finally closing work at Cuttack. Toward the end of the same season Mr. Carlleyle proceeded to North-eastern Oudh and Gorakhpur district to search for the site of Kapilavastu, the birthplace of Buddha. After a careful search he discovered the true site, afterwards visited by General Cunningham, at Bhuila (?) Tâl, 25 miles to the north-east of Fyzabad, and explored the whole neighbourhood, identifying many other places, such as the *Sarâ-kupa* or "Arrow well," where Buddha's arrow on striking the ground gave birth to a spring. The place still retains the name of Sar-Kua.

In 1875-76 General Cunningham began his tour under the Chunar Hills, and explored all the caves and other remains down to Saha-

sarâm, where he copied the newly discovered inscription of Asoka. He then proceeded to Bodh Gaya, where he made a survey of the country round the great temple. After inspecting Mr. Carlleyle's work General Cunningham went on to Srâvasti, where he made numerous excavations, bringing to light a large building at the northern end, which he believes to be the famous *Gandha-kuti*. A Stûpa also yielded a great seal with 18 lines of inscription. At Tandwa, his next station, he laid bare the exterior of the great brick Stûpa, which he has identified with the Mausoleum of Kâsyapa Muni, the third of the last four Buddhas. From thence he proceeded to Pakhna-Bihâr, near Sankisa, where he obtained a considerable number of old inscribed seals, including one with a representation of the three famous ladders by which Buddha descended from the heavens, accompanied by Brahma and Indra. He also got several terra-cotta figures of the Buddhist period, and an inscription of one of the Indo-Scythian kings, imperfect, but nevertheless of importance, as proving that their rule extended as far eastward as Sankisa, between Farukhabad and Mainpuri. At Sankisa he was fortunate enough to find the basement on which the great Asoka pillar with the elephant capital had originally stood, but he could not find any traces of the shaft of the pillar. Mr. Beglar's work during the same season lay at Bhitari (between Benares and Ghazipur) at Sahasarâm, where he made reproductions of the dated inscriptions of Asoka in the rock-cell of Chandan Shahed, and photographs and plans of the great rock tombs of Sher-Shah and his family. At the fort of Rohtâs, which was thoroughly explored, he discovered a large seal of Rajah Sasangka, the great opponent of Buddhism, shortly before A.D. 600. The letters are sunk in the rock in reverse. He also visited numerous other ruins, caves, old forts, &c., and secured a copious collection of photographs, plans, &c.

In 1876-77 General Cunningham found a fine statue of Buddha at Rhita, near Allahabad, with an inscription. At Tigowa he examined a very old temple which he had discovered two years before. It proved to belong to the Gupta period, and to be a very fine specimen of that early style of Indian architecture. From thence he visited the ruined city of Besnagar, situated at the confluence of the Betwa and Bes rivers, and made a complete survey of the place. Numerous remains of a very early date were brought to light, among which are a colossal female figure of the time of

Asoka, and several pillar capitals of the same date. Two are surmounted by lions, one by an elephant with rider, one by a crocodile, and one by the famous *kalpa-vriksh* or tree of plenty, which yielded to the fortunate possessor whatever he desired. The tree itself is represented as a banyan, with pendent roots, from which hang skins filled with wine, and vessels of various shapes overflowing with coins. At Deogurh, in Southern Bundelkhand, General Cunningham found a fine temple of the late Gupta period, ornamented with some large sculptures of unusual merit and beauty. During the same season Mr. Beglar accompanied General Cunningham for some time for the purpose of taking photographs of sculptures and architectural remains, chiefly of the Gupta period. At Bhita, south of the Jumna, several Buddhist sculptures were photographed, among which is a fine figure of Buddha, of the Gupta period, with the head-dress of a Tibetan Grand Lama. At Garhwa some very beautiful pillars and sculptures, also of the Gupta period, were discovered. He visited several ruins in North Bundelkhand, a curious old temple built of polished stones at Mokunddwâra in Rajputana, which he thinks to be the oldest structural temple yet found, as well as various other sites in Rajputana and Ajmere, and finished the season by taking photographs of the fine Asoka capital at Sankisa, of the inscribed pillars of Kumâra Gupta's temple at Bhilsan, and of the curious brick temple of Bhitargaon, with its carved and moulded ornaments and its terra-cotta *alti rilievi* 2½ feet in height. Mr. Carlleyle's work lay eastward of his previous season's operations, in the direction of Kasia, already identified with Kusinagara, the scene of Buddha's death. This identification has now been settled beyond all doubt by Mr. Carlleyle's discovery of the colossal statue, upwards of twenty feet in length, of Buddha lying dead with his face turned to the westward, and immediately to the west of a brick stûpa, exactly as described by the Chinese pilgrim Hwen-Tsang in the seventh century. Here also he discovered a long inscription on a stone slab with the opening invocation to Buddha. The mound about the stûpa was excavated, and revealed the fact that the great Nirvana statue had been enshrined in an arched chamber or temple as recorded by the Chinese pilgrim. This important site being thus fixed, Mr. Carlleyle proceeded to explore the whole neighbourhood, and he has been able to identify many other sites connected with memorable incidents in Buddha's lifetime. The

colossal Nirvana statue of Buddha bears an inscription on its pedestal in characters of the Gupta period. There can be no doubt, therefore, that this is the identical statue seen and worshipped by both of the Chinese pilgrims, by Fa Hian in the beginning of the fifth century, and by Hwen T'sang in the first half of the seventh century.

Volumes I., II., III., IV., and V., of the reports of the Archæological Survey of India have been noticed in the "Memoir on the Indian Surveys," 2nd edition, p. 270. During the current year the sixth volume has been received. It consists of a "Report, illustrated by 24 plates, of a tour in Eastern Rajputana, in 1871-72 and 1872-73, by Mr. A. C. L. Carlleyle, Assistant to General Cunningham." Mr. Carlleyle prefixes to the account of his travels a brief notice of the chief mountain ranges of Rajputana, the Pathar, Karkota, and Aravalli ranges. Of the Pathar chain he observes that the great hill range, of which it forms a part, is one of the most continuous and unbroken, and also one of the longest of hill ranges in India. It is about 200 miles long from south-west to north-east, and yet in maps generally it is laid down incorrectly and confounded with a totally different one, the Karkota range, about twenty miles further west. Mr. Carlleyle ascertained that southward the people call this range Araballa, and he therefore regards it as the true Aravalli range, instead of the one commonly so called which lies further west on the borders of the desert.

Mr. Carlleyle first visited several sites in the Fathipur Sikri range of hills to the west of Agra, where he discovered stone cairns, monoliths, and some colossal statues, the latter at Rûp-bâs. He next visited Baiâna, which before the time of the Lodis was a sort of secondary capital to Delhi, and the neighbouring hill fortress of Vijaymandar, where he found a *lât* or monolith of red sandstone, with an inscription dated in the Samvat year 428, (probably 506, A.D.). General Cunningham points out that this inscription, which is quite perfect and has been translated by Dr. G. Bühler, is of special value, as we have hitherto found but very few dated records of so early a period. Here also Mr. Carlleyle discovered a curious minar, apparently built in the time of Muhammad Shah bin Farid Shah of the Sayyid dynasty, who reigned between 839 and 847 A.H. The sides of the minar bulge outwardly with a gentle curve, and the upper storey is ornamented about the middle by a coloured band of

green and blue squares, probably glazed tiles, built into the structure. Its present height is 74 feet, and it is built of two storeys, but it had formerly a third storey, and in all probability was surmounted by a cupola pinnacle, and so must have been over 100 feet at its full height. He afterwards visited the ancient town of Mâchâri, where he discovered another original tomb, some dated inscriptions, and a sort of colonnade of sixteen pillars, with their shafts richly sculptured, principally with bands of floral devices of considerable elegance and variety. At Bairat Mr. Carlleyle discovered a rock inscription of Asoka. It was imperfect; but after some time General Cunningham found it was a third copy of the dated inscription of Asoka, of which two nearly perfect texts had been found at Rûpnâth and Sahasarâm. At Deosa (nearly due east of Jaypur) Mr. Carlleyle found several monoliths, which in most cases had been formerly disposed in circles, and were in his opinion the work of aborigines during the prehistoric period. At Thoda (about equidistant from Ajmir and Jaypur), the chief attraction is the great temple, with a plinth or basement elaborately sculptured, of which plans and drawings were made, and in a fine old temple at Visalpur, about seven miles off, Mr. Carlleyle found two dated inscriptions of Prithvi Raja, the earliest dated Samvat 1231. Nagar or Karkot Nagar, the next place of importance visited, is a very ancient place, founded, as it would appear, about 1350 B.C., and probably destroyed by some volcanic convulsion; about six thousand ancient coins were here picked up by Mr. Carlleyle and his servants, and the better specimens of these furnished the names of nearly forty different kings. As Buddhist symbols occur on many of these coins, it may be inferred that the ancient kings of Nagar were Buddhists from the time of Asoka up to the third century of the Christian era. The destruction of ancient Nagar probably occurred about the end of the fourth or the beginning of the fifth century of the Christian era. General Cunningham remarks of these coins that, as nearly the whole of them bear the name Mâlavâns, which he takes to refer to the Mâlavâns of the Hindu Purâns, and, as this name occurs in characters of all ages from the time of Asoka (250 B.C.) down to about 500 or 600 A.D., he concludes that the city must have flourished throughout the whole of this long period.

Tambavate Nagari, lying about 11 miles N.E. of Chitor, is of special interest, as it is undoubtedly one of the oldest cities in

Northern India, and although known by repute to Colonel Tod, (author of the "Rajasthan," &c.), was searched for by him in vain. About 145 coins selected by Mr. Carlleyle, out of a larger number found here, have been ascribed by him to periods varying between 350 B.C. and the eighth century of the Christian era. A descriptive list of them finds place in Mr. Carlleyle's volume. He also visited Bijoli, the temples of which are of particular archæological interest, and returned to Agra early in 1873, having spent the greater part of the two cold seasons of 1871-2 and 1872-3, besides the whole of the intervening hot season and rains of 1872, in a prolonged and interesting tour in Rajputana.

The above are the general contents of volume VI. of the Archæological Survey of India.

The following volumes are in various stages of preparation:—

Volume VII. Mr. Beglar's Report on Bundelkhand for 1871-72, and his Report on the Central Provinces for 1873-74.

Volume VIII. Mr. Beglar's Report on the Lower Provinces of Bengal for 1872-73.

Volume IX. Mr. Carlleyle's Report on the Doab, Rohilkhand, and Bhuila Tâl (the ancient Kapilavastu) for 1873-74 and 1874-75.

Volume X. General Cunningham's Report on the Central Provinces and Malwa for 1873-4-5 and 1876-77.

Volume XI. Mr. Beglar's Report on the South-east Provinces for 1874-75 and 1875-76.

Volume XII. Mr. Carlleyle's Report on Kasia (the ancient Kusinagara) for 1875-76.

Volume XIII. General Cunningham's Reports on the Doab and Oudh for 1875-76 and 1876-77.

Volume XIX. Mr. Beglar's Report on Bundelkhand, Malwa, and Rajputana for 1876-77.

In addition to these General Cunningham has been engaged on the following separate publications:—

1. A collection of ancient Indian inscriptions, entitled *Corpus Inscriptionum Indicarum*. Of this Volume I., containing lithographs of Asoka's inscriptions, has been published. Vol. II. is proposed to contain the inscriptions of the Indo-Scythians, and Vol. III. the inscriptions of the Gupta dynasty.

2. A collection of specimens of ancient Indian architecture showing the various styles in use at different periods. A large collection of materials has been made for this subject as well as for the next, for the illustration of the Asoka, Indo-Scythian, and Gupta periods.
3. A collection of examples of early Indian sculpture.
4. A collection of specimens of Indian architectural ornament in mosaic, trellis, &c. A first volume of Indian mosaics, illustrated with coloured plates, has been completed, and a second volume containing plates of Indian trellis work, from the simple chequers of the old Hindu temples down to the elaborate and delicate tracery of the marble screen of the Tajmahal.
5. A collection of specimens of Mediæval Indian architecture (partly done).
6. A collection of specimens of Muhammadan architecture (nearly complete).

General Cunningham's most absorbing work, however, has been the compilation of an elaborate monograph, profusely illustrated with photographs and lithographs, on the Stûpa of Bharhut. This work, the illustrations of which are being produced by Messrs. Vincent Brooks, Day and Son, will consist of about 143 pages of letterpress, and photographic and other illustrations reproduced from some excellent negatives, &c. taken by Mr. Beglar. A brief account of the sculptures will be found in the "Abstract of Surveys, &c. for 1872-3."

In Western India Mr. J. Burgess's archæological researches, between November 1875 and May 1876, were of peculiar interest,* being conducted principally in the western part of the Nizam's dominions, a tract hitherto quite unknown to the antiquary. Tuljapur, the first place visited, stands on the borders of the Haidarabad territory, on the verge of the Bâla Ghât, one of the terraces by which the table land of the Dekhan descends westward. It contains a temple and buildings attached, but of no great importance. At Dharasimha, about 12 miles to the north, groups

* Archæological Survey of Western India, Vol. III. Report on the antiquities in the Bidar and Aurangabad districts in the territories of H. H. the Nizam of Haidarabad, 1875-76. By Jas. Burgess, F.R.G.S., M.R.A.S. London (Allen & Co., Trübner & Co., Whittingham, and Stanford). 1878.

of Jaina and (probably) Vaishnava temples were examined, and at Karusa some caves in a hill of laterite were surveyed, one called Mahadeva's being noticeable for a profusion of sculptured incidents in Hindu mythology, while at Nilangâ, south-east of Karusa, a Saiva temple, in what is called the Hemadpanti style, was the chief antiquity. Kalyâna, the next place of importance, was originally the capital of the Chalukya dynasty of the Dekhan, whose rule must have at times extended over a large area, then known as Kuntaladesa, stretching from the Nerbudda river on the north to about the Tungabhadra to the south, reaching to the Arabian Sea on the west, and to the Godavari river and eastern Ghâts on the north-east and south-east. In the southern portion of this area the Kannada or Canarese language is spoken. Mr. J. F. Fleet and Sir Walter Elliot have helped greatly to elucidate and extract from inscriptions the history of this dynasty; the latter has remarked that "it is the oldest race of which we find satisfactory mention made in the records of the Dekhan, and it appears to have belonged to the great tribe that under the general name of Rajputs, exercised dominion over the whole of Northern and Central India." The two dynasties would appear to have flourished from about 465 A.D. to 1190. They were mostly devoted to Vishnu, but both Jainas and Saivas were protected and patronized, as is proved by their inscriptions. Kalyâna was doubtless in the middle ages adorned with many large and splendid temples and palaces, but in the struggles that succeeded the fall of the Chalukyas, and the frequent wars that for four hundred years devastated this part of the Dekhan, the Hindu buildings were ruthlessly destroyed, and the modern city is a purely Muhammadan town.

After visiting Nârâyanpur and Umnabad or Hominabad, Mr. Burgess went on to Bedar or Bidar, a large walled city on a high and healthy plateau 2,330 feet above the sea level, or fully 500 feet above Haidarabad. One of the principal edifices, the remains of which still exist, is the Madrasah or college, built in the latter half of the fifteenth century, and formerly containing a library of 3,000 volumes. There are several Muhammadan remains of considerable interest in Bidar, especially of the Bahmani and Berid Shahi dynasties, but they are falling rapidly into decay.

Between Bidar and Mominabad, a distance of one hundred miles, there was not much worthy of note, but at the latter town a number

of Brahmanical and Jaina cave temples were surveyed at the old town called Jogai Amba, and two inscriptions of the Yadava dynasty of Devāgiri were discovered, one of which has been translated in full by Dr. Bühler. From thence the route lay through Mungi, in the British province of Ahmadnagar, to Paithan, probably the same place as the *Παῖθανα* of the Greek writers and *Pratishthana* of the Hindus. The author of the "Periplus of the *Ærythræan Sea*" says abundance of onyx stones was brought thence, and this stone and the carnelian are still common in the neighbourhood, but not of fine quality. Here the great King Salivahana, who founded the Saka era, is said to have ruled in the first century. The town is beautifully situated on the left or north bank of the Godavari, and is looked upon by Hindus as a favourite resort of Brahma. Its architectural magnificence has long since disappeared, and even the manufacture of silk shawls, which were famous throughout India, has ceased to enrich the place, a ruinous tax having been imposed, which drove most of the weavers away and destroyed the principal source of trade. After visiting the Hindu sacred place at Sanvkhed, Mr. Burgess examined the very remarkable Buddhist rock-cut temples at Aurangabad, which have hitherto apparently attracted but little attention, though Dr. Bradley, in his account of the statistics of the Sarkar of Paithan, furnished a notice of them.

One of the caves (No. III.) is supported by columns of remarkable richness and elegance of detail, lithographed representation and detailed descriptions of which have been given by Mr. Burgess in his report. On an architrave a series of scenes of unknown interpretation, but evidently representing a history or a succession of incidents, is carved. The most striking peculiarity of this cave is a group of worshipping figures, occupying the front corners of the shrine. These have very thick projecting underlips, short chins, long straight noses, and an almost Egyptian cast of countenance, while their styles of head-dress are most varied and ornate. Another of the caves (No. VII.) contains on one side of the door of the shrine a gigantic figure representing the famous Avalokitesvara Bodhisattva, so often spoken of by the Chinese pilgrims, Fah-hian and Hwen Thsang, and identified also in Nepalese and Chinese mythology. He is always represented in Indian sculptures as holding a lotos stalk in one hand, with an opening bud, and generally with a rosary or

jewel in the other; his hair is abundant and falling in ringlets upon his shoulders, and on his forehead is a small figure of Amitabha, the lord of Sukhavati or the Western Happy Land and the fourth Dhyani Buddha. On each side of him are four scenes forming a sort of pictorial prayer or litany. On the other side of the door is another colossal Bodhisattva, probably Manjusri, distinguished for his merciful character.

Mr. Burgess remarks that, while the earlier favourite Buddha symbols, such as the tree of knowledge, the many hooded snake, the sacred wheel, &c., are not found in the later caves, the Bodhisattvas never occur in the earlier ones. This marked fact suggests that the myth respecting Amitabha, his "Western Paradise," and his spiritual son Avalokitesvara was due to a foreign westerly element, and most probably a Christian one. It is not Hindu, yet it sprang up in Southern India and probably on the Malabar coast where Christianity first appeared in India. This seems suggestive of an early influence affecting Buddhism from a Christian source, whether directly missionary, or indirectly through Alexandrian merchants trading with Barugaza (Broach) and other parts on the west coast.

Elurā, the last station visited, is noticeable for the temple of Ahalyabai (1765--1795), a good specimen of Hindu architecture, surmounted with a beautifully sculptured square pyramidal tower or *sikhar* rising in five tiers over the shrine. The survey of the famous and very extensive series of caves, Buddha, Brahmanical, and Jaina, at this place, was begun in 1876, and carried on during the greater part of the working season of 1876-77, when it was completed. But the account of them and of the other groups of cave temples is reserved for a special work now in active preparation by Mr. Burgess and Mr. J. Fergusson.

Mr. Burgess winds up his report with notes on a variety of inscriptions, some from the more northern districts, translated by Dr. Bühler, and twenty-eight from the Belgaum and Kalādgi districts, chiefly from his First Report, and now transliterated and translated by Mr. J. F. Fleet, Bo. C.S.

The subject of Indian inscriptions is closely connected with Indian archaeological research, for by it the chronology and sequence of old dynasties, on which the history of the past is largely recorded, can be ascertained. Hindu literature scarcely supplies any works

of a historical character, and it is fortunate that this want is compensated for by many contemporary records in the shape of inscriptions, which really served as the title deeds of the grants and endowments made by kings and chiefs to temples and religious communities. Some of these inscriptions are on rocks, some on the pillars and walls of temples, others on large stone slabs set up in public places, and others engraved on plates of copper held together by rings, to which is attached the seal of the reigning dynasty. Sir Charles Wilkins, General John Carnac, Sir John Shore, and others, who rallied round Warren Hastings and Sir William Jones, some 90 years ago, to form the Asiatic Society of Bengal, fully recognised their historical importance, and began to collect and investigate the contents of inscriptions. During the first years of the century Colonel Colin Mackenzie is said to have prepared copies of 8,076 inscriptions in Southern India altogether. These however, have never been properly deciphered, and the original copies have lain for many years in the India Office archives. Buchanan-Hamilton also collected many inscriptions, of the value of which nothing is known. During his long residence in India Sir Walter Elliot, K.C.S.I., spared no pains in collecting impressions of copper-plate grants and transcriptions of stone-tablet inscriptions, and by means of them was able to establish the chronology of the great Chalukya dynasty of the Canarese and Maratha countries (400-1100 A.D.), and other dynasties.

Early in 1851 the Bombay Cave Temple Commission called attention to the subject of inscriptions, and obtained the appointment of Lieut. Brett to copy and take impressions of them. Reduced copies of these lithographs, with the Rev. Dr. Stevenson's tentative translations, were published in the Journal of the Bombay Branch of the Royal Asiatic Society. A few years after, the same commission strongly recommended the publication of facsimiles of inscriptions with decipherments and translations, such a *corpus inscriptionum* being very important from an antiquarian and historical point of view. In accordance with their recommendation, Vishnu Sastri Bapat was appointed as pandit, and he copied and translated into Marathi some 88 Pali and Sanskrit inscriptions; but the death of the pandit ensued, and for the time nothing more was done.

About 15 years ago, however, Her Majesty's Government began to take a keener interest in such inquiries. In 1865 there were printed a few copies of a photographic collection of 149 inscriptions

on copper-plates and stone tablets at various places in the Mysore territory from negatives taken by Lieut.-Colonel Henry Dixon, and purchased by the Secretary of State. About the same time the Committee of Architectural Antiquities of Western India was formed, under whose auspices the Mr. T. C. Hope, of the Bombay Civil Service, edited and printed a collection of 64 inscriptions from stone tablets in temples and rocks in Canara, Bellari, and Mysore, the photographic negatives of which had been taken by the late Dr. Pigou and Colonel Biggs. These volumes probably helped to keep up the interest in the subject, and in 1870 the Duke of Argyll, then Secretary of State for India, forwarded to the Bombay Government a scheme for the collection and preservation of ancient Canarese inscriptions, suggesting that those collected by Sir Walter Elliot should be revised and compared with the originals, that any new ones should be added, and the entire series published. The difficulties of the work, however, prevented this scheme from being carried into effect. The starting of the "Indian Antiquary," in 1872, and the commencement of the Archæological Survey of Western India in 1874, helped materially towards the acquisition of perfect copies of inscriptions, and a yearly grant, made by the Secretary of State in Council to the first named publication, has been of immense service in enabling that journal to publish a large number of facsimiles of inscriptions, (including many of Sir Walter Elliot's), along with their transcriptions into modern characters, and translations.

Of the two above-mentioned collections, however, so few copies were available for reference, that the Secretary of State has sanctioned the printing of a new volume* composed of Colonel Dixon's, Colonel Biggs's, and Dr. Pigou's collections, supplemented by photographs and lithographs from estampages and rubbings made by the Archæological Survey of Western India and by Mr. Fleet, and by reproductions of copper-plate grants from various sources. The total number is 287. This collection does not embrace nearly the whole of the inscriptions from Western India and the Dekkan at present available. Sir Walter Elliot possesses a large series of copper-plate grants of the Vijayanagara and other dynasties, while others exist in other private hands both in India and Europe,

* Archæological Survey of Western India.—Pali, Sanskrit, and old Canarese inscriptions from the Bombay Presidency, and parts of the Madras Presidency, and Maisur. Arranged, &c., by Mr. J. F. Fleet, B.A., C.S. under the direction of Mr. J. Burgess, M.R.A.S., &c. London, 1878.

in the India Office Library, in the Royal Asiatic Society, in the Bombay Asiatic Society, and in the British Museum. Fresh inscriptions are also constantly being found and increasing the mass of those awaiting publication. These records contain such ample materials, available nowhere else, for elucidating the history, the religious and social life, the origin and growth of the alphabetical characters, and the development of the vernacular languages throughout India, that it appears desirable, at a time when Prussia and France are doing so much for Latin, Greek, and Semitic inscriptions, that some steps should be taken for promptly and systematically recording the fast disappearing Indian inscriptions.

The *Indian Antiquary*, referred to above, continues, with the help afforded to it by Government, to fully maintain its reputation of being the best means of making at once known all the most recent information on Indian archæology.

During the present year, Major Watson has published in it some fragments relating to Anandapura, in Saurashtra, in connexion with the question whether it is, or is not, the Anandapura of the Chinese pilgrim Hwen Thsang. The evidence is rather against the actual identity of the two towns, though the modern city may have been founded on the site of an ancient city of the same name. Sir Walter Elliot has furnished some interesting notes on a singular hypæthral temple in Orissa, which is evidently deserving of a minute examination and a detailed report, and has given an account of an edifice, formerly known as the Chinese or Jain pagoda, at Negapatam.

Mr. Fleet's series of Sanskrit and old Canarese inscriptions embraces grants of the Eastern and Western Chalukya, the Kadamba, the Ganga, and the Sendra dynasties, with incidental disquisitions, the importance of which will be recognised when the time comes for piecing together the ancient history of the south and west of India. By no means the least important of his papers are those which give in detail the two forged grants of the Western Chalukya kings, Pulikesi I. and Vikramaditya I., and these expose the two errors which have led to so much confusion in the early chronology of this dynasty.

Dr. Burnell has given a valuable contribution on the locality of the Southern Charitrapura of Hwen Thsang. There appears to be

little doubt that he is correct in identifying it with the once famous port of Kaveripattana, the *Chaberis emporium* of Ptolemy.

Some further important grants of the Gurjara and Valabhi dynasties are given by Dr. Bühler, who also indicates reasons for doubting the accuracy of referring the dates of the Valabhi plates to the Gupta era, commencing in A.D. 319, and enunciates his own opinion that the initial date of the era of the plates must fall either shortly before or shortly after A.D. 200. Further researches may probably justify this opinion, but may at the same time render it necessary to carry back the initial date of the Gupta era to the same epoch, and thus to make the Gupta and the Valabhi eras still identical, as they are now held to be, though they will both start from an earlier initial date than is now allotted to them, chiefly on numismatical grounds. At p. 141, Vol. VII., of the "Antiquary" Dr. Bühler has given further notice of the three new edicts of Asoka, published by him at Vol. VI., p. 149. The historical value of these new edicts lies in the facts that, 1., they fix absolutely the length of time which elapsed between Buddha's *nirvana* and Asoka; 2., they prove the accuracy of the chronology of the southern Buddhists, as far as India is concerned; 3., their *data*, together with the information of the Greek historians, prove the *nirvana* of Buddha to have taken place between B.C. 483-2 and 472-1; and, 4., they indicate the direction in which future efforts to fix the exact date of Buddha's *nirvana* should be made.

Some interesting Hindu and Jain remains at the ruined capital of Bijapur and in its neighbourhood are noticed by Mr. Sinclair at p. 121.

At p. 168, Mr. Rice has published two new grants of the Ganga kings, the dates of which are interpreted by him as A.D. 350 and A.D. 481 respectively. The real era of these kings is as yet very doubtful, inasmuch as Mr. Fleet's stone tablet inscriptions at p. 101-112, make them several centuries later than the copper-plate grants given here and elsewhere by Mr. Rice.

The Editor, at p. 196, has given a valuable contribution in translating, from M. Stanislas Julien's French work, Hwen Thsang's account of Harshavardhana. The want of a carefully revised and annotated translation, this time in English, of the Chinese pilgrim's works has been much felt for a long time past; there are hopes that it will shortly be supplied.

VII.

INDIAN METEOROLOGY, 1876.

The second Annual Report by Mr. H. T. Blanford, Meteorological Reporter to the Government of India on the meteorology of India, being that dealing with the observations recorded in 1876, was published in the early part of the present year at Calcutta. It deals with a somewhat more extensive area than the preceding report. In India proper, indeed, the system is still incomplete. Five or six additional stations began work during the year under review, but the greater part of Western India was but little better represented than in the preceding year. But to the eastward, two new observatories at Rangoon and Moulmein extend the area of discussion to Pegu and Tenasserim, and bring into view, for the first time, the distribution of temperature and pressure far down on the eastern margin of the Bay of Bengal, while away to the west the establishment of an observatory at Bushire, at the head of the Persian Gulf, supplies a link in the connection of the Indian system of registration with that of Europe and Western Asia. During the year 1877 additional observatories have been started at Bassein in Pegu, Mergui in Tenasserim, and Quetta in Baluchistan. Most of the new stations in Bombay, Central India, and Rajputana will also contribute registers for 1877. In India additional registers for 1876 are furnished at Peshawar, in the extreme north-west of the British possessions and at Sirsa on the northern margin of the western desert; at Mount Abu, at a height of about 4,000 feet on the southern confines of the same; at Bhuj in Cutch, at Sutna, half way between Allahabad and Jubbulpore, linking the Gangetic plain with the more elevated tract forming the Central Provinces; at Sironcha on the Godavari, which, through Secunderabad, helps to connect the latter region with the Madras system, and to push the network of stations one step further into the wild and unrepresented country about the Lower Godavari. The number of rainfall stations has been much increased, 28 additional having been started in the Madras Presidency, and 43 additional in the North-west Provinces, the Central Provinces, and Berar. Rajputana, with Central India, and British Burma are still imperfectly represented, but Mr. Blanford hopes to remedy this

shortly. He regrets his inability to obtain more data regarding the average values of the chief meteorological elements in the Madras stations, the tables for which are very deficient, although the meteorology of that presidency is invested with exceptional importance in the light of the recent disastrous famines.

It is the great failure of the rainfall which lends special interest to the meteorology of the year 1876, and the analysis of this phenomenon Mr. Blanford has kept steadily in view in his report. Mr. Meldrum's researches, it is known, have drawn attention to the apparent cyclical variation of rainfall, and its coincidence in a greater or less degree with the cyclical variation in the number of sun spots. While acknowledging the persistence of this phenomenon, Mr. Blanford shows, that according to Mr. Meldrum's own researches, the total cyclical variation in the course of two cycles does not exceed 15 per cent. of the whole, and that to that extent *only* are we justified by proof in regarding the rainfall of India as a recurrent phenomenon. The great fluctuations, alternately productive of flood or famine, are therefore mainly non-periodic and local. Thus in 1877, there has been an almost complete failure of the summer monsoon rainfall in the Upper Gangetic valley, and a large part of Central India, Rajputana, &c., while the rain withheld from these provinces was poured out over the Bay of Bengal and the Burmese peninsula, and while the cultivator of Upper India has watched his weakly sprouted *sorghum* withering to hay under the unclouded sun and the dry hot blast from the western desert, his Burman brother has seen his vigorous rice crops washed away and drowned beneath the wide spreading floods of the overcharged Irawadi.

The discussion of the results for 1876, with the averages deduced from previous registers, and the tabulation of the several anomalies, month by month, confirm the idea that abnormal as well as normal conditions are remarkably persistent in India. The failure of the rainfall in the peninsula, and its deficiency in the Upper Gangetic Provinces are traceable to the remarkable persistency of northerly or land winds, which again are evidently connected with certain anomalies in the distribution of the pressure, which were manifested in the previous year but were more intense in 1876, and presented some new and probably important features.

The meteorology of the year is described under the following headings:—(i.) Temperature of solar radiation; (ii.) Temperature of nocturnal radiation; (iii.) Air temperature; (iv.) Atmospheric pressure; (v.) Anemometry; (vi.) Hygrometry; (vii.) Cloud proportion; and (viii.) Rainfall.

As already remarked, the most important and striking fact in the meteorology of 1876 was the failure of the rainfall in the Presidencies of Madras and Bombay, and its partial failure in a large portion of the North-west Provinces, more especially the Gangetic plain north of the river, and in some parts of the Central Provinces.

In Madras, with the exception of the low country below the Western Ghats, the failure was almost universal, while on the other hand, the extreme western and northern districts of the Bombay Presidency, where the rainfall is as a rule precarious and uncertain, did not participate in the general calamity. In Sind, indeed, the rainfall was somewhat in excess of the average amount, and along the extreme north of the Punjab, both on the Himalaya and at stations along the foot of the hills, the fall was considerably greater than usual. At Darjeeling, it was somewhat greater, but over the districts at the foot of the Sikkim Himalaya, and on the low valley of Assam there was a considerable deficiency. It was limited, however, to these tracts, since the Gangetic delta, Silhet, and the south-east of the Bay of Bengal received an excessive supply, the latter especially in the last three months of the year, when the south-west current, influenced by the rise of pressure over Northern India, recurves cyclonically around the Bay of Bengal, and discharges its burden of vapour on the south-east coast of the peninsula. In 1876 the rainy monsoon of the Carnatic failed almost completely, but only on the Madras coast. On the east coast of Ceylon, which also participates in the rains of that season, the fall was on the whole an average one.

These facts show, in Mr. Blanford's opinion, that the failure of the rainfall was essentially a local phenomenon, affecting indeed a large part of India, but not universal, and compensated by an increased fall around the borders of the area. It may be inferred from the researches of Mr. Meldrum, that 1876 was a year of less than the average rainfall, since it was a year of few sun spots, and, as referred to above, his statistics collected from large areas, both in the northern and southern hemispheres, tend to show that, in the

first or second year following that of maximum sun spots, the total precipitation is about 8 per cent. above, and, in one or two years in anticipation of the minimum period, 7 per cent. below the average. To this extent, and no more, Mr. Blanford points out, can our present knowledge justify us in attributing the deficiency or excess of rainfall in any part of the world to the immediate influence of the corresponding cyclical variations in the condition of the sun. Possibly, in some portions of the earth's surface local geographical peculiarities may serve to exaggerate, diminish, or even reverse these effects, but at present this is mere surmise.

The first striking peculiarity in 1876 is the apparently unusual prevalence of northerly and north-westerly winds in the Central Provinces and Berar, and of westerly winds in the Upper Gangetic Provinces. For years previous to 1875 there are unfortunately no data available, but, as compared with that year, the northerly tendency of the winds on the Dekkan plateau was very characteristic and probably abnormal, and equally so was the prevalence of north-westerly winds in the eastern part of the peninsula in October and November, when, as a rule, east and north-east winds bring the monsoon rainfall of the Carnatic. Hence it may be asserted in general terms that the land winds, varying in direction according to the locality, predominated throughout the greater part of the year, and that the replacement of the usual sea winds by these outflowing dry currents from Upper India and the interior, may be assigned with most probability as the proximate cause of the failure of the peninsula rainfall.

Proceeding a step further, Mr. Blanford shows that the relatively high pressure at Bombay, combined with the low pressure of Orissa, must have tended to impress a northerly or north-westerly direction on the movement of the air in Berar and the Central Provinces, while the depression about Benares and Patna, with a relatively high pressure to the westward, would intensify the north-west winds of the Upper Provinces and the westerly winds to the south of the Ganges. Taken together with the Orissa depression to the south-east, the excess about Chittagong would increase the strength of the southerly current from the bay across Bengal, which would then turn and blow along the mountains as a south-east and east wind to the northern side of the Gangetic plain, accounting for the excessive precipitation in that quarter above referred to. This rain on the

outer hills is generally accompanied by snow on the main and higher ranges, and the snow of the early spring of 1877 appears to have been considerable and late.

To this unusually late and copious fall of rain and snow on the Punjab and the North-west Himalaya may, in Mr. Blanford's opinion, be ascribed the comparative dryness of the Upper Provinces and the plateau south of the Ganges, but he considers there were doubtless other, and probably independent causes, which contributed to the general result, more especially as regards Southern India, and for the elucidation of these we must look forward to the gradual development of the *rationalis* of meteorological processes.

Mr. Douglas Archibald, of the Bengal Educational Department, and Mr. S. A. Hill, the Meteorological Reporter of the North-west Provinces, have suggested that in years of minimum sun spots the winter rains of Upper India are more copious than in years of maximum sun spots, thus reversing for that tract and season the law of total annual rainfall arrived at by Mr. Meldrum. For this theory there is *prima facie* evidence apparently borne out by the fact that some of the most severe famines of Northern India, *e.g.*, those of 1837-38 and 1861, have occurred immediately after years of maximum sun spots.

During the present year, Part II. of the first volume of the *Indian Meteorological Memoirs* was issued. It contains three papers; the first (No. IV.) by Mr. J. Elliot, M.A., Meteorological Reporter to the Government of Bengal on Storms in Bengal during the year 1876, accompanied with increased atmospheric pressure and the apparent reversal of the normal diurnal oscillation; the second by Mr. S. A. Hill, B.Sc., Meteorological Reporter to the Government of the North-western Provinces and Oudh, on the rainfall of Benares considered in relation to the prevailing winds; and the third by Mr. H. F. Blanford, on the diurnal variation of the barometer at the Indian stations.

During the present year, an important work by Mr. Charles Chambers, F.R.S., Superintendent of the Colaba Observatory, Bombay, has been published in England, by order of the Secretary of State for India. Its title is "The Meteorology of the Bombay Presidency;" it is divided into four parts, with an Appendix, and

is accompanied by a portfolio of charts and diagrams. The first part gives a very brief sketch of the history and character of the Colaba Observatory, an account of the records, and an examination of the results deduced from the observations, both as to the typical character of the climate of Bombay and its periodical variations.

Colaba Observatory is situated at the extremity of a narrow strip of land extending two miles to the south-west of the Fort of Bombay. The main building was designed for an astronomical observatory and was erected in 1826, but the scheme fell through.

No meteorological observations taken at the Observatory are on record till the year 1841, when, on the recommendation of the Royal Society, the Observatory became associated in the prosecution of magnetical and meteorological research with the British colonial observations of Toronto, St. Helena, the Cape of Good Hope, and Hobarton, and with the Indian Government observatories of Madras, Singapore, and Simla. Its active life must be reckoned from this date. Its first director was Mr. Arthur B. Orlebar, Professor of Astronomy and Mathematics in the Elphinstone College, who appears to have displayed great judgment in the conduct of the magnetic and meteorological observations.

The discussion of all the phenomena, except rainfall, have been confined to the manuscript abstracts of the years 1844 and 1847 to 1872. These comprise observations of the barometer, dry and wet bulb thermometers, the degree of cloudiness, temperature of the ground, rainfall, and direction and movement of the wind. These are followed by a brief chapter on the comparison of the diurnal variations of different phenomena.

Part II. of the work deals with the observations at the five (so-called) military stations in the Bombay Presidency, and the observations there recorded. These observatories were organised in consequence of a representation made to the Court of Directors of the East India Company by the Imperial Government, who in 1851 had instituted a system of meteorological observations at a number of military stations in the United Kingdom and in the Colonies, which were supplemented by others carried on on the same system at other stations under the Admiralty. Of the five observatories in the Bombay Presidency, four—at Belgaum, Poona, Deesa, and Karachi, were in charge of the senior medical officers of

the European hospitals at the several stations, and one, at Bombay (Colaba), in charge of the Superintendent of the Colaba Observatory, and all five were kept up till the end of March 1876, when they were merged in the general organisation of meteorological observations instituted by the Government of India. The system comprised two sets of observations every day at 9.30 a.m. and 3.30 p.m., and a complete set of 24 hourly observations for one day in every month, comprising observations on the barometer, dry and wet bulb thermometers, direction of wind, cloudiness, and rainfall. Once a day the maximum and minimum thermometers were exposed. With certain exceptions (the most numerous of which are in the case of the Belgaum, Deesa, and Kurrachee observations) the series is available for 17 years—from 1856 to 1872.

Part III. contains a disquisition on the temperature of the Presidency, based upon the records of temperature at Colaba and the four military stations, and at a small number of other stations, the printed sheets of observations of the Goa Observatory, the Report of Mr. James Glaisher "On the Meteorology of India," and the fourth or meteorological volume of the Messrs. De Schlagintweit's India and High Asia. In the concluding Part (No. IV.) an effort is made to connect together some of the general phenomenal results that have been arrived at.

VIII.

STATISTICAL SURVEY AND IMPERIAL GAZETTEER OF INDIA.

The operations connected with the Imperial Gazetteer of India range themselves under two heads: the Statistical Survey of India carried out, district by district, with a view to the collection of local materials, and the Imperial Gazetteer, in which those materials are condensed into a concise alphabetical form. In the second edition of the *Memoir on the Indian Surveys*, an account was given of the progress of the first of these two operations up to the 31st of May 1876. It is unnecessary therefore to do much more here than review the progress which has since been made. On the 31st May 1878 the state of publication of the results of the Statistical Survey was as represented in the following statement.

Province.	Area in Square Miles.	Population.	Number of Districts compiled May 1878.	Number of Vols. and Pages printed.						Districts remaining to be compiled 31st May 1878.	Name of Provincial Compiler.
				May 1876.		May 1878.		Vols.	Pages.		
				Vols.	Pages.	Vols.	Pages.				
1. Bengal	196,942	62,815,370	47	13	5,578	20	8,246	Nil	W. W. Hunter.		
2. Assam	53,856	4,132,019	13	Nil	Nil	2	917	Nil	W. W. Hunter.		
3. North-west Provinces	86,528	31,438,217	35	4	2,840	5	3,340	20	{ E. T. Atkinson. A. C. Tapp. H. C. Conybeare.		
4. Punjab	219,610	22,956,970	32	30	2,440	32	3,000	Nil	E. J. Cunningham.		
5. Oudh	23,992	11,220,232	12	1	500	3	1,737	Nil	{ C. McMin. Dr. Selons.		
6. Central Provinces	113,797	9,251,229	19	1	769	1	769	Nil	C. Grant.		
7. Bombay and Sind	191,834	23,180,721	24	2	1,230	2	1,474	15	{ J. M. Campbell. A. W. Hughes.		
8. Madras	147,789	34,962,005	21	5	3,086	6	3,476	15	The District Officers.		
9. Berar	17,631	2,226,496	6	1	317	1	317	Nil	A. C. Lyall.		
10. Mysore	29,325	5,055,412	8	1	500	2	1,249	Nil	L. Rice.		
11. Coorg	2,000	168,312	6	Nil	Nil	1	312	Nil	L. Rice.		
12. British Burmah	88,556	2,747,148	15	Nil	Nil	1	264	Nil	Captain Spearman.		
13. Ajmere and Mhairwara	2,711	396,889	1	1	104	1	104	Nil	J. D. La Touche.		
14. Aden	35	22,722	1	Nil	Nil	1	235	Nil	Captain F. M. Hunter.		
	1,174,606	210,573,742	240	59	17,324	78	25,440	50			

The Statistical Survey is now completed for four-fifths of British India, that is for 190 out of 240 districts, and 78 volumes of statistical accounts, aggregating 25,440 pages, have been printed.

In BENGAL (population 62,815,370; 47 districts), by which is meant the province under the Lieutenant-Governor of Bengal, comprising a third of the population of British India, the work was entrusted to Dr. Hunter, as Provincial Compiler, in addition to his duties as Director-General of Statistics. The work of collecting the materials and personally visiting the districts occupied him till 1874. The compilation was then started, and the work had made some progress, when the high cost of literary compilation in India and the magnitude of the undertaking, made it apparent to the Government that the work would be cheaper done in England. Estimates were framed, and, it having been calculated that the adoption of this plan would reduce the period from four years to 23 months, and the cost from 17,000*l.* to 5,450*l.*, the arrangement was sanctioned, and Dr. Hunter was directed to proceed to England with all his materials and there engage a literary staff. The result has justified the expectations of the Government. On the 16th of November 1876 the Statistical Account of Bengal was completed in 20 volumes, aggregating 8,246 pages, and on the 20th December 1876 the Lieutenant-Governor published in the "Calcutta Gazette" the final orders of the Government.*

* Extract from the Orders of the Government of Bengal, No. 4045, dated Calcutta, 20th December 1876.

Para. 3. "Sir Richard Temple cannot but regard these results with high satisfaction. He regards them as eminently creditable to you. Every volume of the Statistical Accounts has passed under his own personal supervision, and he is able, therefore, to testify to the quality of the work. The thanks of the Government of Bengal are emphatically due to you for the vigour and energy with which you have accomplished the collection of such diverse and varied information, and for the ability and literary skill which you have uniformly displayed in dealing with, sifting, and analysing and arranging materials supplied to you from so many quarters.

Para. 4. "The Lieutenant-Governor's thanks are also accorded to the Assistants who have laboured under your directions in compiling several of the Accounts. The names of Mr. J. S. Cotton, late Fellow and Lecturer of Queen's College, Oxford; Mr. H. H. Risley, of the Bengal Civil Service; and Mr. C. A. Dollman, are especially mentioned in your letter. I am to request that you will communicate to each of these gentlemen an expression of the Lieutenant-Governor's thanks and approbation of their work.

5. "It only remains that the Lieutenant-Governor should record his further

ASSAM. — Population, 4,132,019; 13 districts. The Statistical Account of this Province was also retained in Dr. Hunter's own hand as Provincial Compiler. By 1875 the materials were collected, and they were revised on the spot at intervals during the next two years. But on visiting the Province in 1876, Dr. Hunter found that the late administrative changes since Assam had been erected into a separate Chief Commissionership necessitated further revision, which Dr. Hunter carried out. The brief period which has elapsed since these administrative changes has rendered it impossible for the District Account to be brought up to the standard aimed at in the Statistical Accounts of the older Bengal districts. The work for Assam is completed in two volumes, aggregating 917 pages, and its publication only awaits the maps now on their way to England.

NORTH-WEST PROVINCES. — Population, 31,438,217; 35 districts. The compilation of the Statistical Account was here entrusted to a special officer. In 1876 four volumes, comprising 13 districts, and aggregating 2,840 pages, had been printed. In 1876-77 the Provincial Compiler was withdrawn from special duty, since which time one more volume has been printed, and two districts have been compiled. A series of brief district abstracts have been therefore obtained from the compiler and his *locum tenens*, to serve as materials for the Imperial Gazetteer, but it is not possible as yet to assign a date for the completion of the Gazetteer.

PUNJAB. — Population, 22,956,970; 32 districts. The work was here made over to a member of the Lahore Bar, and the 32 districts are treated of in 32 small volumes, aggregating about 3,000 pages. The Punjab volumes Dr. Hunter considers susceptible of much improvement, but at the same time he thinks it would be inexpedient to attempt a revised edition before the next Census of 1881, the last enumeration of the people having been made in 1868, before the

acknowledgments to the District and Sub-divisional Officers under the Government of Bengal, who, with great personal trouble, have supplied, from their local knowledge and resources, the detailed information on which the whole of the Statistical Account of Bengal is necessarily based. The active co-operation of all officers in Bengal has, as you fully acknowledge, at all times been cordially extended to you in your inquiries. The Lieutenant-Governor congratulates you and your Assistants, and the District Officers of Bengal generally, on the successful completion of the Statistical Account of Bengal."

principles of the Indian Census had been elaborated. The present edition of the Punjab Statistical Accounts, together with the valuable settlement reports of the various districts, and the yearly administration returns yield fairly adequate materials for the Punjab articles in the Imperial Gazetteer.

In the SEVEN MINOR ADMINISTRATIONS the work has been much less complicated, and the Statistical Accounts for all of them are now complete. They comprise (1) Oudh, (2) Central Provinces, (3) Berar, (4) Mysore, (5) Coorg, (6) British Burmah, and (7) Ajmere with Mhairwara, having in all 67 districts and an aggregate population of 31 millions. In these minor administrations the complexity and difficulties were incomparably less than in large and powerful administrations like Bengal, Madras, and Bombay, which were each characterised by local developments and divergencies. The chief difficulty in the case of the minor administrations has been in the scanty resources of the local printing offices. The work has been done with very different degrees of accuracy and completeness; but of Mysore, Dr. Hunter observes that the volumes compiled by Mr. Lewis Rice, Director of Public Instruction (who has also compiled that for Coorg), are better than anything he himself has been able to do even for Bengal. Mysore will shortly return to native rule, and these volumes form an invaluable record of what an episode of honest English administration has effected for an Indian State. The accounts for the Central Provinces and Berar were practically done before the present statistical operations commenced. Dr. Hunter pronounces them excellent of their kind, and he is now revising them by the light of recent returns and administrative reports for articles in the Imperial Gazetteer. The Statistical Account of Ajmere and Mhairwara as first compiled proved to be inadequate, but the renewed operations have since been carried out by an able Settlement officer in addition to his other work. Those for British Burmah have occupied a longer period, but the whole is being now printed off. They contain a striking picture of the meaning of English rule in a backward Province. What were fishing hamlets or mud banks when the country passed into our hands are now busy harbours and populous centres of commerce.

BOMBAY AND SIND.—Population, 23,180,721; 24 districts. The

work here has been much delayed, the Provincial Compiler having been often withdrawn to compile the Annual Administration Report of the Presidency, and Dr. Hunter has consequently arranged for the supply of a series of brief abstracts for the purposes of the Imperial Gazetteer. According to the most recent information, four districts accounts of the Bombay Presidency (exclusive of Sind) have been compiled, leaving 15 still to be completed. The Statistical Account of Sind, which in some respects forms a minor administration, was admirably done by Mr. A. W. Hughes of the Uncovenanted Service, and a second edition has been published in England. Mr. Hughes has also lately put forward a very useful work on Baluchistan.

MADRAS.—Population, 34,962,005; 21 districts. The arrangements adopted in 1862 provided for the preparation of a "Manual" for each district, and since the issue of those orders six* have been completed, 15 remaining uncompleted. A series of abstract accounts of the uncompleted districts has, however, been furnished for the purposes of the Gazetteer, but the completion of the District Accounts is still unprovided for.

ADEN.—Population, 22,722; 1 district. An account of this Settlement has been prepared by Captain F. M. Hunter, First Assistant Resident.

Summarising the operations in British India, it may be observed that during the past seven years the operations have been completed and the Statistical Accounts printed for four-fifths of British India, including all the eight minor administrations, including Assam, and two of the five first-class governments, viz., Bengal and the Punjab.

The scope of the Imperial Gazetteer was thus defined by the Secretary of State.† "The Imperial Gazetteer will be the condensation and fruit of a series of Statistical Surveys of each of the Administrative or Political Divisions of India, specially and minutely compiled within moderate limits of time; and it will thus occupy a very different position from all previous essays in this direction, in which the materials were derived in part from data which were

* Bellary, Cuddapah, Godavari, Madura, Nellore, and Vizagapatam.

† Despatch from the Secretary of State to the Governor-General of India, dated 22nd February 1877.

frequently far from contemporaneous, and often no better than the chance records of travellers."

As the Secretary of State's Despatch of 1867 had led to the organisation of the Statistical Surveys in 1871, so the Despatch of 1877 formed the basis of the Imperial Gazetteer. Under its instruction Dr. Hunter organised an office and staff in Edinburgh, by the members of which the various articles are being prepared under his general supervision. As an administrative guide-book the Gazetteer will be somewhat impaired by the statistics not being brought up to date, the census of 1872 being still the basis of Indian statistics for most of the provinces, and this necessitating contemporaneous statistics for all the various branches of the Administration. Complete uniformity has not been attainable owing to the various changes made since, such as the creation of Assam into a Chief Commissionership, and the amalgamation of Oudh with the North-west Provinces. The figures will, however, represent the facts substantially between 1872 and 1878.

As a book for general information the Imperial Gazetteer will, Dr. Hunter fears, be deficient in archæological details, as the Archæological Surveys of India and Bombay are still at work, and that of Madras is not yet begun. The Statistical Survey of India was deficient too, in the fact that the Native or Feudatory States were omitted from its scope. A special assistant, Mr. Roper-Lethbridge, has, however, been appointed to compile (in communication with the Foreign Department, Calcutta) articles on the Native States for publication in the Imperial Gazetteer, and Dr. Hunter considers that those already prepared mark a vast stride in advance beyond anything that has hitherto been done towards the elucidation of the Native States. The Imperial Gazetteer will also contain, for the convenience of reference, articles on independent neighbouring States beyond the British frontier, but these will be compiled simply from materials already before the public, and will be of a strictly non-official character. The identifications of names of places will be provided for by the insertion of the co-ordinates of latitude and longitude, which will be furnished by the Surveyor-General of India.

The Imperial Gazetteer will contain from five or six to 20 or 30 names for each district of British India. These names will include those of (a) the Presidencies and Provinces; (b) all Divisions

or Revenue Commissionerships; (c) Districts, Collectorates or Deputy Commissionerships; (d) all Sub-districts in Provinces where the sub-divisional system has been introduced, and where this has not been introduced; (e) the separate administrative unit such as the *tāluká* or other rural area with local court-house and an executive officer in charge; (f) any Native States or foreign territories; (g) important hills or ranges; (h) important rivers, lakes, marshes, or canals; (i) towns containing 5,000 inhabitants, and in addition (j) all municipalities or towns and rural unions with a municipal constitution; (k) trading and manufacturing towns; (l) places of historical interest, battle fields, old fortresses, scenes of great religious gatherings, and plans of architectural interest. Besides the above, all military cantonments or fortresses in occupation by troops (but not temporary outposts), and features of the coast in maritime districts, such as ports, harbours, really important roadsteads, capes, lighthouses, islands, &c.

The spelling of the proper names in the Gazetteer will be regulated according to the Provincial Lists prepared for each Province of British India. Those for Madras and British Burmah have, however, not yet been received, so that the amalgamated index, which will probably contribute more than anything else towards the eventual general adoption of the scheme resolved upon, cannot be yet prepared. With the exception of the names which are supposed to have acquired a fixity of spelling in British India, the proportion of which to the bulk of the names varies considerably in the different Provinces, the system will be in accordance with that advocated by Dr. Hunter, which adopts a uniform value for each letter, and takes as its basis the Indian vowel sounds of *a* and *u* as in *rural*, *e* as in *grey*, *méchant*, and *i* and *o* as in *police*.

IX.

TRANS-FRONTIER EXPLORATIONS, AND MISCELLANEOUS.

During the year 1876, "the Mullah," one of the native explorers attached to the Great Trigonometrical Survey Department, made a survey of the Indus from Amb, where it enters the plains above Attock, to its confluence with the Gilghit River. All other portions of the course of the Indus, from its source in the plateau of Tibet to its mouth, have long since been surveyed, but hitherto

this portion has been merely "dotted in" on our maps. Here it traverses a distance of some 220 miles, descending from a height of about 5,000 to 1,200 feet above sea level. Its course is tortuous, amid encompassing ranges, the peaks of which are rarely less than 15,000 feet in height, and culminate to the north in the well-known giant mountain Nanga Parbat, 26,620 feet high. In many places the river is hemmed in so closely by these great ranges that its valley is but a deep-cut narrow gorge, and as a rule there is more of open space and culturable land in the lateral valleys than in the principal valley itself.

The positions and heights of all the most commanding peaks in this region had been long fixed by Captain Carter's observations at trigonometrical stations on the British frontier line, and some native itineraries collected by Dr. Leitner were combined by Mr. E. G. Ravenstein in a map published in the "Geographical Magazine" for August 1875. No European or scientific traveller, however, is known to have penetrated into it. It is very difficult of access from all quarters, and is inhabited by a number of hill tribes, each independent and suspicious of the other, who are in a great measure separated and protected from each other by natural barriers and fastnesses. As a whole the region has never been brought into subjection by any of the surrounding Powers. Each community elects its own ruler, and has little intercourse with its neighbours, and with the outer world communicates only through the medium of a few individuals who have the privilege of travelling over the country as traders. The Mullah possesses this privilege, and thus in the double capacity of trader and explorer, he traversed along the Indus, and through some of the lateral valleys, leaving the others for exploration hereafter.

This work done, he proceeded, in accordance with his instructions, to Yassin, marching through the Gilghit Valley, but not surveying it, because the labours of the late Captain Hayward, who was murdered at Yassin, already supplied a good map of that region. From Yassin he surveyed the southern route to Mastuj through the Ghizar and Sar Laspur Valleys; this has furnished an important rectification of a route which had hitherto been laid down from conjecture only, and very erroneously; for the road, instead of proceeding in a tolerably straight direction from Yassin to Mastuj, as was supposed, turns suddenly from south-west to north-north-

east at Sar Laspur, which is situated at some distance to the south of the direct line, in a valley lying parallel to the valley of Chitral. At Mastuj the Mullah struck on to his old survey of the route from Jelalabad, *viâ* Dir and Chitral, to Sarhadd-i-Wakhan, in 1873, and then proceeded along that route towards the Baroghil Pass, as far as the junction of the Gazan with the Yarkhun River, and then along the northern road from Mastuj to Yassin. This road turns up the Gazan Valley, crosses the Tui or Moshabar Pass—which is conjectured to be not less than 16,000 feet in height—and, after traversing a deep crevassed glacier for a distance of about eight miles, reaches the point where the Tui River issues in great volume from the glacier; the road then follows the course of the river down to its junction with the Warchagam River, a few miles above Yassin.

Returning to Sar Laspur, the Mullah next surveyed the route to the south-west, up the valley leading to the Tal Pass. This pass is situated on a plateau of the range which connects the mountains on the western boundary of the valley of the Indus with those on the eastern boundary of the valley of Chitral, and is generally known by the people of the country as the Kohistan. The sources and most of the principal affluents of the Swat and the Panjkora Rivers take their rise in this region, all the most commanding peaks of which were fixed by Captain Carter's triangulation; but of the general topography of the valleys relatively to the peaks nothing at all definite has been known hitherto. The Mullah has done much to elucidate the geography of this region. On crossing the Tal plateau he descended into the Panjkora Valley, and traversed its entire length down to Dodbah, at the junction of the Dir River with the Panjkora, where he again struck on his route survey of 1873.

As circumstances prevented him from going down the Panjkora to its junction with the Swat River, he travelled along the Havildar's route of 1868 as far as Miankalai, and then surveyed the road to Nawagai and on to Pashat in the valley of Kunar, and, finally, returning to Nawagai, he surveyed the road thence down to the British fort of Abazai.

The explorations of the Mullah have thus added much to our knowledge of the geography of the interesting regions lying beyond our northern Trans-Indus Frontier. A good deal, however, still remains to be done before our knowledge of these regions is as full

and complete as it should be, and Colonel Walker promises that every effort will be made to carry out further explorations as soon as possible.

A sketch map has been constructed to illustrate the Mullah's operations; it also shows the localities where more information is wanted. In the north-east corner the results of a recent reconnaissance of portions of the Karambar and the Nagar Valleys by Captain Biddulph are given, but somewhat modified from his map of the country.

During 1877, Colonel C. M. MacGregor, C.S.I., and Captain R. B. Lockwood, of the Quartermaster-General's Department, made an important reconnaissance of the desert of Baluchistan. The results have been embodied in a cartographic form on the new map of the territories of the Khan of Kelat, published in the Surveyor-General's Office at Calcutta, but the journals have not yet been made public. Starting from Gwadar and Pasni on the Mekran coast, the routes of these two officers soon converge and extend northward towards Kuhak, contributing some additional topography to Major St. John's map. After skirting the Kuhak territory on its eastern side they followed the course of the Mashkel (not Mashkid) River, which is found to bend eastward and then again to the north-west, flowing into a swamp or *hamun*, called Mashkel Hamun, and situated about $28^{\circ} 15'$ N. latitude. They then proceeded due north as far as about $29^{\circ} 13'$, and thence diverged north-westwards to Shah Godar, skirting a range of hills running due east and west, the southern drainage of which converges into the Kindi or Talab Hamun west of the Mashkel Hamun, and the northern face of which drains in the direction of God-i-Zirreh, a salt waste (quite dry at the time visited) which occupies the centre of a depression between the range just mentioned and the Helmand River. Shah Godar, the limit of the journey, is situated on the western bank of a canal flowing into the God-i-Zirreh. On the return journey, Colonel MacGregor crossed several streams running south-west into the Kindi and Mashkel swamps; he then proceeded eastwards between two long narrow ranges of sand hillocks south of the Lora swamp, and crossing (for the second time,) Captain Pottinger's route of 1810, from Nushki to Budu, returned to India by way of Sohrab and the Gundava Pass.

Captain Lockwood took a different route on his return journey. He visited Chageh, on the *hamun*, in which the Lora River deposits

its waters, and the centre of which is situated about $29^{\circ} 20'$ N. latitude and $64^{\circ} 40'$ E. longitude. It appears to be shut in on three sides by sand hills. Skirting the southern side of the swamp he made for Nushki, and returned to India *via* Mustang and the Bolan Pass.

The result of this exploration is to help to fill up an extensive blank in the Baluchistan desert south of the Lower Helmand, and to fix approximately, amongst other things, the position of the depression in which the Lora discharges itself. Another more important result is to shed some further light on the question of the northern boundary of Baluchistan. The published map, above referred to, modifies the northern frontier of the country slightly from the line laid down in Colonel Walker's Turkistan map, and makes it run E.N.E. from Kuh Malik-i-Siyah, then to skirt the southern or left bank of the Helmand, without crossing the river, and then to stretch across the desert towards Quetta. The northern and north-western frontiers of Baluchistan have, however, never been surveyed, so that these lines can only be regarded as approximations.

During the current year the geographical business of the India Office has been transferred to the Statistics and Commerce Department. Among the most important labours of the Geographical Section or Department have been the publication of the General Catalogue of Manuscript and Printed Reports, Field-books, Memoirs, Maps, &c. of the Indian Surveys, deposited in the Map Room of the India Office, and that of the second edition of the Memoir on the Indian Surveys. The scope of these works has been fully described, both in the "Abstracts of Surveys" and in the second edition of the Memoir itself. It only remains to state that the former work forms a volume of over 600 pages, and, by means of the copious index attached, any one can ascertain quickly what geographical information, published or unpublished, is available in the Map Room of the India Office respecting any given locality. The second edition of the "Memoir on the Indian Surveys," is, generally speaking, built on the lines of the first edition, but is brought up to date and includes a review of all Indian geographical operations up to the close of the season 1875-76. It is from the pen of Mr. C. R. Markham, C.B.

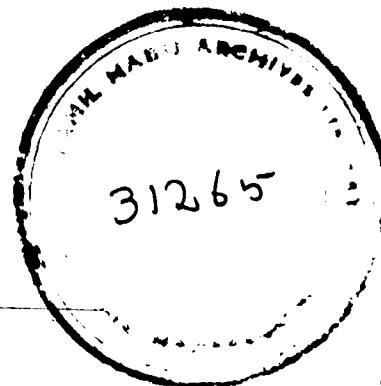
The Map of Afghanistan, mentioned at page 60 of the Abstract for 1874-5, has been nearly completed. This important work, which

has been compiled by Major Wilson from all available materials which could be obtained from the various Government Departments in India, includes the country from Herat to the Indus, and from the Oxus to the Mekran coast. It is contained in 20 sheets, and is on the scale of 8 miles to the inch. All the portion south of the Hindu Kush has been completed and is now undergoing redrawing preparatory to reproduction at the Ordnance Survey Office, Southampton.

CHARLES E. D. BLACK.

Statistics and Commerce (Geographical) Department,
India Office,
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