ABSTRACT

OF

REPORTS OF THE SURVEYS,

AND OF

GEOGRAPHICAL OPERATIONS

IN

INDIA

FOR

1874–75.

GEOGRAPHICAL INDIA

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PREFACE.

THE Annual Abstract of the Surveys and of other Geographical Operations in India during the year 1874–75 is arranged on the plan of the "Memoir on the Indian Surveys" and of the Abstracts for previous years. The intention of these Annual Abstracts is to indicate the more important and interesting operations of the year, previous to the perusal of the detailed reports, with their valuable appendices. They are also designed to be useful for future reference.

The "Memoir" appeared in 1870, and Annual Abstracts have been published in the six succeeding years. In the end of the present year a second edition of the "Memoir" will be published, embodying the contents of the six Abstracts, under the respective heads, and with numerous corrections and additions.

The present Abstract has been somewhat delayed, in order that it might contain a full notice of Captain Taylor's first report on the Marine Survey Department.

The Abstracts for 1873–74 and 1874–75 were prepared by Mr. C. E. D. Black, an officer to whose zealous assiduity and special qualifications I am much indebted in conducting the business of this Department.

CLEMENTS R. MARKHAM.

GEOGRAPHICAL DEPARTMENT,
INDIA OFFICE,
April 1877.

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ABSTRACT.

I.

INDIAN MARINE SURVEYS, 1874–6.

THE Department of Indian Marine Surveys has been officially organized during the latter year under review, and the provision of this most necessary work may therefore be said to be now permanently secured.

According to a resolution[1] of the Government of India, published in the Gazette, the duties to be discharged are as follows:

Systematic surveys of the coasts of India are to be carried on with suitable vessels efficiently equipped and manned. These surveys are to be connected with the shore surveys, and closed in on points already fixed by the Great Trigonometrical Survey. The original surveys of ports, harbours, and river entrances will be photozincographed, and issued for local navigation and engineering purposes, and from them charts of the coast will be compiled on a medium scale for the purposes of general navigation. Copies of all original surveys will be forwarded to the Admiralty Hydrographer for publication; and all corrections of surveys and other information, such as notices of changes in the places of buoys, lights, &c., will also be transmitted at once to the same office. A catalogue of all the charts of the Department will be kept, besides a sufficient stock of Admiralty charts, and copies of these will be furnished to the Local Governments and public officers on demand. The Superintendent of Marine Surveys is also charged with the duty of compiling an annual chart of wrecks, an annual list of lights, with descriptions of them and their position, and sailing directions for the Indian coasts. He will report on the lighting and marking of the sea approaches to all great Indian ports and rivers; suggest improvements in harbour conservancy by means of buoys, beacons, and lights, and in the navigation of rivers throughout India. Any extracts from log books of vessels belonging to the Bengal and Bombay Marine, or to H. M.'s Squadron, which bear upon any discoveries, dangers, or errors in the charts of the Indian Seas will be communicated to the Department of Marine

[1] Nos. 782–792, Department of Revenue, Agriculture, and Commerce, dated Simla, October 25, 1875.

Surveys, which, like all the other branches of the Survey, is affiliated to the Department of Revenue, Agriculture, and Commerce.

The foregoing describes the nature of the duties. The agency by which they are to be discharged consists of a Superintendent (Commander A. D. Taylor, late I. N.), two Deputy Superintendents, and nine Assistant Superintendents, three executive officers, one Medical Officer and Naturalist, and a Superintendent of the Drawing Branch. The five surveying officers next in rank to the Superintendent belong to the Royal Navy, their services having been lent to the Indian Government by the Admiralty. The whole cost of the Department does not exceed two lakhs of rupees or 20,000*l.* per annum.[1]

The first general report on the operations of the Marine Survey of India was issued by the Superintendent, Commander Taylor, in the latter part of December 1876. It commences with a retrospect of the preliminary steps from 1871 to 1873, which led to the deputation of Commander Taylor to India in the latter year. It touches upon the proposals of the Government of India for securing efficient surveys and charts, the measures taken in England to obtain qualified surveyors, and the final departure of Commander Taylor and the officers selected for service under him in December 1874.

The vessels chosen for the Marine Survey operations were at that date as follows:—

The "Clyde" (steamer) and the "Constance" (schooner) had been fitted at Bombay for surveying purposes, and the "Guide" (brig) and the "Lady Lawrence" (schooner) had been selected by the Kidderpore dockyard authorities for the same service. The last-mentioned vessel, however, could not carry a steam cutter, and was unsuitable for chart work, so was retransferred to the Marine Department. The "Clyde" eventually proved to be almost useless under sail, and the "Guide" to be so affected by dry rot as to be

[1] The Department on 31st March 1876 consisted of the following officers:—Commander A. D. Taylor, I.N., Superintendent; Staff-Commander J. H. Ellis, R.N. Deputy Superintendent, 1st Grade; R. C. Carrington, Esquire, Superintendent of the Drawing Branch; Navigating Lieutenant F. W. Jarrad, Deputy Superintendent, 2nd Grade; Navigating Lieutenant G. C. Hammond, R.N., (one vacancy,) Assistant Superintendents, 1st Grade; Navigating Lieutenant E. W. Petley, R.N., Mr. M. Chapman, (two vacancies,) Assistant Superintendents, 2nd Grade; Mr. P. J. Falle, (one vacancy,) Assistant Superintendents, 3rd Grade; and Dr. J. Armstrong, B.A., Surgeon and Naturalist.

unseaworthy and not worth repairing. These disappointments have caused much delay, and have necessitated the provision of a new steamer, which is eventually to be constructed in England.[1]

Notwithstanding the lack of vessels, the Department has been able to accomplish much valuable work. Mr. Chapman, late I.N., in the "Constance," made a plan of Kolachel Harbour and surveyed the Enciam Rocks in Travancore, charting 6 miles of coast and $5\frac{1}{2}$ square miles of water. He then rounded Cape Comorin, passed through the Paumben Pass, obtained additional soundings in Palk Strait, and verified those on the published charts, and then proceeded to Coconada, where he commenced the survey of the Bay, till relieved by Lieut. Hammond and Sub-Lieut. Petley. This survey was completed on the 24th August 1874. It comprised 79 square miles of water and 42 miles of coast, charted on a scale of 2 inches =1 nautic mile. The survey has since been republished by the Admiralty Hydrographer. Regarding the question of the lighting of the port of Coconada, Lieut. Hammond considers that two new lighthouses are required; one of the 1st order dioptric, with a radius of 21 miles, on Point Gordeware, and another for Coconada Harbour of the 3rd order dioptric, to show at a distance of 10 miles and to be erected $4\frac{1}{2}$ miles S.S.E., of the present lighthouse.

On the 8th April the "Guide," under the command of Navigating Lieut. J. E. Coghlan, proceeded down the River Hooghly, and surveyed the dangerous James and Mary Shoals, Luff Point to Anchoring Creek, including the entrance to the Roopnarain River, on the scale of 10 inches to the nautic mile (this being subsequently reduced for publication by photozincography to 6 inches to the mile). The chart is a valuable one for record, and Captain Taylor remarks that if the whole of the river from Chandernagore were annually surveyed in the same way, a comparison of the results would be most invaluable in carrying out engineering works for the improvement of the conservancy of the river.

Staff Commander Ellis, R.N., in the "Clyde," had in February connected by meridian distance Pigeon Island with one of the Laccadive group, in his voyage from Bombay to Calcutta. He was also enabled to make an examination of the channel into

[1] The Asiatic Society of Bengal have requested Government to have this vessel constructed with appliances for deep-sea dredging. The point is still under consideration.

Mootapetta Bay (Port Lorne), the soundings near which differed considerably from Captain Powell's survey in 1837. The dredging and blasting operations in Paumben Pass are still continued. A depth of 11 feet 9 inches had then (March, 1875) been attained, and it was confidently expected that the Pass would soon be available for vessels of 14 feet draught.

Survey operations along the Burma coast were commenced in November 1875 by Lieut. Jarrad in the "Clyde" examining the approaches to the Rangoon River. The erection and maintenance of a tide pole was a matter of great difficulty, owing to native boats fouling it, and the great strength of the tidal streams. Captain Taylor considers the establishment of a self-registering tidal gauge there very desirable. This important survey was completed on the 8th March, and comprised 37½ miles of coast, trigonometrically laid down, and 216 square miles of water examined. In consequence of a discrepancy in longitude discovered in the compilation of the sheet, including the coast of Tenasserim and Singapore and Penang, the meridian distance between Elephant Point Obelisk, which has been determined by the Great Trigonometrical Survey, and Amherst, was astronomically measured. The result proved that the position of Amherst on Admiralty Chart, No. 823, is 4½ miles too far west. Commander Taylor intends to have observations made next season at Diamond Island, off Cape Negrais, and Amherst, for the same purpose, and there would then be three principal points in the Gulf of Martaban fixed astronomically. These measurements of meridian distances are of great importance, as the whole of the eastern side of the Bay of Bengal has been very incorrectly laid down on the Admiralty Charts, an error of from five to eight miles sometimes existing.

After obtaining some prolific dredging between Diamond Island and Akyab, the "Clyde" commenced the survey of that port on the 21st March. Much time was spent in clearing the hill tops of jungle, owing to the independent character of the Burmese, and the difficulty, through want of an interpreter, of communicating with them. On the night of the 30th March, Navigating Sub-Lieut. C. George, R.N., was suddenly seized with cholera, which had been rife for some time among the native population; and though everything possible was done to arrest the progress of the disease, the unfortunate young officer died at noon on the 1st April. Lieut. George was a son of Staff-Commander C. George, R.N., Map

Curator to the Royal Geographical Society, and a young officer of much promise. Owing to the threatening prevalence of the disease, Commander Taylor, who was on his way down the coast of Burma on a visit of inspection, ordered Lieut. Jarrad to leave Akyab. The "Clyde" accordingly proceeded northwards, and tested the correctness of the coast between Cheduba and Kyouk Phyou, as shown on Admiralty Chart, No. 821. Lieut. Jarrad reports it to be roughly laid down and out of bearing when referred to Cheduba Island. The published plan of Kyouk Phyou proved to be so incorrect that arrangements were made for the survey of the Port to be continued the ensuing season.

The "Constance," under the command of Lieut. Hammond, left Calcutta in December 1875 for the purpose of making a plan of the anchorage of False Point on the Orissa coast. In spite of many mishaps with the steam cutter, the survey was completed by the 9th March. The anchorage was charted on the 6-inch scale, the coast for 5 miles to the south and 10 miles to the north was surveyed on the 3-inch scale, and the soundings extend to from 5 to 8 miles off shore. Lieut. Hammond then proceeded to the northern portion of the shoal off Dhumrah River, where he measured a base, and proceeded to sound the shoals. Unfortunately, work was completely stopped by a heavy gale, and a great number of the crew falling sick compelled Lieut. Hammond to return to Calcutta, whence he proceeded to England on medical certificate.

During the months of April and May 1876, Commander Taylor made a tour along the eastern coast of the Bay of Bengal, and inspected the ports of British Burma. He visited first Akyab and Moulmain, and then proceeded to Amherst. This port has never been properly surveyed. The late Mr. Pearson, of the Bengal Marine, examined the Moulmain River in 1865, but no steps were taken to have the Admiralty Chart corrected by the survey. Commander Taylor is of opinion that no large port of British India requires so much to be properly surveyed and mapped, and has accordingly arranged for Lieut. Jarrad to commence next season's work at Amherst. The Admiralty Chart of Tavoy proved to be dangerously erroneous; and the British India Steam Navigation Company's steamer "Mahratta," when navigating by it, struck on a rock in Tavoy River. Subsequently, Captain Taylor discovered a copy of the survey of Tavoy, executed by Lieut. R. Moresby, of the Bombay Marine, in 1824, and published by Horsburgh in 1827,

which is far superior to that issued by the Admiralty. Captain Taylor proposes to issue amended charts of Tavoy, Mergui, Pakchan, &c. After visiting Mergui he turned his attention to the passage from Mergui to Pakchan, which urgently needs sailing directions,—none of which at present exist. He proposes to issue these in the form of hydrographic notices, explanatory of the normal trading route between Moulmain 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 Kopah, which has great tin mines like most of the ports along the Siam coast, but no trace of such a fine river as depicted on the Admiralty Chart. A new chart of Kopah is now in preparation. Of Junk Ceylon or Salang a pretty good survey was obtained from Captain Richelieu, commanding the Siamese Royal gunboat "Coronation." This officer was trained in the British Royal Navy, is a good observer, and most intelligent in surveying the coast and islands. The actual survey of this island differs immensely from the published one, and the corrected charts will be a great boon to the British India Steam Navigation Company and the coasting trade.

The Superintendent of Marine Surveys has been consulted by Government on a variety of marine questions of great importance. Among these may be mentioned that of the re-organization of the River Hooghly Survey, on which an exhaustive report has been submitted by him. Commander Taylor is of opinion that an elaborate scientific survey of the whole tidal basin of the Hooghly River, at least from Chandernagore to the Sand Heads, is required, as well as an accurate series of levels from Calcutta to below Diamond Harbour.

During the year under review a valuable list of lighthouses and light vessels in British India, including the Red Sea and coast of Arabia, has been issued by the Marine Survey Department. The list is in the form of a hand-book, giving in tabular order the lights, with their names, latitude and longitude, colour, radius of illumination, height, and other particulars. This little book will be a most useful aid to navigation. It has been compiled by Mr. R. C. Carrington.

The programme of work to be undertaken by the Marine Survey Department during the season of 1876–77 was as follows:—The "Clyde" was to leave Calcutta in November, call at Diamond

Island (Bassein River), and connect the same astronomically with Rangoon and Amherst Pagoda, and then to proceed to survey the approaches and entrance to Moulmain River, on a $2\frac{1}{2}$-inch scale. After that the "Clyde" is to examine the entrance to the Sandoway River, and then to complete the survey of Akyab Port,—a task which will probably occupy two months.

Commander Taylor proposes himself to visit first the Mergui Archipelago, in which trip he is to be accompanied by Dr. Armstrong, (the opportunities for research in natural history and geology being very promising in these islands,) and then to inspect all the ports on the Coromandel Coast, with a view to satisfying himself regarding their requirements as far as regards lighting, buoying, &c. This programme has received the sanction of the Government of India.

The Annual Indian Wreck and Casualty Statement for 1875 has not yet been received in England, and a review thereof is therefore impracticable.

II.

Great Trigonometrical Survey of India, 1874-5.

The out-turn of work by this department amounted to 89 principal triangles, covering an area of 6,416 square miles, in connection with which two astronomical azimuths of verification have been measured; of secondary triangulation, an area of 4,049 square miles has been closely covered with points for the topographical surveys, and an area of about 6,000 square miles has been operated in *pari passu* with the principal triangulation; and of topographical surveying, 4,525 square miles on the scales of one inch, two inches, and four inches to the mile. Of geographical exploration much valuable work has been completed by officers of the department on the northern frontier of Afghanistan, and on the lines from Ladakh to Lhasa, and Lhasa to Assam.

The financial administration of the department during the year under review has been exceedingly difficult and embarrassing. A large increase of expenditure had been occasioned by the introduction of a system of consolidated salaries, and by the resumption of operations in British Burmah. The orders for these measures were speedily followed by orders for large reductions of expenditure, which, according to present arrangements, are to be gradually carried out within

the next three years by the stoppage of promotions, and a reduction of numbers as vacancies occur.

The revision of portions of the Great Arc south of Bangalore having been completed, as stated in last year's abstract,[1] the Madras party was deputed to start the Ramnad Longitudinal Series, which is to extend eastwards from the Great Arc and along the coast to Ramesweram, with a view to the proposed connection of the triangulations of India and Ceylon. The work of clearing "rays" between the stations was very slow, owing to the occurrence of belts of dense palmyra forest intermixed with groves of cocoanut trees, which necessitated the erection of the stations to a sufficient height, by means of lofty scaffolding. Major Branfill extended a succession of quadrilaterals as far as the land's end, utilising islets of coral reef which lie parallel to the mainland at a distance of from 4 to 5 miles. The connection with Ceylon will be completed, it is hoped, by next season. A curious instance of religious bigotry was exemplified in the refusal of some village priests to allow the *gopuram* or entrance tower (80 feet high) of the Tirupullani Temple to be used for a station, although Major Branfill offered to pay liberally for the use of it. He has drawn up a most useful alphabetical list of the proper names of the stations and landmarks fixed during the season, with the root-meaning. The vernacular form was ascertained on the spot, and this will, no doubt, prove of service in correcting the spelling in further maps and charts.

As mentioned in the Topographical Surveys section,[2] Lieut. Harman was deputed to join the Duffla Hills expeditionary force. His first triangulatory operations were confined to the country between Jorhat and Dibrugarh. He subsequently accompanied the field force as Major Godwin Austen's assistant, and made a reconnaissance of the Ranga Valley and the hill-ranges to the east of the tracts occupied by the force. He made good friends of the mountaineers, and after an absence of three months returned to his own party, but the extraordinary difficulties of the country prevented him from completing more than two triangles.

In British Burmah the want of proper topographical maps had necessitated the suspension of the Geological Survey; and as isolated Town Surveys were being carried on, and Marine Surveys of the

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[1] See Abstract for 1873–4, p. 4.

[2] See infra, p. 17.

coast were about to be commenced, Colonel Walker was requested to prosecute the triangulation vigorously.

The Brahmaputra party was accordingly re-organised and transferred to Burmah, under Mr. W. Beverley, who worked in the country to the south of Rangoon, while Mr. Mitchell, his assistant, who was transferred from the Eastern Frontier Series, reconnoitred the ground and laid out the triangulation north of Rangoon. The object was to lay out secondary triangles from the principal sides of the Easter Frontier Series, in order to fix all the large towns, prominent and permanent objects, peaks, &c., in British Burmah, for detail and geological surveys, and lighthouses along the coast for the marine surveys. Owing, however, to the unfavourable nature of the weather and difficulties of the ground, it was not possible to connect the two sections; this, however, was to have been accomplished the following season.

The Eastern Frontier Series[1] has been extended in a S.E. direction to within 40 miles of the town of Moulmain. The same obstructions as had been met with in previous years—the dense forest and tropical vegetation growth, the sparse population, the reluctance of the Burmese to work for hire, and the practice of firing the grass jungles during the field season and so obscuring the atmosphere—all these circumstances combined to render a less out-turn of work than would have been obtained elsewhere in India. The area amounted to about 3,150 square miles, and the preliminary operations for future triangulation were carried over a distance of about 100 miles. One hill station, Chaiteo, 3,600 feet above sea-level, is described by Mr. Rossenrode as a very remarkable sight. It consists of stupendous projecting rocks surmounted by masses of other rock raised in successive tiers. Each of these rocks is crowned by a pagoda, the principal one standing on a rock which projects like a rhinoceros horn over a yawning precipice several hundred feet in depth. The Burmese ascribe, not unnaturally, the erection of these super-imposed masses of rock to superhuman agency.

Captain Rogers's party[1] extended its triangulation northwards through the Deserts of Jaisalmir and Bikanir,—tracts which, though fairly inhabited during the rainy season, are deserted in the hot

[1] See Abstract for 1873–4, p. 6.

months, owing to the failure of water. The out-turn was very good, amounting to an area of 2,472 square miles.

The topographical operations in Kattywar[1] have been carried on under the charge of Captain Pullan, owing to Captain Trotter's engagements on duties connected with the Geographical Exploration beyond the British Frontier. The area topographically surveyed amounted to 1,749 square miles, while preliminary triangulation was extended over 2,200 square miles. On reaching the coast of the Gulf of Cutch a satisfactory junction was effected with the Marine Survey of that gulf, executed by Commander A. D. Taylor in 1851. This portion of the country lying along the borders of the Gulf of Cutch proved very difficult to survey, on account of the treacherous mud banks and mangrove swamps which fringed the coast.

Major Haig was engaged during the year under review in carrying on in Guzerat a system of survey[1] planned so as to combine the work of the Bombay Revenue Survey with the accurate measurements of the professional survey. This combined survey is on the scale of 4 inches for the British districts, and 2 inches to the mile for the Native States. The area surveyed topographically was 1,375 square miles, the out-turn being almost exactly double what it was the previous year when the operations were of a tentative nature, and the best method of utilising the Revenue Survey details had still to be ascertained. About 550 square miles were surveyed by Lieut. Gibbs in the Dang Forests, the Dang Hills being the first step of the trap formation leading to the Deccan table-land. Lieut. Gibbs says that in the Gaekwar territory he was struck with the wretched state of the trees, especially teak, and that one might reckon on the core of any teak tree over a foot in diameter being rotten, and the trees all misshapen. On working into the Dang States, the superiority in size, symmetry, and healthy growth of the trees under the Forest Department strikes the untrained eye at once. A copious list of trees and plants is given by Lieut. Gibbs, with the scientific name and locality.

The Surveyor-General of India having expressed very decided opinions against the expediency of using at all the Bombay Revenue Survey work for geographical purposes, a conference of survey and engineer officers was assembled by Government to report on the

[1] See Abstract for 1873–4, p. 7.

whol ject, including the question of scale, but, owing to the div s of opinion, no report could be agreed on. Under these circ es Government ordered the adoption of a medium course, and ... ed the employment of the 2-inch scale and the utilisation of ' ie Revenue Survey maps.

The surveys in the Dehra Dun and the Siwalikhs are being carried on conjointly by part of the Kumaun and Garhwal party, under Captain Thuillier,[1] who is surveying the non-forest tracts and by the newly formed Department of Forest Surveys, under Captain Baily.[1] The areas topographically surveyed by this combined party were 225 and 288 square miles respectively,—the ground, particularly in the interior of the Siwalikhs, being very broken and difficult to delineate.

During the rainy season of 1874 a detachment from Captain Thuillier's party under Mr. Ryall was located at Almora in Kumaun, with a view to make the most of the short interval between the cessation of the autumnal rains and the setting in of winter weather. The out-turn amounted to 2,176 square miles, and the portion of country triangulated in advance covers 800 square miles. Much of this work required all the skill and nerve of the surveyors, owing to the great height of the mountains; Mr. Pocock's work, particularly in the upper part of the Mana Valley, lay above 21,000 feet, the maximum height reached being over 22,040 feet above sea-level. There only remains now 1,200 square miles to be completed; but, operations in these desolate and inaccessible regions being expensive, their further progress has for the present been postponed.

The spirit-levelling operations in the Madras Presidency were undertaken by Captain McCullagh (*vice* Lieut. Harman, transferred to Assam), who carried his work from the S.W. end of the Bangalore base to Bellary, and thence to Raichore Railway Station, a total distance of 297 miles. At Bellary a junction was effected with the line of levels which had been carried from thence to the Port of Karwar in the preceding season. There was a discrepancy of 4·5 feet: this will probably be eliminated when the mean sea-levels at Karwar and Madras have been exactly determined.

The determinations of mean sea-level in the Gulf of Cutch,[2] commenced in 1873 and continued up to the year under review under

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Captain A. W. Baird, R.E., were undertaken as a first step towards deciding whether progressive changes are taking place in the level of the land at the head of the Gulf, as has long been supposed to be the case. It is proposed that the operations shall be repeated at the same points a few years hence, and the comparison will show what variation has occurred.

The tidal stations are three in number, connected with each other by carefully-executed lines of spirit-levelling. The self-registering gauges are erected on shore over iron cylinders, which are sunk vertically into masonry wells, and communicate with the sea by a system of piping, terminating in a rose suspended by a buoy in deep water. Each station is also furnished with self-registering instruments for recording the direction and velocity of the wind, and the barometric pressure.

During the monsoon of 1874, which was one of great severity, the piping at Nowanar was completely buried by sand, and as new piping had to be procured from Bombay, a break of nine months duration occurred in the registration of the observations. At Okha the breaks in the continuity of the registration were very short and of no importance; at Hanstal they were more numerous and longer, the water being here muddier and causing more sediment. Owing to the trying nature of the work of inspecting the stations during the monsoon, the registration was continued to within a few days of the commencement of the monsoon, and the stations then dismantled, the cylinders being surmounted by cairns to serve future identification. The first series of operations to determine the relative changes of land and sea is thus now accomplished.[1] From the combined tidal and levelling operations preliminary results have been obtained, showing that the mean sea-level is higher by 7 inches at the head of the Gulf, and by 4 inches midway up, than it is at the mouth of the Gulf.

During the year 1875 the tidal observations taken in 1871–72 at Tuticorin had been reduced by the harmonic method by M. E. Roberts of the Nautical Almanac Office, and mathematical expressions have been deduced by which the height of any tide may be computed with great exactitude.

In consequence of Captain Herschel's absence from India, and of

[1] The final reduction of the registrations is being now (April 1[illegible] England.

Captain Campbell being deputed to assist Colonel Tennant in the operations connected with the transit of Venus at Roorkee, the determinations of longitude by the electro-telegraphic method have been suspended during the year under review.

The Computing Office, besides being employed in its usual duties of examining and reducing the observations, has aided in the completion of the third and fourth volumes of the "Account of the Operations of the Great Trigonometrical Survey." These volumes, however, will not be issued till the second, which is still in hand, is completed. This volume is intended to give a historical account of the triangulation, and descriptions of the methods of procedure and of the instruments which have been employed. Its preparation has fallen mainly on Colonel Walker himself, as well as the portion of Vol. V. which will deal with the pendulum observations. Captain Heaviside, R.E., has been employed at the Head Office for nearly a year in completing the reduction of his pendulum observations,[1] and in passing the late Captain Basevi's and his own observations through the press. Full accounts of these operations have now been printed, and will either form part of Vol. V. or be included in a supplemental volume.

During the year 1875, Colonel Walker issued a third edition of his valuable map of Central Asia, each of the four sheets being entirely re-drawn, and much new material being inserted. A new map of Northern Afghanistan and the countries to the north of the Trans-Indus frontier, on the scale of 16 miles to the inch, has been prepared under Captain Trotter's supervision, to indicate the results of the exploration of the Havildar and Mullah. Two maps illustrating the Pundit's route from Leh to Lhasa and Assam have been prepared, as well as Captain Trotter's preliminary map of Eastern Turkestan, the Gazetteer maps of Kumaun and Garhwal, and various others.

[1] See Abstract for 1873–4, p. 9.

III.

Topographical Surveys of India, and Work of the Surveyor-General's Office, 1874–5.

During the year under review the number of parties employed on this survey remained unchanged. Much, however, remains to be done before the first Topographical Survey of India will have been accomplished, and the task becomes all the more difficult, as the tracts remaining to be surveyed are for the most part situated in the most mountainous and inaccessible parts.

The total results for the season are, of final topography 21,731 square miles on the scales of 1 inch and $\frac{1}{2}$ inch to a mile, and 22,644 square miles of triangulation in advance, the average cost of the survey being Rs. 19 1 per square mile. Large scale plans were made of Jhalra Patun and Gagron Fort, Narsingarh, Sehore, Ajmere, Nasirabad, and Kishengarh; and five forest reserves were surveyed on the scale of 4 inches to the mile, besides which progress was made with the Topographical Survey of Simla.

Compared with the results of the preceding season, this shows a decrease of 2,372 square miles of topography—mainly attributable to the disaster which befell the party in the Naga Hills, and which caused Captain Badgley (who was badly wounded) to retire prematurely from the operations of the field.

The Gwalior and Central India Survey under Captain Charles Strahan was continued west of the meridian of 75° 45′, within the Rajputara and Central India agencies. The triangulation in advance was extended towards the city of Udeypur, and south of the operations of No. 7 party in Rajputara, and a junction was effected with the Karachi or Western Longitudinal Series. In the southern portion of the country which came under survey, the staple produce is opium. The tracts are plentifully watered by small streams, but very little use is made of the water, the only means of irrigation being the ordinary leather bucket drawn up by two bullocks. Cereals are much neglected, and the prices of grain of all sorts are very high. Plans of the cantonments of Jhalra Patun and of the fort of Gagron were made. The great mass of the inhabitants are Rajputs, but in the large towns a good number of Muhammadans are found. The aboriginal tribes are Bhils, who are of peaceful disposition, those of a warlike character being found further west. The soil in the low-lying tracts is mostly rich black cotton soil, on which the opium is grown, while all the high parts are very rocky

and barren. Notwithstanding the large area of forest, there is very little valuable timber.

The ground topographically surveyed by the second party under Mr. F. B. Girdlestone embraced portions of the district of Khandesh, Native or Holkar's Nimar, and the State of Barwani.

The Satpura range of hills extends through it, and hundreds of square miles within the tract are entirely uninhabited, though there is ample evidence that the country must have been fairly populated in former times. Tigers, leopards, panthers, bears, bison, and Sambhar deer are plentiful in the interior, but the sportsman incurs serious risk in pursuing these animals through the high spear-grass and forest. Mr. W. C. Barckley, one of the assistant surveyors, was terribly mauled by a bear, which he wounded, while engaged in surveying, and a Bheel guide was so severely wounded by another that he died soon after. The solitary bison inhabiting these hills is also described as very fierce and vindictive.

The party has still to work in two detachments, on the hills and plains, and the operations are of a complicated character. Those for the season of 1875–6 have been occupied in the Native States between the Tapti and Nerbudda, a tract never before attempted to be delineated.

Owing to the wild and unhealthy nature of the ground of the Central Provinces and Vizagapatam Agency Survey[1], the scale has been reduced from the 1 inch to the $\frac{1}{2}$ inch to a mile, with a view to getting over the ground quicker. The topography obtained covers an area of 2,534 square miles, and connects the previous work of this party with that of the Hyderabad Survey along the eastern boundary of the Upper Godavery districts of Rakapili, Bhadrachelam, and Cherla. The triangulation covers an area of 5,132 square miles. Both Captain Holdich and Mr. Harper were subjected to much hardship and exposure in the course of their work, and the latter fell a victim and died on the 23rd June 1875.

The inhabitants of the vast jungle of Bustar, included between the Saveri and the highlands of Jeypore on the east to the Godaveri district taluks on the west, is occupied by the aboriginal tribe of Koi or Koitor, a branch of the great family of Gond. The ordinary method of disposing of the dead is by cremation. Rude upright stone monuments, called *menhirs*, are found planted along the road in memory of the dead, and some trilithoms (two upright stones with a horizontal one) have also been discovered. Few districts in

[1] See Abstract for 1873–4, p. 13.

India of the same extent so universally abound in game as the eastern basin of the Godavery. Tigers abound, especially in the proximity of the river; bears, leopards, deer of several varieties, bisons or buffaloes, are found; and snakes of great size and variety are plentiful. The chief product of the country is timber.

The Bhopal and Malwa Survey completed 2,237 square miles of topography and 3,385 square miles of triangulation, the ground of their operations lying east and west through the Bhopal Survey, north of the Nerbudda river and south of the parallel of 24° S., which is the limit of No. 1 party. The country triangulated was uninteresting, being very flat, with isolated low flat hills, patches of jungle here and there, but generally cultivated throughout. Opium is the chief product about these parts; other grains are grown, but in small quantities, wheat being very expensive.

As mentioned in last years abstract,[1] the Khasia, Garo, and Naga Hills Survey party was engaged in three detachments. The first, under Major Godwin Austen, accompanied the Duffla military expedition against the tribes on the northern frontier of Assam. The second, under Captain Badgley, and the third, under Lieut. Woodthorpe, R.E., were employed in the Eastern Naga Hills south of the Sibsagar district.

Captain Badgley was enabled to carry his triangulation from a side of the Assam Valley Series of the Great Trigonometrical Survey, to work into the hills immediately to the south and east, with a view to obtain a good basis for the topography, and to establish a connection with the work executed by Captain Samuells of the Revenue Survey during a previous season in the South Lakhimpur Hills east of the Dihing River. This he succeeded in doing, and had secured 792 square miles of triangulation and 657 square miles of topography up to February 2nd, 1875, when the party was suddenly attacked by Nagas from the villages of Sanna and Ninn, assisted by others from the village of Noka, who entered the camp very early in the morning under the pretence of furnishing supplies, and treacherously murdered Lieut. Holcombe, Political Officer, and 80 natives, besides severely wounding in the space of a few minutes Captain Badgley and 51 men, of whom some died afterwards. It was entirely due to Captain Badgley's fortitude and presence of mind under very trying circumstances, and while suffering from serious flesh wounds received in personal combat with several Nagas, two of whom he killed, that the remnant of the

[1] Page 14.

party, carrying the dying and the wounded, were extricated from these hills and brought safely to the station of Jaipur, where medical aid was obtained on the 7th of February. Captain Badgley, though unable to take any further part in the field, recovered sufficiently to resume his duties at Shillong by the time the party went there for the recess.

The detachment under Lieut. Woodthorpe entered the Naga Hills, south of Golaghat, and proceeded into the interior, accompanied by Captain Butler, Political Agent. They had barely begun work when they were attacked by natives from the large Naga village of Wokha. These, however, they defeated; and by this stroke an excellent moral effect was produced on the surrounding Naga villagers, most of whom then sent in friendly deputations. After this, work was continued in a north-easterly direction along the outer ranges of the Naga Hills, so as to join Captain Badgley's work, and complete what remained further south up to the Patkoi range. Owing, however, to the disaster which had befallen Captain Badgley's party, survey work was closed on this side, and Lieut. Woodthorpe and Mr. McCay joined the punitive expedition against the Eastern Nagas; and, besides accomplishing a fair amount of topography, a good junction was established with Captain Samuell's work on the east; and the whole length of the outer and middle ranges south of district Sibsagar and part of Lakhimpur, or about 150 miles in length by 25 to 30 miles in breadth, has been surveyed. The area surveyed by the detachment was 1,507 square miles on $\frac{1}{2}$-inch and 1,075 square miles on the $\frac{1}{4}$-inch scales. The season's total out-turn amounts to 792 square miles of triangulation and 3,239 square miles of topography, or, omitting overlaps and margins, 2,164 square miles of actually new area surveyed.

A very lengthy and interesting account of the Naga Hills and the inhabitants is given in the narratives by Captain Badgley and Lieut. Woodthorpe, which are inserted in the appendices to Colonel Thuillier's report.

The military expedition despatched into the Duffla Hills by the Government of India was accompanied by a survey party under Major Godwin Austen, Lieutenant H. J. Harman, R.E., having being attached thereto temporarily until the arrival of the former. Narainpur on the Dikrung Nullah was reached on the 2nd December 1874, and from a base on the banks of the Brahmaputra a short series of triangles was extended northward into the Duffla Hills.

Owing to the brief period during which the military were in the country, the survey party were unable to remain beyond two and a half months. The out-turn of work amounted to 1,705 square miles of entirely new topography, on the scales of 2 and 4 inches to the mile. A map on the latter scale, showing the results of the season's work in the Duffla Hills, has been compiled by Major Godwin Austen, and is a valuable addition to our geographical knowledge of the region beyond the northern frontier of Assam. Lieut. Harman, R.E., rendered assistance by surveying the course of the Ranga River; and Mr. Lister, of the Royal Botanical Gardens, Calcutta, was assiduous in making a collection of plants, seeds, and dried botanical specimens. The Surveyor-General expresses a hope that these explorations on the Northern Assam frontier will be continued, and is of opinion that with tact and precaution all difficulties in the way of visiting and exploring the narrow strip of hills between the Assam valley and Tibet may be overcome.

In consequence of Captain George Strahan's being temporarily employed in connection with the Transit of Venus observations, No. 7 (Rajputana) party was conducted into the field by Lieut. E. P. Leach, R.E. The area triangulated was 5,160 square miles, comprising most of the remaining good area or cultivated and thickly inhabited tract north of Jodhpur and Ajmere up to the margin of the desert of Bikanir. The country triangulated is very easy and open, little better than a sandy plain, with groups of sand-hills at long intervals. The topography covered 3,741 square miles of ground, and embraces nearly the whole of the British district of Ajmere, besides portions of the States of Kishengarh and Jodhpur. During the recess progress was again made with the extension of the large scale survey of Simla; and though it was interrupted by order of Government for a brief period, it was resumed after an outbreak of cholera, which necessitated measures for obtaining a water supply.

The services of an experienced officer having been required to start a new topographical survey of the Mysore State, Captain George Strahan, R.E., has been transferred to this duty, and Lieut. E. P. Leach has again assumed charge of No. 7 party. The operations of the party have now been well extended towards the west, and are close upon the confines of the "Thur" or desert of Jesulmir and Bikanir, in which water is very scarce, the population

small and scattered, and supplies most difficult to carry or procure. These obstacles will probably necessitate a change of the scale of survey.

The Topographical Survey of Mysore, which is estimated to contain about 27,004 square miles, was arranged for under orders from the Government of India in the Foreign Department; and two half parties from the Trigonometrical and Topographical Survey branches were drafted off with the object of starting the necessary triangulation during the season of 1875–76 as a basis for the topography,—the budget estimate having been sanctioned by the Chief Commissioner of Mysore at Rs. 80,000 for each party. These two half parties were under Captains Strahan, R.E., and J. R. McCullagh, R.E., and commenced work in November 1875, working from the northern portion of the Mysore State, so as to follow in the wake of the completed revenue and assessment measurements of the fields. The scale adopted is 1 inch to the mile; but no fair estimates of the progress or cost can be made till the physical difficulties and peculiarities of the country and its people are fairly experienced.

In the Geographical, Compiling, and Engraving branches of the Surveyor General's Office at Calcutta good work has been done in the year under review. The two maps of India, on the scales of 32 and 64 miles to the inch, have been proceeded with, but early editions of these maps are not yet available. Maps of Bengal, Behar, and Orissa, and of Assam, both on the scale of 16 miles to the inch, have been photozincographed, and a map of Khelat and Balochistan, on the same scale, has been compiled from the best available information, at the request of the Foreign Department of the Government of India. Progress has been made with the drawing of the old Ganjam and Orissa series maps, which by photozincography will be soon available for use.

In the Engraving branch additions and corrections have been made to no less than 133 plates of different sizes, including the plates of Simms' plan of Calcutta, with a view of bringing it up to date. A new survey of the city, to be executed on rigorous principles, is however in contemplation, though no final arrangement has as yet been come to.

In the Photographic branch 142,371 complete copies of maps have been struck off, the increase of work in this branch being very

considerable. The charts of the Marine Survey Department are reproduced by photozincography in this branch, which has also successfully undertaken the task of obtaining permanent prints of life-convicts by carbon printing by the autotype process, during the cold season. In the Lithographic branch 193,449 complete copies of maps have been obtained, including a map of the Lower Provinces and Assam jurisdictions, in twenty sheets, on the scale of 8 miles to an inch. The total number of maps printed in the three branches amounted to 348,153, while maps to the value of Rs. 44,149 were issued to Government officials and the public during the year under review.

IV.

Revenue Surveys of India, 1874–5.

The number of Revenue Survey parties employed during the year under review was 14. Of these eight were engaged in the Punjab and North-west Provinces, and six in Behar, Lower Bengal, Bombay, and Assam. Besides the above, four small parties were employed on detached duty, one on the Nepal Frontier Boundary Survey, one in Darjiling, one in Cachar, and one in the Darrang District of Assam.

The total area of country surveyed amounted to 16,852 square miles, on the respective scales of 2, 4, 16, and 32 inches to the mile, In addition to the above, 2,286 square miles of country were triangulated, and 5,076 square miles traversed and surveyed in boundary in advance.

With the exception of four parties, three of which were engaged on larger scale surveys and one of which had no more work to do, all have given in larger returns of work during the year under review than in the preceding year. The cost of the Cadastral Survey, on the 16-inch scale, has decreased still further to three annas three pies per acre. In the Hamirpur district, where the fields average nearly two acres each, the cost per mile is only a few rupees more than the rates of first class 4-inch = 1 mile survey, showing full area, details of cultivation, fallow, waste, &c., as carried out in the Punjab and Oudh. Had a professional field survey, with permanent fixed stations, been carried out in the first instance in the Punjab and Oudh, and the field maps been printed

and published, it is needless to observe that immense sums of money would have been saved. The present cadastral maps of the districts of the North-western Provinces can be readily kept up to date year by year at a mere nominal expense, thus rendering a wholesale re-survey after re-settlements unnecessary. For extensions of canals or railroads and other engineering projects, these large scale surveys, combined as they are with careful levelling, are invaluable, and will save large expenditure in the future.

During the past year 2,846 linear lines of levelling have been run in the districts of Dera Ismail Khan, Moradabad, Muttra and Banda, Agra and Hamirpur, and have been connected with the main series of levels run by the Great Trigonometrical Survey of India. Most of the Revenue Survey parties were inspected, both in the field and in the recess, by the Superintendents, and much advantage is said to be derived from this newly introduced system.

In the Upper Circle, where operations are carried on under the general superintendence of Colonel Gastrell, the first or Dera Ismail Khan party,[1] under Colonel H. C. Johnstone, were for the most part confined to the low lands of the Indus, south of Kalabagh, where the river emerges from the hills. Five principal and eight secondary stations of the Great Indus Series of the Great Trigonometrical Survey were connected with the survey. The measurements of the two surveys agreed fairly well, those of the Revenue Survey being, however, always in excess, a peculiarity which may be attributed to sand hills and broken ground.

The Gurgaon Survey,[2] under Captain Wilkins, completed altogether 1,348 square miles of 4-inch survey, connection being established with several stations of the Great Arc and Rahun Meridional Series. The *thakbusts*, or settlement boundary maps, are described as very good, but in the Kurnal district the detail areas of the professional and settlement surveys did not agree well. A special investigation and report on this point will be made to Government. During the season of 1875–6 the Cadastral Survey, on the scale of 16 inches to the mile, of the small native state of Patandi was to have been undertaken.

The survey of the State of Bhawalpur[2] was completed in the year under review, by Captain D. C. Andrew, and the party was broken

[1] See Abstract of Surveys for 1873–4, p. 16.

[2] See Abstract for 1873–4, p. 17.

up. The Bhawalpur State covers an area of 17,285·12 square miles, of which 5,082·02 miles are village area and 12,203·10 desert. Captain Andrew has prepared a Statistical and Geographical Report on the Bhawalpur State, which is to be duly published.

In the Moradabad district[1] a gross area of 948 square miles was surveyed cadastrally, on the scale of 16 inches to the mile, by Captain Barron's party. Exclusive of waste tracts, the average size of the fields was 0·91 of an acre, which may afford a notion of the labour involved in the field by field delineation of this district. 204 miles of levelling were carried out in connection with the above survey. The area in the Moradabad district remaining to be surveyed amounts to 339 square miles. In the case of the Muttra and Banda Cadastral Survey, though the average size of the fields was much the same as in the Moradabad district, operations were much complicated by the fact of large fields being often tilled by two or more cultivators, and the necessity for the quasi-boundary between these patches to be shown separately for settlement purposes. The utility of these cadastral maps is exemplified by the fact that the superintending engineer of the Light Provincial Railways had applied for tracings of the sheets, to save the delay and expense of a separate survey. The executive engineer of the Bulandshahr division, too, states that the tracings are of the greatest help in laying out the irrigation lines in the Muttra district.

Good progress was also made with the Agra and Ghazipur Districts Survey, under Mr. E. T. S. Johnson. The average size of the fields in these districts was only ·81 of an acre. In the Hamirpur district 1,238 square miles in all were surveyed by Mr. R. B. Smart, while in the Azamgarh district the party under Mr. Lane, formerly employed in the Central Provinces, completed an out-turn of 398 square miles, and brought the old survey of Allahabad Cantonment and Civil Station, taken in 1867–68, up to date.

In the Lower Circle, where Colonel Macdonald officiated as superintendent, Lieut.-Col. Oakes was placed in charge of the cadastral survey of the Shahabad district in Behar. It was originally arranged that this survey should be on the 16 inch scale, but in consequence of the diminutive average size of the fields (0·273 of an acre), the scale, after some discussion, was increased to 32

[1] See Abstract for 1873–4, p. 17.

inches. The total area surveyed was 685 square miles, and the cost 12as. 4p. per acre, but Colonel Macdonald considers that with additional practice on the part of the Amins the rate may be reduced.

The 12th or Midnapur division survey, under Major Sconce, covered an area of 978 square miles, and five stations of the coast series and one station of the South Maluncha series of the Great Trigonometrical Survey have been connected with the main circuit traverses. A very interesting geographical report on the rivers and embankments of the Midnapur district is given by Major Sconce in the Appendix to the Revenue Survey Report. The embankment on the face of the Bay of Bengal he describes as a magnificent work; it is in some places 25 feet in height, and 150 feet in breadth at base.

The 14th division, or Dearah Survey, was formed out of the late 14th or Lakhimpur and 15th or Bhawalpur party, in order to determine the alterations of land consequent on the changes in the course of the river, between the Chundna river and Goalundo. Numerous masonry pillars were erected to mark the limit of action of the river, and connection of the season's work was made with ten stations of the Brahmaputra series of the Great Trigonometrical Survey.

The boundary between the Native States of Nepal and the British districts of Purneah and Bhagulpore was surveyed by Captain Samuells, in concert with the Nepalese officials. The boundary is marked by a substantial bank and ditch, belts of twenty-one yards on either side being marked as neutral ground, which is neither to be cultivated nor encroached upon by either state.

In the rainy season of 1874, Mr. H. E. Gastrell was deputed to measure the alterations in grants of waste land in the Darjiling Hills. Unfortunately work was taken up here and there, at the instance of the Deputy Commissioner, and no systematic connexion was established, though 25,064 acres in the aggregate were surveyed in the two seasons. In consequence of the confused state of the boundaries, both of forest lands and cultivated holdings, in various parts of the district, the Lieutenant Governor of Bengal arranged for Captain Sandeman, with an adequate party, to complete the survey in two seasons. This work has however been now stopped, and Colonel Macdonald apparently considers that the step is much to

be deplored. Mr. Edgar actually found more than 500 acres of ground in the Terai highly cultivated and inhabited, which had never been assessed, and were paying no revenue. The Government forest lands too require to be carefully demarcated and delineated, their present extent being most erroneously shown on the map. When a settlement of the district is required, a fresh survey will have to be commenced, and nearly all the old work will have been rendered useless.

In the Bombay Presidency, as during the last season, two parties[1] were employed, viz., the 10th and 11th Deccan Surveys. The first-mentioned party, under Captain Coddington, completed 1,900 square miles on the two-inch scale in the Nasik district and the Peint and Salgana States. The country is here poor, sparsely populated, and unhealthy. The other party, under Major H. C. B. Tanner, completed 1,623 square miles on the same scale in the Poona, Adhmednagar, Satara, and Sholapur Collectorates, the tract touching the Nizam's dominions on the east and the great scarp of the Ghâts on the west. Major Tanner graphically describes some of the magnificent scenery in the Western Ghâts, which struck him in the course of his survey, and furnishes the reader with a very vivid notion of the general configuration and geological structure of the country he traversed. He proves very cogently that unless Government takes systematic and vigorous measures to promote vegetation on the Bombay Deccan mountains, and so equalize the distribution of rain, the downpour will soon wash away the thin crust of soil which covers the rocks. He remarks that it is melancholy to contemplate the future of Indapoor and other Talukas similarly situated; for though the land tax is light, yet constantly recurring famines have reduced the mass of the people to great poverty, and unless the Government makes extra exertions to increase the amount of wet cultivation from wells or to provide canal water at a reasonable rate, the future of the cultivation is gloomy indeed.

In Assam, 1,663 square miles were surveyed on the two-inch scale by the 13th or Goalpara party, under Major Macdonald. The district formerly belonged to the Kuch Behar Commissionership, but now forms a portion of the Chief Commissionership of Assam. A brief but exhaustive statistical account of Goalpara is given by

[1] See Abstract for 1873–4, pp. 18 and 19.

Major Macdonald in the Appendix to the Report. Survey operations were also continued in the Darrang district, in order to revise the boundaries of the Lakhiraj holdings and the waste lands grants; and in the Cachar tea grants, to settle the areas which had to be resumed from grantees who had failed to fulfil all the conditions under which they had originally received land from Government.

V.

The Geological Survey of India, 1875.

During the earlier part of the above year Mr. Medlicott's labours were confined to the Satpura Hills. Towards the close of the season he noticed the occurrence of rocks, which he considers as undoubtedly representative of the upper part of the series accompanying the coal-bearing rocks elsewhere, at a point much further west than previously known. Mr. Medlicott has recommended borings, but there is great uncertainty as to the depth at which the coal may be found. Up to the beginning of 1876 no definite results had been obtained from the borings instituted at Toondnee and Khappa. An interesting account is given by Mr. Medlicott in the *Records* of a visit paid by him to Khatmandu in Nepal, a country of which better knowledge, both geological and topographical, is much to be desired. Mr. Medlicott's inspection was necessarily brief and partial, but the continuity of the zone of newer rocks which fringes the Himalayan range to the north-west has been established and the occurrence of the newer tertiary groups also proved. At the commencement of the season of 1875–6, Mr. Medlicott, in conjunction with Messrs. Theobald and Lydekker, commenced a revision of the tertiary rocks of the North-west and Punjab, with the main object of seeing whether the marked stratigraphical separation of two distinct groups of rocks in the Nahun country was accompanied by a distinction further west in their fossils.

A knowledge of the structure of Sind has long been of great importance with reference to a study of the tertiary rocks of India. The examination of the province has often been put off, though with great reluctance, by the department. The sections in Sind were known to be unusually clear and well exposed. Many of the rocks were richy fossiliferous; and though a very large number of

species had been already collected and described it had become evident that they had been erroneously referred to the same series. It was also highly probable that in Sind a connecting link would be found between the tertiaries of Cutch and of the sub-Himalayas. Accordingly Mr. Blanford and Mr. Fedden took up the examination of Sind in 1874, and before the end of the season of 1874–5 they had completed a fair sketch of the geology of the province, and resumed their labours again last year, Mr. Blanford proposing to traverse the desert to Jessulmir and Jodhpur. Mr. Fedden has made an excellent collection of fossils. During the summer Mr. Blanford was engaged in working out the collections of the late Dr. Stoliczka from Yarkand for publication, and in arranging those brought from Sind. A full sketch of the results is given in the *Records*. Mr. Blanford seems to have established the existence, in addition to the more recent and sub-recent deposits, of pliocene, miocene, and eocene age rocks, all of which had previously been roughly grouped into old tertiary. In some places, again, there are still lower beds, the exact geological age of which is not fixed, but which partly at least are probably cretaceous.

Mr. Willson has continued his work in the Bundelcund and Rewah country, and Mr. Hacket has been engaged first in Rajputana, and subsequently Ulwar. During the entire season Mr. Hughes was engaged in working up the geological maps of the Chanda country, with especial view to the coal-fields of the Wardah valley. During the season of 1875–6 he took up the continuation of the same geological area to the south, and it is hoped that he will be able to join on his work to that of Mr. King, who is extending his examination from the south up the valley of the Godavery.

Mr. Ball completed his researches in the Raigarh and Hingir coal-field,[1] and published a notice of it in the *Records*. During the following season he has been engaged in a revision of the Atgurh sandstones. Dr. Feistmantel, who recently joined the survey, has commenced the description of a history of the fossil flora of Cutch, which Dr. Oldham considers will prove of great value and interest. In spite of severe indisposition Mr. King has continued his examination of the Godavery district, while in the Nellore and Ongole country Mr. Foote succeeded in mapping a good area of the coast region. During the recess Mr. Foote completed a valuable report

[1] See Abstract for 1873–4, p. 24.

on the Southern Mahratta country, and in the season of 1875-6 he was to continue to work northwards so as to join on to the Godavery and Rajahmundry areas.

During the year under review, Vol. XI., Part 2, of the *Memoirs* was issued, containing a detailed description of the salt-producing country in the Kohat district, Trans-Indus. The *Records* were published quarterly as usual, and the following papers in them claim notice: On the "Altum Artush" by the late F. Stoliczka; a note on the Geology of Nepal by Mr. Medlicott; on the Khareean Hills in the Punjab by Mr. Wynne; a sketch of the geology of Scindia's territories; a full sketch of the Shapur coal-fields with notices on the explorations in progress in the Nerbuda valley for coal; also an account of the Raigarh and Hingir coal-field by Mr. Ball; while the directly practical bearings of geological research are illustrated by Mr. W. Blanford's paper on the water-bearing strata of Surat, Mr. Hughes and Mr. Medlicott on fire bricks, Mr. Mallet on coal measures near Hoflong, &c.

Of the *Palæontologia Indica* the publication of the Jurassic Cephalopoda of Cutch has been completed and issued, though the preparation of the numerous plates occasioned much delay. Dr. Oldham considers that this is unquestionably one of the most valuable contributions to the fossil history of the series ever issued. Good progress has been made in the preparation of plates for the next issue, which will be devoted to the fossil flora of Cutch. Dr. Waagen, the palæontologist, has unfortunately been compelled to resign his appointment, chiefly through ill-health contracted in his public labours, but arrangements have been made by which he will work up for publication the description of the fossils collected by him in the Trans-Indus region.

Dr. Oldham, the accomplished head of the survey, has resigned his post after a long and arduous career of over twenty years. Before commencing his service in India he had been on the Irish Survey, and was Professor of Geology at Trinity College, Dublin. A statement of his services will be found at page 165 of the Memoir on Indian Surveys[1] and in the succeeding Abstracts. He was the first to establish the plan of steadily mapping out the country from east to west, and to set his face against the desultory method of sending geologists about from place to place to report on fancied discoveries of minerals. The abundant materials which have been

[1] First Edition.

collected during his administration will render the publication of a general map of the geology of India a comparatively easy task. Dr. Oldham has been succeeded in the superintendentship by Mr. H. B. Medlicott, M.A., F.G.S., C.E.

VI.

Archæological Surveys of India.

During the past year no report of General Cunningham's operations has been received in England. The last report received is still Vol. V. of the series, dealing with the researches in the Punjab during the season 1872–3, and reviewed in last year's "Abstract," pp. 26 *et seq.*

The Secretary of State has drawn the attention of the Government of India to the fact that in the scheme originally prepared for the conduct of this survey it was provided that an annual narration of the progress of operations should be submitted to Government, whereas hitherto the object appears to have been to submit only detailed descriptions and discussions of results accompanied by illustrations, which works have of necessity appeared much in arrears.

The second volume[1] of Mr. Burgess's report dealing with his archæological investigations in Kattywar and Cutch has been issued in England during the year 1876. A notice of these researches will be found in the Abstract for 1873–4, pp. 41–44. The first chapter is devoted to Ahmedabad and its structures; the second, to Kattywar or Kâthiâwâd, the Σαυραστρήνη of the Greeks and Romans and Sorath of the Muhammadans, the ancient geography and history of which is expounded; the third chapter, one of considerable importance and some length, is by Mr. E. Thomas, F.R.S., &c., on the Sâh and Gupta coins obtained from Kâthiâwâd by Mr. Burgess. Mr. Thomas has enlarged the scope of the chapter to the extent of collating the extraneous data bearing on the history of the dynasty, viz., inscriptions, written history, tradition, and coins. The fourth chapter is devoted to an account of the Valabhi dynasty, including a brief notice of Hwen Tsang's visit to Valabhi

[1] Archæological Survey of Western India. Report on the antiquities of Kâthiâwâd and Kachh, being the result of the second season's operations of the Archæological Survey of Western India, 1874–5. By James Burgess, F.R.G.S., &c. London, 1876 (Allen, Trübner, King, and Stanford).

(Fa-la-pi), and the fifth to Thân. The celebrated rock inscription of Asoka as well as the Sâh or Rudra Dâmâ and the Skandagupta inscriptions at Junâgadh form the subject of the sixth, seventh, and eighth chapters.

The caves at Junâgadh and the temples of Mount Girnar are then dealt with, and these are followed by descriptions of the royal tombs at Junâgadh, of the temples at Ghumli or Bhumli and Gop, and of the beautiful palace at Jamnagar, a very noticeable photograph of which is given. An interesting account of Kachh or Cutch (which has hitherto been an unworked field to the antiquarian), its geography, modern and ancient, its people and history, is to be found in chapter XV., and the remainder of the volume is occupied with descriptions of the towns in Kachh and Gujarat visited by Mr. Burgess. Translations of inscriptions from Belgaum and Kaladgi, by Mr. J. F. Fleet, of the Bombay Civil Service, are given in an appendix to the work, which is illustrated by 74 plates.

Mr. Burgess has also prepared a document of much utility with a view to meeting the recommendations of those who in 1873 urged upon the Secretary of State the necessity of adopting systematic measures for the preservation of historic monuments in India. This paper consists of a series of provisional lists of the antiquities throughout the different collectorates of the Bombay Presidency, Kattywar, Guzerat, the Central Provinces, and Berar. The lists are compiled from various sources, and largely from native reports, but after being widely circulated and enriched with such information as can be supplied by the local officers they will prove a valuable guide to the archæologist, to the compilers of the Gazetteers, and many others. Mr. Burgess appends a list of queries, drawing attention to the chief heads of information required in regard to every object of antiquity. These heads consist of the following: exact locality, work, age, style, size, character, and particulars of the inscriptions. When this information has been all collected it will be possible for the archæologist to draw up a classification of the various monuments, showing which should, in the first place, be kept up in permanent repair by Government; secondly, which should be rescued from further decay, but which would need only occasional subsequent attention; and, lastly, those of which, either from their advanced stage of decay or comparative unimportance, it is impossible or unnecessary to undertake the preservation, but of which a record is desirable.

No steps have been taken in the organization of the Archæological Survey of Southern India, referred to in last year's "Abstract," p. 44. The suggested appointment of Dr. Burnell has been rejected by the Government of India, and a proposal made to postpone further consideration of the matter. This decision is to be deplored, as the deterioration of monumental records in Southern India is extremely rapid. Even in the absence of a regular organized survey, preliminary steps, such as the preparation of lists of monuments and antiquities, similar to those drawn up by Mr. Burgess and referred to above, might be undertaken with great advantage.

During the last three cold seasons (1872–5) copies have been made by Mr. Griffiths, decorative artist, and students of the Sir Jamsetjee Jejeebhoy School, of the celebrated paintings in the Ajanta Cave temples. The original paintings themselves have been much damaged by damp and by animals infesting the caves, chiefly through the neglect to provide sooner doors and shutters to the apertures in the caves. This precaution has now been taken, and has been found to answer well. The copies of the paintings have been deposited in the India Museum, and will in some measure replace the valuable copies taken by Major Gill under the orders of the Honourable Court of Directors, and destroyed in the fire at the Crystal Palace.

VII.

Indian Meteorology and the Madras Observatory.

The recent re-organization of the Indian Meteorological Department, referred to in last year's Abstract, pp. 45 *et seq.*, has delayed the submission of the usual Bengal Meteorological Report for 1875. As, however, under the new system the local reports will be summarized, digested, and reviewed in the general report of the Meteorological Reporter to the Government of India, the chief interest will henceforth centre in this latter production. Mr. Blanford proposes to deal with the year 1875 as a commencement of the new scheme by which attempts are to be made to deduce generalized conclusions from the basis of local observations. This report is understood to be in preparation.

The reports received in England during the past year (1876), comprise the following:—

Report on the Government Observatory, Colaba, for the year ending 30th June 1876 :

Administration Report of the Meteorological Reporter for the Bombay Presidency, Rajputana, and Berar for 1875-6 :

Reports on meteorological observations in the North-West Provinces for 1874, Punjab for 1874, Hyderabad assigned districts for 1874, Mysore for 1874, and Oudh for 1875-6.

The regular series of magnetical and meteorological observations, amounting to five per diem, were continued regularly at the Colaba Observatory during the year 1875-6. The first assistant at the Observatory, Mr. F. Chambers, was appointed on the 17th November 1875 to fill the new office of Meteorological Reporter for Bombay, and he has taken the opportunity to give in his Administration Report for 1875-6, a brief history of previous endeavours to prosecute geographical meteorology in the Bombay Presidency.

The first attempt at systematic registration at provincial stations in the Bombay Presidency was made in 1851 at twelve principal stations of European troops. These observations were made under the superintendence of the senior medical officer by hospital assistants trained at the Bombay Observatory. The training was, however, generally speaking, of a very imperfect nature, the instruments incomplete and seldom verified, and the entries of ten questionable. In 1852 a new impetus was given by the transmission of five complete sets of new and verified instruments from England, which were located at Belgaum, Poona, Bombay, Deesa, and Karachi. It was hoped by the Board of Directors that the zeal and energy of the medical officers and their love of science would suffice for the due registration of the observations without the entailment of any public expenditure. This arrangement, however, would not work, and in 1856, two European soldiers, previously trained at the Observatory, were told off for service at each station, on a salary of Rs. 25 per mensem ; and this marks the commencement of thorough and trustworthy registration. The programme comprised observations on the following meteorological phenomena at 9.30 a.m. and 3.30 p.m. : Barometric pressure, temperature of air and evaporation, direction and pressure of the wind, extent of cloudy sky, remarks on the weather and dew-point by Daniell's and Regnault's hygrometers. The following observations were taken once a day : Maxima and minima of the thermometer in the sun and on the grass, maxima and minima of the

air and of evaporation, amount of rainfall, with two gauges, and of ozone. Besides the foregoing, on the 21st of each month, observations of the first seven phenomena were taken at each of the twenty-four hours.

Of these different observations, Mr. F. Chambers remarks that those on evaporation and ozone are, judging from the present standpoint of meteorological science, probably unnecessary, while instruments for measuring the velocity of the wind instead of its pressure have recently come into use, besides more sensitive wind vanes than were formerly used. Nevertheless, provision was made for securing a very complete and correct registration of observations, but owing to the very different way in which the instruments were exposed, a comparison of the registers was impracticable.

Mr. F. Chambers remarks that the chief reforms which the new Reporter for Bombay, Rajputana, and the Berars will have to see to, will be to secure, firstly, greater uniformity in the mode of exposing the thermometric instruments; secondly, new wind instruments erected in perfectly exposed and unobstructed sites; and thirdly, improved hygrometers. It is also very desirable that an attempt should be made to give absolute value to the old observations by a redetermination of the errors of the instruments, of which most of the important ones are still uninjured.

Besides the five observatories at Bombay, Belgaum, Poona, Deesa, and Karachi, there are to be started fourteen others of the third class, *i.e.*, where only two complete sets of observations daily are to be recorded. The observers will have no calculations to make, but only to register readings of the instruments at stated times, and for this extra work they are to receive Rs. 15 per mensem.

The inspection of the instruments and observing stations being a matter of considerable importance, Mr. F. Chambers made it his duty on being first appointed Meteorological Reporter to bring the existing observatories into working order. He took with him a set of portable instruments which had been previously compared with all the standards at the Observatory with a view to determine the errors of the local instruments in use. Poona, Sholapur, Belgaum, Vingorla, Goa (where the co-operation of the Portuguese Government was secured), and Ratnagiri were visited. On Mr. Chambers' return to Bombay the travelling barometers were compared with the Colaba standard, and the errors were found

to be the same as at starting. At the end of January 1876, Mr. Chambers commenced a tour from Bombay to Karachi, through Sind to the Upper Sind frontier district, and back through Cutch and Kattywar.

Mr. Chambers remarks of his inspection tours that among the advantages secured by them may be mentioned the determination of the instrumental errors, and the conversion of observations for past years into absolute measures of the various phenomena recorded, rescuing them by this means from the stigma of doubt. The improvements required at each station have been brought to light, the best sites for stations have been selected, and local defects have been avoided.

An important paper on "The Meteorology of the Bombay Presidency" has been completed during the year 1876 by Mr. Charles Chambers, F.R.S., Superintendent of the Colaba Observatory, and has been presented by the author to the Royal Society with a view to publication. The work consists of four parts—the first dealing with registrations of meteorological phenomena at the Colaba Observatory during a period of twenty-seven years; the second with moderately full observations at five military stations in the Bombay Presidency during a period of nineteen years; and the third with large numbers of observations from civil hospitals and revenue stations, being those of selected registers extending over various periods from not less than a fortnight up to a number of years; in this part the phenomena treated are temperature of the air, winds, and rainfall only, and the extent of territory to which the observations refer includes the whole of the Presidency, Sind, and the western half of Rajputana. In the fourth part are discussed the general distribution (as regards both space and season) of temperature and rainfall, and the variations of the wind; first with respect simply to the physical geography of the country, and then in combination with certain theoretical views, the elucidation of which, by means of the dynamical theory of heat and the kinetic theory of gases, occupies much space.

Nearly half the memoir is devoted to the work of the Colaba Observatory, of the history of which a short sketch is given. The design of this part is to give a compendious account of the results of a long and continuous maintenance of the Observatory, both in the shape of numerical determinations of meteorological elements and of their periodical and other variations, and in throwing light by means of these upon the physical conditions and actions which

give rise to the observed relations between different phenomena, and to the variation of these relations with time.

In the course of the work the author introduces several new modes of picturing clearly to the mind, and of representing graphically, the general results of the various phenomena observed; he also develops a theory of aerial circulation, including a dynamical theory of convection currents, which is original, and, so far as he knows, put forth now for the first time.

Of the report of Mr. Elliott on meteorological observations in the North-West Provinces for 1874, Mr. Blanford observes of it, that, judged both by an absolute standard and by comparison with all previous reports, it is one of high merit, and that much has been done towards making the observations of past years worthy of some confidence. In the case of the Punjab, Oudh, and Berar observations, from various causes, the records are pronounced by Mr. Blanford as of little trustworthiness.

A useful new serial publication has been issued by Mr. Blanford, under the name of "Indian Meteorological Memoirs," being occasional discussions and compilations of meteorological data relating to India and the neighbouring countries. It is not intended to issue the parts at fixed dates, but papers accepted for publication will be printed and issued as expeditiously as circumstances will admit of. The work is designed as a vehicle for publication of such portions of the work of the meteorological officers as do not form part of the regular Annual Report on the Meteorology of India. Thus descriptions of local climates, of important and unusual phenomena, and of investigations in meteorological physics, will more fitly find place in the present serial. Part I. of the first volume contains three papers, viz., (1) on the winds of Calcutta, (2) on the meteorology and climate of Yarkand and Kashghar, being chiefly a discussion of registers kept by Dr. Scully during his deputation with the Mission in 1874–5, and (3) on the diurnal variation of the barometer at Simla.

Madras Observatory.

An inquiry was made last year into the operations of the Madras Observatory for the past thirteen years, with the view of ascertaining the actual work done both in observations and reductions. A catalogue of about 2,200 stars observed between 1853 and 1858, and chiefly selected from Taylor's Madras Catalogue and that of the

British Association, still awaits completion. There are also observations of the sun, moon, principal and minor planets, of Donati's comet of 1868, the mean places of the 144 Nautical Almanac stars from 1853 to 1858, observations of Mars at the oppositions of 1854 and 1856, of moon culminations for longitude, and a long list of occultations of planets and fixed stars and of the phenomena of Jupiter's satellites, which complete the old astronomical arrears previous to 1861. With the exception of the minor planets, Donati's comet, and the occultations, all these observations are reduced and ready for press.

In 1861 the equatoreal by Messrs. Lerebours and Secretan was used to good advantage by the discovery and observation on fourteen nights of the planet Asia. These observations were at once reduced and printed in the *Astronomische Nachrichten.* A conspicuous comet, which appeared very suddenly in July, as well as the Solar Eclipse and the Transit of Mercury in the same year, were duly observed. In 1862 the new transit-circle was completed and brought into use; and the equatoreal work was heavy, comprising the refinding of Asia on her first return to opposition after discovery, observations of the comet for which the year was memorable, and of Encke's comet. The first of a series of measurements of the planet Mars when in opposition, by differences of right ascension from adjacent stars near his rising and setting, was taken in September and October, and 49 observations were secured, but no final reduction of them has been effected up to the present. The object of this operation is to correct the value of the solar parallax on the sun's mean distance from the earth. The repetition of these measurements at successive oppositions of Mars is an important work, and it can be carried out to the best advantage at a tropical observatory like Madras. In 1863 the new transit-circle was in full work, and satisfactory results were obtained throughout the year.

The year 1864 was a pre-eminently successful one as regards the general work of the Observatory. The maximum number of observations with the transit-circle was attained, viz., 2,681. With the equatoreal the planet Freia was detected; but the supposition of its being a new planet was dissipated by the calculation of its orbital elements, which proved it to be identical with the one discovered by Professor D'Arrest at Copenhagen in 1861. Another new planet (Sappho) was discovered and its orbit calculated. The planet Mars

being again in opposition in November, a second series of differential right ascensions was observed, for investigation of the solar parallax.

The new equatoreal by Messrs. Troughton and Sims was received early in 1864, but the dome under which it had to be used had to be removed for the officers of the Great Trigonometrical Survey, to enable them to fix surrounding stations with the centre of the Madras transit-circle. On completion of these operations the reconstruction of the dome was undertaken on improved principles. The chief event of the year 1866 was the mounting of the new equatoreal; and of 1868, the total eclipse of the sun on August 18th, one of the chief results of the Masulipatam Expedition being the detection of bright lines in the solar corona. The third series of measurements of Mars for investigation of the solar parallax was made with the new equatoreal in February 1869, and though the opposition was by no means a favourable one, the stability of the instrument gave the observations a weight to which the two former series in 1862 and 1864 with the old equatoreal could lay no claim. The observations of D'Arrest's periodical comet were the operations of principal interest in 1870. An ingenious electrical discharging apparatus for firing the Fort gun as a time signal was also adopted.

The year 1871 was one of heavy extraneous work. A fourth series of observations of Mars at the opposition in March and April was made with the new equatoreal as in 1869. The laying of the submarine cable to Singapore led to the necessary observations being secured for determining the longitude between Madras, Singapore, and Batavia. The central shadow path of another total eclipse of the sun across the Presidency on 12th December led to the equipment of several local expeditions, as also of some from England, France, and Germany. The station selected for the Government Observatory party was Avenashy in the Coimbatore district. Three successful pictures of the totality were obtained, showing the corona and other phenomena. The annular eclipse of the sun on 6th June yielded results equal if not superior in interest to those of the total eclipse expeditions. Four good photographs where taken of the annular phase. Two observations of Biela's comet were taken under unusual circumstances, after a period of eighteen years, during which it had been given up as a lost or annihilated comet. In 1873 the meridian circle was used exclusively for star places, to complete the catalogue in hand.

A fifth and more favourable series of Mars observations was taken in April and May with the new equatoreal.

The year 1874–5 was devoted to finishing works in hand and preparing them for publication, rather than to accumulating more observations. Considerable progress has been made in this direction, and it is anticipated that ere long arrears of every kind will be completely cleared off. The Star Catalogue, which is being made by means of the meridian circle, is very nearly finished. The observation of the transit of Venus was a failure at Madras owing to cloudy weather; but valuable aid to observers at Karachi, Muddapore, and Roorkee was rendered by means of telegraphic determinations of longitude.

The transmission of Madras mean time to every Government telegraph station daily at 4 p.m. has been continued throughout the last-mentioned year, and the telegraph to the Master Attendant's Office for weather warnings was serviceable during three stormy periods.

VIII.

Geographical Exploration, 1873–5.

The geographical explorations carried on beyond the British frontier during the two years above mentioned have been unusually important, besides the valuable results derived from the Yarkand Mission referred to in last year's Abstract. The Havildar who had been deputed to survey unknown portions of the head-waters of the Oxus, and the Pundit who had been instructed to survey the direct road from Ladakh to Lhasa, both returned to the head-quarters at Dehra almost simultaneously, and brought each numerous journals, records of astronomical observations, and route surveys, which Captain Trotter, who was on the point of returning to England, volunteered, by remaining in India, to put into shape for publication. The "Report on the Trans-Himalayan Explorations during 1873–4–5" has, however, not appeared up to the present date (February 1877), though it is possible that the narrative of the journey of the Pundit through Tibet with its accompanying observations and map may be published separately. The brief abstract accounts of these journeys given in Colonel Walker's report enable us to summarize the results.

The Havildar, who is well known for his journey in 1870 from Peshawur through Chitral to Badakshan, started from Kabul in the guise of a travelling merchant on the 3rd November 1873, and struck at once northwards, instead of taking the more circuitous and westerly route by the Bamian Pass. He crossed the Hindu Kush range by the Sar-ulang Pass, and passing Khinjan took the direct north-easterly route by Narin and Ishkamish to Faizabad on the Kokcha in Badakshan, the greater part of which route had never before been surveyed. Thence he turned westward to Rustak, and from thence due north to Kolab, crossing the Oxus at Samti, which is the point above which the river assumes the name of Panjah instead of Amu. His instructions were to ascend the stream, keeping closely to its course, but as this would have led him away from the main roads and awakened suspicion, he had to stick to the frequented roads, and accordingly proceeded viâ Khuwalin and Sagri-Dasht to Kila Khumb (the capital of Darwaz), where he again struck the river at the northernmost point of the bend in its course through the mountains between its rise in the Pamir and its downward plunge into the plains of Kolab and Badakshan. From Kila Khumb the Havildar advanced for a distance of about 50 miles in a south-easterly direction along the bank of the river, making a detour to Kila Wanj *en route*, this being apparently in order to avoid having to follow the path along the river, which, in many places where the cliffs are perpendicular, consists of supports of rope attached to iron pegs driven into the face of the rock. The traveller makes his way along with his feet on the rope supports, while he holds on to the pegs with his hands. The Havildar finally reached Yazghulam, the frontier village of Darwaz. Here he was most unfortunately turned back, under orders from the Khan of Darwaz. Thus his exploration of the Upper Oxus was stopped at the distance of about a day's journey from Pigish, the lowest point reached by Captain Trotter's native surveyor from the opposite direction just two months previously. Being very anxious to complete his survey of the bend of the river, and being ignorant of what the other explorer had done, the Havildar returned to Faizabad by his former route, and thence proceeded to Ishkashim, the point where the Oxus makes its bend, whence he followed the river for about 35 miles, but was then again stopped, this time by the guards on the Shignan frontier. There is thus a gap of about 20 miles between the work of the

Havildar from the west and that of Captain Trotter's agent from the east, which is much to be regretted; but on the other hand it is a matter of congratulation that so large a portion of the course of the Oxus, which was unknown when that river was adopted as the northern boundary of Afghanistan by the British and Russian governments, has now become clearly defined.

Being unable to complete the survey of the river, the Havildar returned to Kolab, and from thence struck westward through regions north of the Oxus, of the geography of which very little was known. His route determines the position of the important town of Kubadian, and proves that the Surkh-ab river (also called the river of Karatigin, Kizil-su, or Waksh-ab), which rises in the Alai plateau, south of Khokand, joins the Oxus not near Kolab, as has long been supposed, but a point about 80 miles lower down. His route survey was carried southwards from Kubadian, crossing the Oxus at the Aiwaj ferry (probably the Swachik of some maps), down to Khulm, from whence he travelled eastward to Rostak, where he had left some property, and thence back to India by the Bamian Pass and Kabul.

The Havildar's explorations in Kolab and Kubadian cover part of the ground traversed by the Russian expedition to Hissar in the summer of 1875, and the longitudes and latitudes of those two towns as determined astronomically by the Russians agree very fairly with the positions as deduced from the Havildar's previous work at those places. A second connecting link has thus been obtained between the British and Russian Surveys in Central Asia.

The Mullah, a man of good education, had accompanied the Havildar as far as Jalalabad, from which place he started on the 28th September 1873 with the object of ascending the Kunar river as far as its source in the Hindu Kush range. He was enabled to follow the course of the river as far as Asmar, but from that point to Mirkandi had to make a detour, as the Khan of Asmar was at war with the neighbouring Kaffir tribes. He therefore made his way over the hills on the left bank of the river to Janbatai, a place on the Havildar's route in 1870 from the Punjab in Badakshan, which route the Mullah followed as far as Chitral. At Chitral he was detained some time, but eventually managed to be allowed to make for Sarhadd Wakhan, and thus struck into new ground. He ascended the course of the river, viâ Mastuj up to the Baroghil Pass, which he crossed, and descended to Sarhadd-i-Wakhan, the

position of which had been fixed by Captain Trotter. The Mullah's work was very carefully executed, and shows that the positions of Dir and Chitral as given by the Havildar must be altered by a few miles. It gives the entire length of the Kunar river with the exception of a length of 25 miles above Asmar.

The journey performed by the Pundit Nain Sing is among the most important, as regards geographical discovery, that has been made in the present century. For the first time the vast lacustrine plateau of Tibet has been traversed by an educated traveller, who was able to take observations and describe what he saw; and thus a great increase has been made to our scanty knowledge of Tibet.

Nain Sing, a native of the mountainous district of Milam in Kumaon, is the chief among the natives trained by Colonel Montgomerie, and his travels beyond the Himalaya have won for him a place in the foremost rank of Asiatic explorers. His geographical labours were commenced upwards of twenty years ago. He was first in the service of Captains H. and R. Strachey, and then in that of Messrs. Schlagintweit, in Kashmir and Ladak, during 1856 and 1857. He then joined the Education Department, and was head-master of a Government vernacular school in his native district of Milam from 1858 to 1863. In the latter year Colonel Montgomerie trained him as an explorer, and he has since been constantly employed in the department of the Great Trigonometrical Survey. His famous journey to Lhasa, in 1865 and 1866, earned for him the reward of a gold watch from the Royal Geographical Society. In 1867 he visited the Tibetan gold mines of Thok-Jalung, and in 1873 he accompanied the mission of Sir Douglas Forsyth to Yarkand.

In July 1873 Pundit Nain Sing set out from Leh on his final and most important journey, to cross the plateau of Tibet to Lhasa, and thence to make his way down into Assam.

Nain Sing reached Tankse, near the frontier, on the 21st of July, and entered Tibet, at Chágra, as a Lama professing to be going on a pilgrimage to a temple near Rudok. At first he followed the Chang-chenmo road to Yarkand, crossing the Marsemik-la at a height of 18,420 feet above the sea, and then turned to the east by a route over the Kin-la, which is still higher than the Marsemik, reaching Noh, a small village of the Rudok district. The progress was slow, as all baggage is carried by sheep, 20 to 25 lbs. each, which are never fed, and live on the pasturage by the road-side. Yet, out of the twenty-six which originally started from Tankse,

where there are two monasteries and 700 lamas, and here he made out that the Brahmaputra continued its eastward course for 30 miles, and then turned south-east.

At Chetang the route ascended the valley of the Yelung, a tributary of the Brahmaputra, on its right bank, which flows through and a rich fertile valley where there are fruit trees and large patches of wheat and barley. After 36 miles the Dalatang plain is reached, a grassy expanse stretching for 15 miles to the Karkang-la, a pass over the central chain of the Himalaya, 16,210 feet above the sea. Seventy miles to the south, over a lofty region, brought the traveller to the Kya-kya Pass, leading down into the Tawang valley, on the southern slopes of the southern chain. Here, the Chona-jong, in the Chukhang valley, there is a great exchange mart, where the Tibetan merchants meet those from Assam. The market, at its height, contains several hundred shops. The Pundit was detained in Tawang for some months, and eventually reached Odálguri in Assam on the 1st, and Calcutta on the 11th of March 1875.

This really magnificent exploring achievement has yielded rich and valuable geographical results. The distance from the Pangong Lake, by Lhasa, to Odálguri, is 1,319 miles of previously unknown country, except for a very short distance traversed by the Pundit in 1872; 1,200 miles were entirely unknown; and the whole extent was traversed with bearings and pacings, 276 astronomical observations were taken for latitude, and 497 for elevation above the sea. The eastern extremity of the Pangong Lake was settled, a system of numerous lakes and rivers was discovered, the existence of the vast snowy range of the northern Himalaya (Gangdis-ri) was clearly demonstrated, several peaks were fixed, 30 miles of the Brahmaputra was discovered, and the Tawang route from Tibet to India was surveyed.

Nain Sing, though little past the prime of life, has become enfeebled by exposure in Tibet and other trying climates, and has been compelled to give up the public service. His arduous and brilliant services have, however, not been allowed to pass unnoticed. The Paris Geographical Society have awarded him a gold watch, and the Secretary of State, on the recommendation of the Government of India, has sanctioned the grant to him of a village in Rohilkund, with a jumma of Rs. 1,000.

position of which had been fixed by Captain Trotter. The Mullah's work was very carefully executed, and shows that the positions of Dir and Chitral as given by the Havildar must be altered by a few miles. It gives the entire length of the Kunar river with the exception of a length of 25 miles above Asmar.

The journey performed by the Pundit Nain Sing is among the most important, as regards geographical discovery, that has been made in the present century. For the first time the vast lacustrine plateau of Tibet has been traversed by an educated traveller, who was able to take observations and describe what he saw; and thus a great increase has been made to our scanty knowledge of Tibet.

Nain Sing, a native of the mountainous district of Milam in Kumaon, is the chief among the natives trained by Colonel Montgomerie, and his travels beyond the Himalaya have won for him a place in the foremost rank of Asiatic explorers. His geographical labours were commenced upwards of twenty years ago. He was first in the service of Captains H. and R. Strachey, and then in that of Messrs. Schlagintweit, in Kashmir and Ladak, during 1856 and 1857. He then joined the Education Department, and was head-master of a Government vernacular school in his native district of Milam from 1858 to 1863. In the latter year Colonel Montgomerie trained him as an explorer, and he has since been constantly employed in the department of the Great Trigonometrical Survey. His famous journey to Lhasa, in 1865 and 1866, earned for him the reward of a gold watch from the Royal Geographical Society. In 1867 he visited the Tibetan gold mines of Thok-Jalung, and in 1873 he accompanied the mission of Sir Douglas Forsyth to Yarkand.

In July 1873 Pundit Nain Sing set out from Leh on his final and most important journey, to cross the plateau of Tibet to Lhasa, and thence to make his way down into Assam.

Nain Sing reached Tankse, near the frontier, on the 21st of July, and entered Tibet, at Chágra, as a Lama professing to be going on a pilgrimage to a temple near Rudok. At first he followed the Chang-chenmo road to Yarkand, crossing the Marsemik-la at a height of 18,420 feet above the sea, and then turned to the east by a route over the Kin-la, which is still higher than the Marsemik, reaching Noh, a small village of the Rudok district. The progress was slow, as all baggage is carried by sheep, 20 to 25 lbs. each, which are never fed, and live on the pasturage by the road-side. Yet, out of the twenty-six which originally started from Tankse,

where there are two monasteries and 700 lamas, and here he made out that the Brahmaputra continued its eastward course for 30 miles, and then turned south-east.

At Chetang the route ascended the valley of the Yelung, a tributary of the Brahmaputra, on its right bank, which flows through and a rich fertile valley where there are fruit trees and large patches of wheat and barley. After 36 miles the Dalatang plain is reached, a grassy expanse stretching for 15 miles to the Karkang-la, a pass over the central chain of the Himalaya, 16,210 feet above the sea. Seventy miles to the south, over a lofty region, brought the traveller to the Kya-kya Pass, leading down into the Tawang valley, on the southern slopes of the southern chain. Here, the Chona-jong, in the Chukhang valley, there is a great exchange depart, where the Tibetan merchants meet those from Assam. The market, at its height, contains several hundred shops. The Pundit was detained in Tawang for some months, and eventually reached Odálguri in Assam on the 1st, and Calcutta on the 11th of March 1875.

This really magnificent exploring achievement has yielded rich and valuable geographical results. The distance from the Pangong Lake, by Lhasa, to Odálguri, is 1,319 miles of previously unknown country, except for a very short distance traversed by the Pundit in 1872; 1,200 miles were entirely unknown; and the whole extent of area traversed with bearings and pacings, 276 astronomical observations were taken for latitude, and 497 for elevation above the sea. The eastern extremity of the Pangong Lake was settled, a system of numerous lakes and rivers was discovered, the existence of the vast snowy range of the northern Himalaya (Gangdis-ri) was clearly demonstrated, several peaks were fixed, 30 miles of the Brahmaputra was discovered, and the Tawang route from Tibet to India was surveyed.

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IX.

Statistical Survey of India, New Gazetteers and other Publications.

The Statistical Survey of India, organised under the general direction of Dr. W. W. Hunter, has now been in progress upwards of five years, and the statistical accounts of the different presidencies and provinces have so far approached completion as to enable the new Imperial Gazetteer of India to be commenced on the 1st of February 1877. Dr. Hunter has prepared an interesting report[1] on the subject, which deserves a somewhat extended notice.

The organisation of a Statistical Survey of India was sanctioned by Lord Mayo in 1869; but during the century preceding there had been numerous efforts after the same object, and the results of these different surveys formed a vast storehouse of unpublished information scattered over different provinces. In Bengal the first effort of this sort, dated from 1769, or precisely one century before Dr. Hunter's investigations commenced. For Madras a magnificent series of 200 manuscript folios, known as the Orme Collection, was compiled between 1740 and 1770, and, with the exception of portions utilized in Orme's two printed volumes, remains inedited to this day. The Bombay Government created a distinct department, and Colonel Sykes, as Statistical Reporter, drew up a mass of papers, which, with previous documents, furnish a continuous picture of that presidency since the establishment of British rule. In the case of minor provinces like Mysore, Travancore, and Cochin, the investigations had been even more carefully carried out. In fact each conspicuous period of administrative improvement or reform has left behind it the traces of a fresh inquiry into the state of the country.

For instance, in 1769, when English officers were first appointed to the Bengal districts, the President in Council issued an elaborate circular, calling for information respecting the political, ethical, and social history of the province, after which an investigation into the land tenures was to follow, together with a list of the products of the country, an account of its commercial capabilities, and a report on the means of developing its internal resources. The

[1] Quinquennial Report on the Statistical Survey of India. By W. W. Hunter, L.L.D., Director General of Statistics to the Government of India, 1876.

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pography, history, and climate. The condition of the people was
t considered, the natural productions of the country—ani- vea-
table, and mineral—the modes of tillage, impl elevation
andry, breeds of cattle, and safeguards agains western portion
of the farms, the rates of wages, and, g ated from eastern
ures are selected for review, and the list ury ago. The Pundit describes
nufactures, and commerce of Be en, well armed, and dressed in
ramp and confine the sheep-skin coats, felt hats, and leather boots with curved pointed
toes. They are great sportsmen, and both men and women are
constantly in the saddle. Their ack tents are made of yaks' hair;
they manufacture a very coarse ind of woollen cloth, and live on
meat, butter, cheese, milk, and a ttle flour to thicken their soup.

On the 17th of September the Pundit reached the gold-fields of Thok-Daurakpa, which are not so important as those of Thok-Jalung, which he visited in 1867. There are also two smaller diggings, called Tang-jong and Sarka-Shyar, further east, the whole under the superintendence of an officer from Lhasa, with the title of Sarpon. The whole yield of gold, about 8,000*l.* a year, is sent to Gartokh, whence it finds its way to the sea.

Continuing his journey over the plateau, the Pundit traversed elevated plains for many marches, covered with velvet turf, and frequented by countless herds of antelopes. To the south were the snowy peaks of the northern Himalayan range (Gangdis-ri), which

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subject, are brief. 0 years the work in Bengal seems to have been prises 47 districts, t by individual investigators, such as district and the compilation nised attempt during this period was made within six months. by the Medical Department, 21 separate sionership consisting or laid down. Several of the papers thus In the se two provinces aylor) Dacca and (Dr. John McCosh) In the North-West Prothe standard authorities on the districts compiler; here four volumes od of isolated efforts may be fitly have been printed, and the officers in Eastern Bengal, which beginning of 1878. The Punvolume, entitled "Principal Heads the accounts have all been prne Dacca Division." within the current year. I

In the meantime, the Court of Directors having failed to obta
from the Indian servants any comprehensive account of the terr
tories under their care, had set on foot a distinct series of eff
of their own. They liberally encouraged works bearing o OTHER
subject, and as far back as 1828 a fair compilation, under the
of the "East India Gazetteer," in two volumes, by Walter Har
had reached a second edition. Ten works of this class in a le general
examined by Dr. Hunter, and comprised such works as "Thor s upwards
Gazetteer," "Pharaoh's Gazetteer of Southern India," and "Bal sidencies
Cyclopædia." "Thornton's Gazetteer of the Territories under ble the
Government of the East India Company and of the Native States st of
on the Continent of India" appeared in 1854; and though there are on
a great many grave defects in it, Dr. Hunter expresses his opinion e
that it has done more than any other work to impart to the English d
people a knowledge of their Indian dominions, and that it remains o
to this day one great source from which successive compilers dra ull
sometimes with scanty acknowledgment, the materials for blishe
modern encyclopædias and gazetteers. the firs

But "Thornton's Gazetteer" had one inherent fault, which was y befor
it was not based on a systematic account of each of the geograph nificen
or political divisions of India, compiled district by district, and th n, wa
in the absence of systematic materials, the author had to depe ion c
upon the chance topography of tourists and historians. He brough dite
great industry to bear on the subject, but the practical result i
that while some petty hamlet, in which a traveller had halted ss
night, or any locality which formed the subject of official inuou
respondence, stands out in bold relief, important features ish rul
districts are passed over without a word. The res Travancore, an
less satisfactory than had been hoped, int ore carefully carrie
"Thornton's Gazetteer" were circulated among administrative improve
were requested to supply all omissions. It es of a fresh inquiry int
however, that to conduct a proper revisio
rewriting of the work, for since 1854 a officers were first appointe
enacted in India, a new political geogra a Council issued an elaborat
a new system of government had been pecting the political, ethica
local administrations began to strike o after which an investigation
a statistical and geographical acco ogether with a list of the produc
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that presidency in minute detail.

tical Survey of India. By W. W. Hun
the Government of India, 1876.

Central Provinces and in Bengal, and in October 1867 the local governments were addressed with a view to the extension of the operations throughout India. It soon, however, became evident that there being no uniform system and no central supervision, the expenditure might eventually be considerable without the desired results being obtained, especially as regarded securing comparable statistics. The Council of the Asiatic Society forcibly urged this view, which was concurred in by the Government of India; and Dr. Hunter was accordingly directed to make arrangements for the systematic conduct of the future statistical operations, which were designed to extend over a territory of 1,556,836 square miles, inhabited by a population of 240 millions.

The previous operations, from 1807 downwards, had endeavoured to attain *per saltum* a goal which could only be reached by many weary steps; Dr. Hunter's system, on the other hand, consisted in the circulation of a number of "Heads of Information required for the Imperial Gazetteer," which ensured a fair amount of uniformity of treatment and subject-matter. These materials have been gathered in, almost without cost, by enlisting the unpaid co-operation of district officers and heads of departments throughout India. By appointing a provincial editor in each of the presidencies and provinces, central control has been localised; while the Director General, by means of regular tours, has been enabled to exercise inspection and secure steady progress and fairly uniform execution the whole.

By this means provision was made for the statistical survey of the whole of British India, the Native States being alone excepted. The results, according to Dr. Hunter's report of last summer, which is the most recent information on the subject, are briefly as follows: As regards Bengal, which comprises 47 districts, the accounts of 41 have been already compiled, and the compilation of the remainder will be probably completed within six months. Of Assam, which now forms a chief commissionership consisting of 12 districts, about half have been compiled. In these two provinces Dr. Hunter has acted as provincial compiler. In the North-West Provinces Mr. E. J. Atkinson has acted as compiler; here four volumes, comprising 13 out of the 35 districts, have been printed, and the remainder are expected about the beginning of 1878. The Punjab comprises 32 districts, of which the accounts have all been printed, and will probably be published within the current year. In Oudh the manuscript accounts of all

the 12 districts has been completed, and the whole is expected to be published next year. The "Gazetteer of the Central Provinces" was published in 1870, before the Census of 1872 had taken place. The more accurate statistics supplied by this will be incorporated into the Gazetteer under Dr. Hunter's eye. In Bombay and Sind, as in the North-West Provinces, the scale of the operations has been magnified, so that the time of completion of the whole of the statistical accounts is a matter of some uncertainty. The Gazetteer of Sind, by Mr. Hughes, however, has been published, comprising five out of the 24 districts of the Bombay Presidency. Mr. Campbell is provincial editor as regards the other districts.

In Mysore and Coorg the whole of the materials have been collected from the district officers, and although the checking of these materials has been a laborious task, owing to the imperfect means of communication, still all the four volumes comprising the nine districts will be completed before the end of the year.

The system adopted in Madras dates as far back as 1862. Here each district is done separately, and there is no central officer or provincial editor appointed. The preparation of the "District Manuals," as they are termed, thus proceeds but slowly, only five out of the total 21 having been as yet published in the course of 11 years. Of these the Vizagapatam Manual, by the Hon. D. F. Carmichael, is pronounced by Dr. Hunter to be a model of administrative information and local research. But much repetition is involved by the scheme of decentralisation thus adopted, and Dr. Hunter has found it necessary to stipulate for the supply of short digests or abstracts of the outstanding manuals, so as to enable the "Imperial Gazetteer" to be proceeded with without delay.

In British Burmah the operations are somewhat of a tentative character, as many years must elapse before the information here permits of the elaborate completeness of the statistical accounts of the older British Provinces. But Captain Spearman, the provincial editor, has brought great industry and steadiness of purpose to his task, and the volumes embracing the whole of the fifteen districts are expected at no distant date, the MS. having been already completed. Mr. La Touche completed a statistical account of Ajmir and Mhairwara in 1874.

Thus of the 233 districts of British India with which the

[1] Vizagapatam, Madura, Nellore, Bellari, and Cuddapah.

operations deal, the statistical accounts of 162 have been already completed, while out of the twelve provinces into which British India is divided, the work in 10 is either completed or so far advanced as to hold out a fair prospect of completion within two years.

No provision was made for the survey of Native States, but inasmuch as this was necessary for an Imperial Gazetteer, Dr. Hunter has taken measures for obtaining accounts of those under the local governments, such as the groups of Native States under the Bengal, North-West Provinces, Punjab Madras, and (more especially) the Bombay Governments. Those under the Foreign Office are more difficult of access, but for these Dr. Hunter purposes to base his accounts on the forthcoming new edition of Aitchison's "Treaties and Engagements," as amplified and revised in the Calcutta Foreign Office. A collection of administrative reports by the political officers in charge of Native States will also be placed at Dr. Hunter's disposal, and these, combined with other papers in the Foreign Office, will enable a far more complete account of the Native States of India to be given than has, as yet, been attempted. As regards the French and Portuguese possessions, no considerable body of materials has been discovered by Dr. Hunter in the course of visits to Goa and Pondicherry, but some statistical accounts will be derived from the Annuaires and semi-official publications of the respective governments, and some fresh facts from materials in the Calcutta Foreign Office.

The condensation of all these provincial accounts into the "Imperial Gazetteer of India" commenced, it is understood, on the 1st February 1877. This work will be designed primarily for the use of the controlling body in England; in the second place, for the use of Indian officials; and thirdly, for the public at large. The general plan will be that of alphabetical arrangement of articles varying from a few lines to about twenty pages in length. The period of time which the preparation of this important work will occupy will probably be four years from February 1877. Owing to the great expense of literary compilation in India, the staff engaged in Scotland by Dr. Hunter for the purposes of the Bengal and Assam Gazetteers, will be retained by him for the preparation of the "New Imperial Gazetteer." The cost is estimated at an aggregate of 3,000*l.* (for four years) as against 6,500*l.* (for from four to six years) which would have been the cost in India.

The "New Imperial Gazetteer" will represent a series of local inquiries and comparative statistics spread over an area but little less than that of all Europe excepting Russia. It forms the necessary complement of the great Indian surveys, trigonometrical and topographical, which have been in operation for nearly a hundred years.

The great difference between it and "Thornton's Gazetteer" (the only work in any way comparable with it) has been already indicated above; and the elaboration and care bestowed on the preparatory arrangements, as well as the abilities and experience of the editor, afford a guarantee that the execution of the work will be commensurate with its importance.

In close connexion with the Statistical Survey of India is the subject of a uniform orthography of Indian names. This question has been dealt with in previous abstracts, and after much wear discussion is now nearing settlement. Briefly described, it is th method which adopts a uniform value for each letter, and take as its basis the Indian vowel sounds of *a* and *u* as in *rural*, *e* in *gre* and *i* and *o* as in *police*. Vernacular lists have been prepared the names of districts, towns, rivers, and places in the various provinces, and carefully translated on this basis into the Roman character. In the case of well-known places which have obtained a popular or historical fixity of spelling, this customary spelling has been retained. For all other names the correct transliteration has been prescribed. In this way lists have been drawn up, approved, and published in the Gazette, for Assam, the North-Western Provinces, Oudh, the Punjab, the Central Provinces, the Berars, Bombay and Sind, Mysore, Coorg, and Bengal. That for Madras has not yet been received, and for Burmah it is not known whether any list will be prepared.

Dr. Hunter states that through the agency of the Gazettes, official reports, the new maps, and the greater part of the Indian newspapers, the adoption of the scheme is gradually becoming general. But (he continues) the tangled growth of a century cannot suddenly be transformed into order or cleared away. A whole generation of Anglo-Indians must pass before general uniformity can be looked for, but meanwhile the old standing difficulties in the way of a uniform orthography for the "Imperial Gazetteer" have been removed.

Part III. of the series of Central Asian Gazetteers issued by the

Quartermaster General's department has been received in this country. It is entitled "A contribution towardsthe better knowledge of the topography, ethnology, resources, and history of Belochistan," compiled by Lieut.-Colonel C. M. MacGregor, Assistant Quartermaster General, Calcutta, 1875. It is furnished with some useful tables of routes.

Another work on Balochistan has also been published, entitled "The country of Balochistan, its geography, topography, ethnology, and history," by A. W. Hughes, F.R.G.S., F.S.S., Bombay Uncovenanted Civil Service. Mr. Hughes is the author of the Gazetteer of Sind noticed in the Abstract for 1872–3, p. 67, and he has exhibited in the present work the same research and careful compilation which he displayed in the former work. The book contains geographical and ethnological sketches of both Persian and Kalati Balochistan, general descriptions of the whole country, and a history thereof from the earliest period down to the year 1876, while in an appendix are furnished a genealogical table of the Khans of Kalat, a vocabulary of the Baloch and Brahuiki dialects, a list of the principal road routes in Persian and Kalati Balochistan, and a careful index. Mr. Hughes has compiled his work from most trustworthy sources, and its interest and usefulness cannot fail to be appreciated.

Bannu is the name of the district on the extreme north-west of our Indian frontier, being bounded on the west by Waziristan, on the north by Kohat, and on the south by the Dera Ismail Khan district. It was originally annexed in 1848 by Lieutenant, afterwards Sir Herbert Edwardes, who published a most popular work on it, called "A year on the Punjab frontier." Mr. S. S. Thorburn, the present settlement officer of the district, has had, since 1872, much opportunity of studying the manners and customs of the inhabitants, and he has published his experiences in the shape of an interesting work called "Bannu or our Afghan frontier" (Trübner). This work, besides geographical and historical accounts of the district, contains a most useful and lucid section on the land tenures and settlements, while the book concludes with a very full record of the popular stories, ballads, and proverbs of the inhabitants.

The recent disastrous cyclone at the mouth of the Megna in the Lower Provinces of Bengal will have lent much interest to Mr. Beveridge's "District of Bákarganj," a work which deals exhaustively with the district referred to from every point of view. It will

also prove most useful for statistical reference, used in conjunction with the account of Bákarganj published in Vol. V. of Dr. Hunter's "Statistical Accounts of Bengal" mentioned above, p. 43.

Among miscellaneous geographical reports should be mentioned an interesting account[1] by Mr. J. W. Strettell, Deputy Conservator of Forests, of a six months' journey made by him in 1873-4 in Burma proper, under orders from the Government of India, to report on the *Ficus elastica* there, and the best method of forming plantations thereof in British Burma. Mr. Strettell journeyed to Mandalay, and thence to Bhamo. From Bhamo he made a short excursion eastward to the Kakhyen Hills, and a more extended one northward along the Irrawaddy to Mun-tsoung (lat. 26° N), where the river forks into two large branches, the eastern being the more important. He then returned and struck westward, making a circuit of the En-daw-gyee Lake, and returned to Bhamo in March 1874. Mr. Strettell found the *ficus* to extend southward as far as 25° 10′, or half a degree further than the limit assigned to its distribution by Mr. Gustav Mann. Eastward of the Irrawaddy it would appear from native report to be unknown. Mr. Strettell's work is illustrated by a map containing much new topographical information.

X.

Geographical Department of the India Office, 1876.

The general catalogue of original and other records of the Geographical Department of the India Office, comprising manuscript and printed reports, field books, memoirs, maps, and charts of the Indian surveys, has owing to various circumstances been long delayed in publication. The whole of the catalogue, comprising all additions to the collection made up to the end of 1876, is, however, now in type, and its publication and issue during the course of the year has been definitely arranged for. The general nature and scope of the catalogue was fully explained in the Abstract for 1872-3, p. 69; it only now remains to say that it has been enlarged in its details and brought up to date, and that its value for purposes of statistical reference will be sure to be appreciated.

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[1] "The *Ficus elastica* in Burma proper, or a narrative of my journey in search of it." By G. W. Strettell. Rangoon, 1876.

A new edition of the catalogue of the maps sold by the agents to the India Office has been issued, in which are included all maps published in India up to the end of 1875. In order to convey prompt intimation of the receipt in England of new maps, arrangements have been made for the immediate publication and distribution of slips giving all necessary particulars respecting every map received in each quarterly consignment from India.

Among the maps prepared by the department may be mentioned a map of the northern frontier of Khorassan with parts of Irak and Mazanderan, drawn, on the scale of 16 miles to 1 inch, from a manuscript map of Captain the Hon. G. C. Napier. The map is based on St. John's Persia, sheets 2 and 3, and represents a new view of the structure of the Daman-i-kuh or Atak range and the plateau south of it, the former being treated simply as the escarpment of the latter. A good deal of new topographical information was acquired by Captain Napier during his sojourn in the country and embodied in the map, and it may fairly be anticipated that his subsequent journey to the same region will on his return enable him to place on record a still fuller geographical knowledge of this important frontier province of Persia.

The map of the Nandair Circar of the Nizam's dominions was also issued in 1876. This map, which is in 31 sheets, has been prepared uniform with the previous ones of the series, commenced by Mr. John Walker and continued by Mr. Trelawney Saunders. These surveys of the Hyderabad Circars are a part of the General Topographical Surveys of Native States, carried on under the superintendence of the Surveyor General of India. They were commenced in 1818, and continued till 1852, when, in consequence of the mismanagement of the officer in charge, they were suspended. In 1855 the Hyderabad Survey was resumed by Mr. Mulheran, an excellent surveyor, who made good progress, and successfully carried a branch series of triangles from the great arc to Nagpore, during the rising of Tantia Topee. Till 1858 these circars were lithographed under Mr. John Walker, late Geographer to the Secretary of State, and 13 circars in all were completed by him. From 1858 to 1870 there was a period of inaction as regards the reproduction of these maps, but in the latter year the local demands (chiefly from railway engineers) had become so frequent as to cause the Government of India urgently to recommend the continuance of the lithography. Since that date Mr. Saunders has

finished the lithography of eight circars (viz., Medduck, Bheer, Beder, Mullangoor, Warungul, Eilgundel, Daroor, and Nandair). There are still 11 circars, the materials of which cannot be discovered, and, besides these, six of the assigned districts (East and West Berar), the limits of which do not appear to have been fixed from actual survey. No steps can be taken to reproduce maps of these territories until more satisfactory material is forthcoming.

Major St. John's map of Persia[1] was also issued during the year under review.

The Abstract of Surveys for 1872–3 described the skeleton on which the details given in the map are fitted, and promised an account of the sources and extent of those details, which are nearly all new to cartography, on completion of the map. Commencing with determined frontiers, the coast-line of the Gulf from Al-Basrah to Cape Jashk is taken from the Admiralty chart, corrected for the longitude of Bushire as ascertained by telegraph (*vide* Abstract for 1871–2). From Jashk to Gwádar the Makrán coast was reduced from the manuscript of Captain Stiffe's chart. On the north the coast-line of the Caspian Sea is delineated from the Great Russian chart, the surveys for which were made in 1860–1. The Russo-Persian frontier from Mount Ararat to the Caspian is borrowed from the large scale official map of the Caucasus, and the Balúch and Sistán boundaries from the surveys by Majors St. John and Lovett, when serving on the commissions under Sir F. Goldsmid. These complete the list of the settled frontier of Persia. Surveyed, but not yet determined by treaty, is the long line of frontier from Mount Ararat to the Persian Gulf. The sheets of the Turco-Persian Frontier Commission Map were reduced to the scale of 4 miles to the inch, and photo-zincographed in the Ordnance Survey Office at Southampton; and from the reduced copy thus obtained, Major St. John borrowed the details for this part of the frontier. The eastern boundary of Persia other than in Balúchistán and Sistán is entirely unexplored, though fairly settled; the north-eastern frontier exactly the reverse.

The details available for the delineation of the vast country included by the above-mentioned boundaries vary in character,

[1] Map of Persia, in 6 sheets. Scale, 16 m. to 1 in. Compiled principally from original authorities, by Major O. B. St. John, R.E., by order of H.M. Secretary of State for India. (Allen & Co., King & Co., Stanford, and Trübner & Co.)

from careful surveys made by competent topographers to mere routes of travellers who did no more than jot down the names of their halting-places and guess the length of their marches. Nothing, however, has been inserted for which there is not European testimony, and no topographical details given for which there is not valid authority in the shape of maps compiled from original surveys or of tangible verbal description. The routes obtained from natives by Kinneir and others, which form a prominent feature on most published maps of Persia, are omitted, having been found eminently untrustworthy in every case in which they have been tested by subsequent travellers; and large blanks are thus left where previous maps show considerable detail.

Commencing in the north-west corner, the delineation of the province of Adarbaijân is derived from very full though very discordant sources. The large official map of the Caucasus gives in outline an immense amount of information regarding the Persian districts bordering the frontier, besides noting certain points fixed by triangulation. These last have, of course, been accepted, as have been the courses of streams and positions of villages in the immediate vicinity of the frontier line. But the greater part of the Persian topography on the Caucasus maps appeared on examination to be nothing more than a number of routes, probably obtained during the wars of 1827–29, and compiled on a few astronomical data since found to be erroneous. No attempt appears to have been made to fit the old work to the framework subsequently obtained. This was, however, partially done by M. Khanikoff in his map of Adarbaijân, which, considering that he had neither the Turko-Persian frontier survey nor the latest survey of the Araxes at his disposal, is a very creditable performance. Major St. John's topography is therefore mainly taken from M. Khanikoff's map, checked carefully throughout by General Monteith's earlier map, Sir Henry Rawlinson's travels, and the new frontier maps as far as they extend. Nearly the whole of Adarbaijân is thus filled in, but the country about Ardabil, the southern [illegible] Lake Urmieh (about the extent of which, in that direction, authorities are at variance), and the country eastwards to Miana require exploration.

GILAN AND MAZANDÁRÁN.—The Tálish Mountains, though their general contours are doubtless correctly shown in General Monteith's map, which has been generally followed, present a field of great

interest both to the topographer, the botanist, and the naturalist. Equally unexplored and equally interesting are the rest of Gilán and whole of Mazandárán, of which nothing but the sea-coast and a few isolated spots can claim to be correctly shown. Lemm (1829) fixed the latitude and longitude of several places between Astarabád and Tehrán, and Khanikoff (1858–59), crossing the Alburz Mountains from Shahrúd to the former town, showed that they consist not of one but of three distinct parallel ranges. The new Russian map of Persia, of which more hereafter, gives a large amount of topographical detail, but, for the most part, apparently without authority. Much has therefore been rejected. Major St. John's own exploration on the Alburz near Tehrán afford for the first time an accurate delineation of the Shamirán Mountain, the upper part of the Lar River which nearly encircles Mount Damavand and divides it from the water-parting, and of the direct route from Tehrán to the Caspian through Anán, which is shifted 30 miles to the west of the position it has hitherto occupied on our maps.

IRÁK.—Turning next to the great province of Irák, now merely a geographical expression, the topography of the district of Persian Kúrdistan is derived from entirely original sources—in the west from the Turko-Persian frontier survey, in the east from the great Russian map. This was compiled at Tiflis in 1869–71, but its publication has been postponed till the results of the Sistán and Balúchistán Boundary Commissions, then in progress, should be made public. Photographs of the manuscript, lent and copied in England, gave for the first time the detailed topographical result of M. Khanikoff's journeys in Eastern Persia, and the work of the Turko-Persian frontier surveys, which it appears extended over a far greater extent of country than that covered by the official map. The latter takes in the strip of frontier only; the surveys appear to have comprehended the whole of Khúzistán, and the roads from Karmánsháh to Sihna in Kúrdistan; to Isfahán through Búrújird and Khousar; to Shústar through Khoramábád; and to Dizfúl, the Karkhah Valley, as well as the whole western shore of Lake Urmieh. Of these surveys, only that of Khúzistán and a small portion of the Khoramábád road seem to have been transcribed by the English members of the mission, and deposited in the Foreign Office Library, where they were made over by Mr. Hertslet, C.B., to Major St. John. For the remainder, the latter has been dependent on the small scale photographs of the Russian general map.

which there was much difficulty in deciphering. Nevertheless, they add immensely to our knowledge of the topography of those regions.

Other original sources of information in Irák are,—Major St. John's surveys of the main road from Bushire to Tehrán; Major Lovett's routes from Kóm to Tehrán through Saveh and through Varamin; and the same officer's road survey from Tehrán to Mashad. All the rest of Irák is very imperfectly shown. No proper survey of the great Kasvín-Tehrán and Tehrán-Hamadán roads is believed to exist. Sutherland's map and the manuscript map of the journeys of Sir John Malcolm's second mission are the main authorities for that part of Irák lying in the quadrangle of which Kasvín, Tehrán, Isfahán, and Hamadán are the four corners. Of the second map mentioned, those portions done by Mr. Webb, the surveyor, are good, and, it appears from comparison with later surveys, checked by astronomical observations; but the rest is very inferior work. This part of Persia is not very interesting, except for the carpet manufactories of Faráan, or Faraghán, an unvisited district, but its exploration would be easy, and fill an unsightly gap in one of the most populous parts of Persia.

Fars.—The general positions of places in this province are shown with approximate accuracy on existing maps, but the physical features are, as a rule, given with a detail which existing data did not altogether warrant, and which are naturally extremely incorrect. The main authorities for Western Fars appear to have been Mr. Arrowsmith's maps illustrating General Monteith's paper on the road from Bushire to Shiráz, in the Journal of the Geographical Society, and the map of Shiráz and its environs in Baron de Bode's Travels. Both are very faulty. For Western Fars, the foundation of our atlas maps would appear to be D'Anville's map, on which Pottinger's, Ouseley's, Trézel's, and one or two other routes have been marked in addition to those above given. In the new map, the country in the quadrangle—Bushire, Kazrán, Shiráz, Firázabád—is from original surveys by Major St. John, who also gives both roads from Shiráz to Isfahán, together with the intervening country and the main road towards Karmán. Major Lovett's survey affords a delineation of the road from Niris to Shiráz, along the south shore of the salt lake of the same name, erroneously called Bakhtagán on older maps, and placed 20 miles too far north. The late Mr. Keith Abbott's carefully recorded

observations have also been utilised, but not to the same extent as in the neighbouring district of Karmán, and a coast road travelled by Dr. Colville from Bushire to Bandar Abbass has been noted. This is particularly interesting, as showing the outlet of the river system of Fars by the Mún, miscalled on maps the Prestkáf river. For the very scanty details available between the Shiráz-Karmán road and the sea, older authorities have been followed. Much remains to be done here; no route has been recorded from Bandar Abbass to Karmán, and none surveyed from Bandar Abbass to Shiráz. The position of the important town of Lar is simply guessed.

KHUZISTAN.—An almost complete survey of this province, on the scale of one mile to the inch, was unexpectedly found in the library of the Foreign Office. Its plain parts are, perhaps, therefore more accurately shown than any other part of Persia. The mountains, however, with the neighbouring parts of Isfahán and Fars, comprising the upper basin of the Karún River, are almost a *terra incognita*. The solitary peak marked Dacna on our maps, and supposed by Ritter to be 11,000 feet in altitude, is shown by Major St. John to be a ridge extending 30 miles, in a N.W. to S.E. direction, and covered with eternal snow. It can, therefore, be hardly less than 17,000 feet in altitude, and may be more. Under any circumstances, it is probably the most important mountain range in Persia as far as dimensions go.

YAZD AND KARMAN.—The astronomical observations recorded by M. Lenz when serving on Khanikoff's staff—though internal evidence and comparison with the work of other observers has shown they are not implicitly to be relied on—have served, after due correction, as a foundation for topographical details, collected by the late Quartermaster-Sergeant Bower, R.E., when travelling from Isfahán through Yazd to Karmán with Sir Frederick Goldsmid. Major St. John's survey from Bampur in Balúchistán through Bam to Karmán and onwards to Shiráz; Major Lovett's sketch of the country from Karmán to Bam by Khabbis; the same officer's route across the desert from Bam to Sistán with Sir F. Goldsmid; Mr. Keith Abbott's observations on the road from Sirján to Bam by a circuitous road to the south, and by the eastern road from Karmán to Yazd; and routes by Majors Murdoch and Euan Smith from Bam to Bandar Abbass, are shown for the first time on this map. The route of Dupré and Trézel between the Shiráz-Isfahán

road and Yazd, has not, it is believed, been before noticed by geographers. The great range of mountains stretching from near Kóm to Balúchistán, though indicated by Khanikoff, and one of the most remarkable features of the geography of Persia, is now given its true proportions. Altogether there is, perhaps, as much novelty in this as in any other portion of the map, except the next.

BALÚCHISTÁN.—With the exception of the coast-line and Grant's route (1809) through Geh, everything is new in this part of the map, being entirely founded on the surveys of Majors St. John and Lovett in 1871–72. Comparing it with existing maps, it will be seen that the dimensions of this part of Balúchistán are much restricted towards the north, where the direction of the axes of the mountain ranges, as in Karmán, is shown to be N.E. and S.W., instead of being parallel to the coast-line. The great desert south of the Halmand and all the northern hills are shown to be drained in the direction of Sistán, instead of into the Arabian Sea. Many erroneous names have been expunged, and a large amount of topographical detail given. Much, however, remains to be done. The district of Bashakird, which properly forms part of Karmán, not Balúchistán, is quite unknown, as are the Irafshán and Sarhad districts, whilst no details exist regarding the country about Geh. It may be remarked, though the subject forms no part of Persian cartography, that a zone of unexplored country, nearly two degrees of longitude in breadth, intervenes between the frontier districts and the mapped parts of Kalat-i-Balúchistán.

KHURASAN.—The scanty map published with M. Khanikoff's Travels throws a flood of light on part of the geography of this the largest and perhaps the most interesting province of Persia, of which cartographers were not slow to take advantage. His routes will, however, be found given for the first time in detail on this map, owing to the kindness of M. Khanikoff in lending photographs of the manuscript. Partly covering the same ground, and elsewhere intersecting M. Khanikoff's routes in various points, are the surveys of Major Lovett when serving on Sir F. Goldsmid's Sistán Boundary Commission. That officer's map of Sistán, in particular, supersedes Connolly's imperfect sketch. Other work, original as far as a complete map is concerned, is a transcript of the Russian surveys north of the Atrak, showing the true direction and extent of the Kopet and Kuren chains, and of Baker's and Gill's work further east in 1873, including the hitherto unvisited Darah Gaz and

Kalat-i-Nadiri, the most useful contribution made to the geography of Persia by private travellers since Fraser's journey over part of the same ground in 1829. Neither that traveller's route, nor that of Burnes from Kabushan to Astrabád, has been since followed, and remain unaltered on the map. Owing to the political interest which must attach for some years to come to the north-east frontier of Persia, regular additions to our knowledge of Northern and Eastern Khorasan may be confidently expected. Further south, all routes across the great salt desert have been carefully revised. One valuable addition is a direct route from Shahrúd to Yazd, by which it appears that the level of the lowest part of the desert must nearly reach that of the sea, and that the extent of the actual saline tract has been much exaggerated. Further details on this point will be found in Major St. John's general sketch of the physical geography of Persia forming part of the two volumes on "Eastern Persia" recently published.

A new map of Afghanistan is in course of preparation for the India Office, at the hands of Major C. W. Wilson, R.E., late director of the Topographical Depôt of the War Office. The map is to be compiled from all available materials, for which due search has been made in the Political, Survey, and Quartermaster General's Departments in India. It is in 20 sheets, and comprises a large extent of country from Mashhad on the west to Multan on the east, and from the province of Hissar in the north to Karachi in the south.

In connexion with the preparation of this new map of Afghanistan it may be mentioned that Major H. Raverty, late of Bombay, has undertaken, at the request of the Secretary of State for India, the translation of a considerable mass of geographical information in the Persian and Pushto languages, collected by him for his forthcoming history of the Afghan nation. This information consists of a variety of detailed routes through the north-west and other parts of Afghanistan, as well as detailed accounts of the districts and territories of Kabul, Peshawar, Bajawr, Kashkar, Afghanistan and the Derah-jat. Amongst other documents there is an account, written by an eye-witness who accompanied the force, of the expedition of Prince Dara Shukoh, son of the Emperor Shah-i-Jahan, against Kandahar. He led a great army, with a numerous train of artillery, from the Punjab thither, without touching either the Bolan or Khyber routes, which many believe to be the only

practicable routes between Afghanistan and India. Other papers which will be included in Major Raverty's translation, are the history written by Akhund Darwezah, the Tajik, who is the saint of the Afghans, and whose work is rich in geographical details respecting the tracts between the Indus and Jalalabad on the Kabul river and further north, and the travels of Mirza Rajab' Ali into the Kohistan of Kabul, his account of Khuwarazm (Khiva), and routes to the north, north-east, and north-west of Kabul.

Major Raverty's translation of these important documents is anticipated to occupy about a year in preparation, and when completed will be deposited for utilization and record in the Geographical Department of the India Office.

During the year under review, an important varied selection of Indian maps, plans, charts, and manuscript memoirs was exhibited in the Geographical Section of the Loan Exhibition of Scientific Instruments at South Kensington. It included some tracings of the old Dutch charts of the Malabar and Coromandel coasts, Rennell's map and atlas of India, a collection of Dalrymple's charts, and various general and provincial maps issued during the last half-century, and arranged in order of the date of production. The collection also included some maps and plans, selected specially as specimens of cartography, and was altogether a thoroughly representative one of the publications of the Indian Surveys from the earliest times.